112th Congress, 2d Session – – – – – – – – – – – – House Document 112–153

SAVANNAH HARBOR EXPANSION PROJECT CHATMAN COUNTY, GEORGIA AND JASPER COUNTY, SOUTH CAROLINA: FINAL GENERAL RE-EVALUATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT JANUARY 2012

COMMUNICATION

FROM

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

TRANSMITTING

THE CORPS' FINAL GENERAL RE-EVALUATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT

PART 15 OF 15

NOVEMBER 9, 2012.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

U.S. GOVERNMENT PRINTING OFFICE

81–605 WASHINGTON : 2013

AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

FINAL
ENVIRONMENTAL IMPACT STATEMENT
SAVANNAH HARBOR EXPANSION PROJECT
Chatham County, Georgia and Jasper County, South Carolina

January 2012
(Revised July 2012)

Appendix O
to
Appendix Z

Volume 6

US Army Corps of Engineers
Savannah District
South Atlantic Division

ENVIRONMENTAL IMPACT STATEMENT
APPENDIX O: Formulation of Alternatives

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

US Army Corps of Engineers
Savannah District
South Atlantic Division

EDITOR'S NOTE: Savannah District prepared this document in 2004/2005 to describe the plan formulation work that had been performed at that time. A public review of the report was conducted in May/June 2005. Because of the age of the document, some of the information it contains is now out of date -- descriptions of ongoing construction projects, for example – but the report has been included to inform the reader of the analyses that were performed and conclusions reached at that time. Those decisions are important in the overall study process. The District has reviewed the decisions described herein and believes they are still valid. In addition, Label "G" on Figure 1 should read "Disposal Sites 14A/B" to correspond with the discussion later in the document (pp. 72-76).

The table on the following page summarizes the measures that were considered, the conclusions reached in 2005 on those measures, and reviews those decisions to ensure they are still valid.

MEASURE	CONCLUSION IN 2005 REPORT	SUMMARY REASON IN 2005 REPORT	2012 ASSESSMENT
Non-Structural			
Reduce Underkeel Clearance Requirement	No improvement is possible	Savannah Underkeel Guidelines are consistent with other deep-water ports. Harbor Pilots do not believe they could operate safely with less clearance.	Concur. Detailed analysis includes present underkeel clearances.
Increase Efficiency of Landside Operations	No further action needed beyond W/O Project Condition	Would only consist of advancing already planned capital improvements to the Garden City Terminal	Concur. GPA continues to make capital investments to increase the terminal's throughput capacity.
Specialization / Optimization of Facilities	Not needed beyond W/O Project Condition	GPA has specialized the Garden City Terminal and is increasing the efficiencies in landside handling and storage. New berths and facilities are being developed to handle Post-Panamax container ships.	Concur. GPA continues to make capital investments to increase the terminal's throughput capacity.
Improve Traffic Management Practices	No additional measure would be helpful	Further coordination or a system to facilitate coordination would not be helpful	Concur. Pilots have not identified a system that would improve their operations.
Structural			
Minor Modifications			
Passing/ Meeting Areas	Include	Required with a larger design vessel to maintain the present level of service	Concur. Ship simulation studies confirmed the need for these measures.
Bend Wideners	Include	Ship Simulation Report identified areas where bend wideners would be needed to allow safe transit of the design vessel	Concur. Ship simulation studies confirmed the need for these measures.
Aids To Navigation	Include	Additional aids would not be helpful in the inner harbor; New aids would be required on an extension to the entrance channel	Concur. New aids would be placed to mark the extended entrance channel.
Vessel Traffic Coordination	Not include	Further coordination or a system to facilitate coordination would not be helpful	Concur. Pilots have not identified a system that would improve their operations.
Alternate Terminal Locations			
Garden City Terminal	Most cost effective site when harbor deepening and landside facility costs are considered	Presently a large functioning container terminal (infrastructure already in place); Planned expansions in terminal capacity would be part of Without Project Condition	Concur. GPA continues to increase the terminal's throughput capacity. Project costs are higher than previously predicted, but the dredging costs to this site are still much less than the costs of developing a new container terminal.
East Coast Terminal	Low Potential - Eliminated	Inadequate size; East-West landside transportation through City; Relocate existing operation	Concur. Site limitations still exist

Structural (Continued)			
Alternate Terminal Locations (Continued)			
Ocean Terminal	Low Potential - Eliminated	Inadequate size; High cost of renovation; Lack of dredging savings	Concur. Site limitations still exist.
Elba Island	Low Potential – Eliminated	Adjacent to LNG facility; Inadequate size; East-West landside transportation through City; Navigation safety issues	Concur. Site limitations still exist.
Blue Circle	Low Potential – Eliminated	Inadequate size; Lack of dredging savings; Difficult rail connection; Relocate existing operation	Concur. Site limitations still exist.
Brunswick	Low Potential – Eliminated	Distance from inland markets; High dredging costs	Concur. Site limitations still exist.
Disposal Area 12A	Medium Potential – Not Cost Effective	Need to develop rail connection; Loss of sediment storage capacity; Adverse environmental effects from access & replacement sediment storage capacity	Concur. Landside development costs are now expected to be $4-5B, greatly exceeding the costs to deepen to GCT.
Disposal Areas 14A/14B	Medium Potential – Not Cost Effective	Need to develop rail connection; Loss of sediment storage capacity; Adverse environmental effects from access & replacement sediment storage capacity	Concur. Landside development costs are now expected to be $4-5B, greatly exceeding the costs to deepen to GCT
Tybee Island National Wildlife Refuge	Medium Potential – Not Cost Effective	Need to develop rail/road connection; Adverse environmental effects from access and replacement sediment storage capacity; Potential Intracoastal waterway impacts	Concur. Landside development costs would be high, coupled with the costs for a bridge over the AIWW.
Alternate Facility Types			
Offshore Transshipment Facility	Low Potential – Eliminated	High development costs; Adverse environmental effects; High costs of double handling; Delays due to weather.	Concur. Development costs still expected to be high. Double handling still required.
Major Modifications			
River Straightening	Not include	Would not markedly increase the efficiency of vessel transits	Concur.
Harbor Deepening	Include	Deepen existing navigation project to reduce light loading and tidal delays	Concur. Vessels calling at the port continue to grow in size. Cargo levels have increased and are expected to continue to grow in the future.

Savannah Harbor Expansion Project

Formulation of Alternatives

General Re-evaluation Report

&

Environmental Impact Statement

US Army Corps
Of Engineers
Savannah District

March 2004
(Revised April 05)

SAVANNAH HARBOR EXPANSION PROJECT
FORMULATION OF ALTERNATIVES

TABLE OF CONTENTS

Savannah Harbor Expansion Project 1

Formulation of Alternatives 1

FEDERAL WATER RESOURCE OBJECTIVE 5
COOPERATING AGENCY GOALS 5
IDENTIFYING PROBLEMS AND OPPORTUNITIES 6
PROBLEM STATEMENTS: 6
OPPORTUNITIES 6
OBJECTIVES 6
PROJECT CONSTRAINTS 7
INVENTORY & FORECASTING CONDITIONS 8
ITEMS TO INVENTORY AND FORECAST 8
WITHOUT PROJECT CONDITIONS 9
FORMULATION OF ALTERNATIVE PLANS 10
POTENTIAL MANAGEMENT MEASURES 10
PRELIMINARY ALTERNATIVES 12
EVALUATION OF PRELIMINARY ALTERNATIVES 14
NON-STRUCTURAL ALTERNATIVES 14
1. Reduce underkeel clearance requirement. 14
2. Modifications of Garden City Terminal (GCT). 19
EVALUATION OF ALTERNATIVE TERMINAL LOCATIONS 26
SCOPE OF THIS INVESTIGATION 27
ALTERNATIVE CONTAINER TERMINALS 27
ENVIRONMENTAL CONSIDERATIONS: 30
ANALYTICAL ASSUMPTIONS 33
Features and Facilities at Alternative Terminals 33
Joint Terminal Operations 34
Benefits of Channel Deepening 34
Construction Costs vs. Operating Costs 34
Maintenance Dredging 34
GARDEN CITY TERMINAL 35
Garden City Terminal Site Profile and Initial Assessment 35
Cost of Modifying Garden City Terminal 36
Dredging Costs: Garden City Terminal 38
Other Considerations: Garden City Terminal 39
Overall Assessment: Garden City Terminal 40

OCEAN TERMINAL 40
Ocean Terminal Site Profile and Initial Assessment 40
Cost of Modifying Ocean Terminal 41
Landside Transportation: Ocean Terminal 44
Dredging Costs: Ocean Terminal 45
Overall Assessment: Ocean Terminal 47
BLUE CIRCLE CEMENT COMPANY 47
Blue Circle Cement Site Profile and Initial Assessment 47
Costs Of Modifying Blue Circle Terminal 47
Landside Transportation: Blue Circle Terminal 50
Dredging Costs: Blue Circle Terminal 51
Other Considerations: Blue Circle Terminal 52
Overall Assessment: Blue Circle Terminal 53
DISPOSAL SITE 12A 53
Disposal Site 12A Profile and Initial Assessment 53
Construction Costs: Disposal Site 12A 55
Landside Transportation: Disposal Site 12A 57
Dredging Costs: Disposal Site 12A 57
Other Considerations: Disposal Site 12A 59
Overall Assessment: Disposal Site 12A 59
EAST COAST TERMINAL 59
East Coast Site Profile and Initial Assessment 60
Costs of Modifying East Coast Terminal 60
Landside Transportation: East Coast Terminal 63
Dredging Costs: East Coast Terminal 64
Other Considerations: East Coast Terminal 64
Overall Assessment: East Coast Terminal 66
ELBA ISLAND TERMINAL 66
Elba Island Site Profile and Initial Assessment 66
Construction Costs: Elba Island Terminal 68
Landside Transportation: Elba Island Terminal 68
Dredging Costs: Elba Island Terminal 70
Other Considerations: Elba Island Terminal 71
Overall Assessment: Elba Island Terminal 71
DISPOSAL SITES 14A/B 71
Disposal Sites 14A/B Profile and Initial Assessment 72
Construction Costs: Disposal Sites 14A/B 72
Landside Transportation: Disposal Sites 14A/B 75
Dredging Costs: Disposal Sites 14A/B 75
Other Considerations: Disposal Sites 14A/B 75
Overall Assessment: Disposal Sites 14A/B 76
TYBEE NATIONAL WILDLIFE REFUGE 76
Tybee National Wildlife Refuge Site Profile and Initial Assessment 77
Construction Costs: Tybee NWR Terminal 78
Landside Transportation: Tybee NWR Terminal 78

Dredging Costs: Tybee NWR Terminal 80
Other Considerations: Tybee NWR Terminal 80
Overall Assessment: Tybee NWR Terminal 81
COLONEL'S ISLAND, BRUNSWICK 82
Colonel's Island Site Profile and Initial Assessment 82
Cost Of Modifying Colonel's Island Terminal 83
Dredging Costs: Colonel's Island Terminal 84
Other Considerations: Colonel's Island Terminal 85
Overall Assessment: Colonel's Island Terminal 86
OFFSHORE TRANSSHIPMENT FACILITY 86
Larger Ships and Increasing Interest in Transshipment 86
Conceptual Design and Operations: Offshore Transshipment Facility 87
Costs and Benefits: Offshore Transshipment Facility 89
Other Considerations: Offshore Transshipment Facility 90
Overall Assessment: Offshore Transshipment Facility 91
EVALUATION OF PROPOSED ALTERNATIVE TERMINAL SITES. 102
GENERAL DISCUSSION: 102
Sensitivity of assumptions: 102
Environmental Mitigation Costs: 102
Summary: 102
Conclusion: 102
Sensitivity Tests: 102
MINOR MODIFICATIONS 104
PASSING AREAS 104
BEND WIDENERS: 106
AIDS TO NAVIGATION: 106
VESSEL TRAFFIC COORDINATION: 106
STRAIGHTENING OF THE RIVER: 106
DEVELOPMENT OF DETAILED PLANS 107
DESCRIPTION OF DETAILED PLANS 109
PLAN A - NO ACTION. 109
PLAN B – CHANNEL DEEPENING 110

FEDERAL WATER RESOURCE OBJECTIVE

The objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

COOPERATING AGENCY GOALS

1. Process related:
    - Determine the specific and differential incremental effects of each channel improvement alternative.
    - Identify and evaluate impacts on the human environment, including impacts on natural resources, economics, and societal considerations (jobs).
    - Contain studies that are conducted in a manner that leads to their technical acceptance by the scientific community.
    - Clearly identify all benefits and costs for the decision-makers.
    - Recognize that mitigation may be necessary for any or all of the identified impacts.
    - If needed, recommend specific actions that should be taken outside the context of the Expansion Project to improve the local environment and/or compensate for past harbor improvement projects. The report would identify the process and participants to accomplish those specific needed actions.
    - Be documented by a report that leads decision-makers to clear decisions on the project.
2. Outcome related:
    - Produce positive economic benefits for the port community and have beneficial environmental effects.
    - Include a mitigation plan that addresses unavoidable impacts to critical natural resources.
    - Include post-project monitoring to ensure that the expected levels of adverse impacts are not exceeded.
    - Be supported by most stakeholders.

IDENTIFYING PROBLEMS AND OPPORTUNITIES

Problems and opportunities statements will be framed in terms of the Federal objective and the specific study planning objectives. Problems and opportunities should be defined in a manner that does not preclude the consideration of all potential alternatives to solve the problems and achieve the opportunities.[1]

PROBLEM STATEMENTS:

1. Existing shippers are experiencing increased/ inflated operations costs due to light loading and tidal delays
2. Light loading and tidal delays will increase as present harbor users increase their annual tonnage and as larger, more efficient ships replace older, smaller ones.
3. Existing ships are experiencing problems associated with turning capabilities and overall maneuverability in certain reaches of the inner harbor.
4. The severity of problems associated with turning capabilities and overall maneuverability in certain reaches of the inner harbor will increase as vessel size increases.

OPPORTUNITIES

1. Beneficial placement of new work sediments (Tybee Island and other locations)
2. Development of new upper harbor disposal area with new work material
3. Reduce O&M annual dredging costs
4. Enhance the natural resources in the project area
5. Advance the understanding of the natural resources in the project area
6. Contribute to the preservation of historically significant resources in the project area
7. Contribute to other agencies environmental decision making resources through development of state of the art modeling tools
8. Reduce constraints of harbor pilot operating practices
9. Identify the accumulated environmental impacts from past harbor development and operation. When consistent with the USACE authorities and policies, include appropriate actions in the plan alternatives.

OBJECTIVES

Definition: Statements that describe the desired results of the planning process by solving the problems and taking advantage of the opportunities identified.[2]

1. Contribute to national economic development by minimizing costs of moving cargo through Savannah Harbor by reducing current and future tidal delays in an environmentally acceptable and sustainable manner.

[1] Planning Guidance Notebook, Para. 2-3.a.
[2] Planning Guidance Notebook, Para. 2-3.a. (4)

2. Include post-project monitoring and adaptive management to ensure that the expected levels of adverse impacts are not exceeded.
3. Reduce current and expected future tidal delays
4. Reduce the need to light load caused by channel depth constraints
5. Reduce the need to light load caused by operational constraints
6. Reduce the current and future impacts and problems associated with turning capabilities and overall maneuverability in certain reaches of the inner harbor.

NOTE: In the plan formulation and evaluation process, incorporate consideration of all identified opportunities while achieving the objectives listed above.

PROJECT CONSTRAINTS

Definition: Constraints are restrictions that limit the planning process. Plans should be formulated to meet the study objectives and to avoid violating the constraints.

1. Underkeel clearance requirements
   - Pilots current and anticipated future operating practices requires 4-feet underkeel clearance
2. Meeting and passing limitations
   - Pilots current and anticipated future operating practices limit meeting and passing in the navigation channel
3. Environmental restrictions on dredging
   - Bar – Sea Turtles, Whales
   - Inner Harbor – Striped Bass, Manatee
4. Proximity of navigation channel to the Savannah National Wildlife Refuge
5. Aquifer
6. Location of cultural resources (Ft. Jackson, Ft Pulaski)
7. Proximity of landside development
8. Coast Guard restrictions on vessel movements
   - LNG Tanker movement limitations on other vessel traffic
   - Transit speed and or wake limitations
9. Tier I Commitments
   - Commitment to GADNR that deepening will not adversely impact recovery of striped bass
   - Shortnose Sturgeon
   - Additional field studies
   - No net effect on Dissolved Oxygen (DO)
   - Refine Hydrodynamic and Salinity Model

INVENTORY & FORECASTING CONDITIONS

An inventory and forecast of critical resources (physical, demographic, economic, social, etc.) relevant to the problems and opportunities under consideration in the planning area. This information is used to further define and characterize the problems and opportunities. A quantitative and qualitative description of these resources is made, for both current and future conditions, and is used to define existing and future without-project conditions.

ITEMS TO INVENTORY AND FORECAST

1. Fleet
2. Commodities
3. Operation procedures
4. Landside capacities
   - Berth characteristics
   - Throughput capacity
   - Acreage
   - Crane capacity
5. Fishery resources in the harbor
   - Shortnose Sturgeon
   - Temporal and spatial distribution of estuarine dependent species
   - Striped Bass
   - Scaienid species
6. Wetlands vegetation in the upper harbor
7. Cultural resources
   - Ft Jackson
   - CSS Georgia
   - Ft Pulaski
   - Others
8. Socioeconomic Considerations
9. Features of existing navigation project
   - Channel
   - Continued use of the existing harbor, at authorized channel dimensions, with no improvements for navigation. Periodic O&M would continue as required.
   - Disposal areas
   - Turning basins
   - Sediment Control Works
10. Adjacent Properties and Structures (to include)
    - Roussakis Plaza
    - East Coast Terminal
    - Blue Circle Cement
    - International Paper
    - Fife and Clydesdale Plantation
11. Water Quality Conditions

- Salinity Distributions
- Chloride Distributions
- Dissolved Oxygen Distributions

12. Sediment Quality
    - Physical
    - Chemical
13. Freshwater Marsh Succession
14. Wetland Resource Utilization
15. Ocean shoreline and riverbank conditions
16. Floridan Aquifer

WITHOUT PROJECT CONDITIONS

Existing conditions are those at the time the study is conducted. The forecast of the future-without project conditions reflects the conditions expected during the period of analysis. The future without-project condition provides the basis from which alternative plans are formulated and impacts assessed.

1. Initial assumptions
2. Detailed description
    - Fleet
    - Commodities
    - Operation procedures
    - Landside capacities
    - Fishery resources
    - Wetlands vegetation in upper harbor
    - Cultural resources
    - Socioeconomic considerations

FORMULATION OF ALTERNATIVE PLANS

Alternative plans shall be formulated to identify specific ways to achieve planning objectives within constraints, so as to solve the problems and realize the opportunities that were identified in Step 1. An alternative plan consists of a system of structural and/or nonstructural measures, strategies, or programs formulated to meet, fully or partially, the identified study planning objectives subject to the planning constraints. An alternative plan is a set of one or more management measures functioning together to address one or more objectives.

POTENTIAL MANAGEMENT MEASURES

Management measures are the building blocks of alternative plans and are categorized as structural and nonstructural. Equal consideration must be given to these two categories of measures during the planning process.

1. Reduce current and future tidal delays
   (a) Non-Structural
      1. Timing/schedule (dealing with a single vessel only)
      2. Reduce under keel clearance requirement
      3. Increase efficiency of landside operations to decrease turn-around time
      4. Specialization/optimization of facilities
         - Modification of Garden City Terminal
         - Increase efficiency of landside operations to decrease turn-around time
      5. Improved traffic management practices (dealing with coordination of multiple vessel movements)
      6. Regional port (feeder hub as well)
   (b) Structural
      1. Deeper channel
      2. Alternate terminal locations
         - Offshore transshipment facility
         - Onshore terminal
      3. Straighter channel alignment
      4. Passing lanes
      5. Increased/Improved landside infrastructure

2. Maneuverability of existing vessels
   (a) Non-Structural
      1. Improved equipment
      2. Vessel design modifications
         - Thrusters
         - Power
      3. Tug assistance
      4. Pilot training

5. Aids to navigation
   - Portable GPS navigation system
   - Harbor based vessel control system
   - Range lights/radar reflectors
   - Fixed radar reflectors along channel
6. Real time environmental data
   - Real time tide data vs. predicted tide
   - Wind speed and direction
   - Current speed and direction
7. Other

(b) Structural
1. Bend wideners
2. Turning basins
3. Passing lanes
4. Straighten river/longer ranges

3. Reduce the need to light load caused by channel depth constraints
   (a) Non-Structural
   1. Timing/schedule (dealing with a single vessel only)
      - Reduce underkeel clearance requirement
      - Increase efficiency of landside operations to decrease turn-around time
   2. Specialization / optimization of facilities
      - Modification of Garden City Terminal
        a. Increase efficiency of landside operations to decrease turn-around time
        b. Specialization / optimization of facilities
   3. Improved traffic management practices (dealing with coordination of multiple vessel movements)
   4. Regional port (feeder hub as well)

   (b) Structural
   1. Deeper channel
   2. Alternate terminal locations
      (a) Georgia
      - East Coast Terminal
      - Ocean Terminal
      - Elba Island
      - Brunswick
      - Other

      (b) South Carolina
      - Disposal Area 12A proposed terminal
      - Disposal Areas 14A/14B proposed terminal location
      - Tybee Island National Wildlife Refuge
      - Other locations
   3. Offshore transshipment facility

4. Onshore terminal
5. Straighter channel alignment
6. Passing lanes
7. Increased/Improved landside infrastructure

4 Reduce the need to light load caused by operational constraints
(a) Non-Structural
1. Timing/schedule (dealing with a single vessel only)
2. Reduce under keel clearance requirement
3. Increase efficiency of landside operations to decrease turn-around time
4. Specialization / optimization of facilities
5. Improved traffic management practices (dealing with coordination of multiple vessel movements)
6. Regional port (feeder hub as well)
(b) Structural
1. Deeper channel
2. Alternate terminal locations
   - Offshore transshipment facility
   - Onshore terminal
3. Straighter channel alignment
4. Passing lanes
5. Increased/Improved landside infrastructure
   - Create breakwaters

5. Reduce underkeel clearance requirement

PRELIMINARY ALTERNATIVES

1. Reduce underkeel clearance requirement
   - Real time environmental data

2. Modification of Garden City Terminal
   - Increase efficiency of landside operations to decrease turn-around time
   - Specialization / optimization of facilities

3. Alternative terminal locations
   a. Georgia
      - East Coast Terminal
      - Ocean Terminal
      - Elba Island
      - Brunswick
      - Other
   b. South Carolina
      - Other than Disposal Areas 14A/14B proposed terminal

- Disposal Areas 14A/14B proposed terminal location
- Tybee Island National Wildlife Refuge
- Other locations

4. Regional port

5. Offshore transshipment facility

6. Deepening existing 42 MLW navigation channel (to Station 103)
   - Alternative 44 (44' Deepening)
   - Alternative 46 (46' Deepening)
   - Alternative 48 (48' Deepening)

7. Improve existing 42 MLW navigation channel
   - Passing Lanes
   - Bend Wideners
   - Aids to navigation
   - Coordination of multiple vessel movements
   - Straighten river / Longer ranges

EVALUATION OF PRELIMINARY ALTERNATIVES

Savannah District conducted a conceptual-level evaluation of the preliminary alternatives identified in the previous section to determine whether they were likely to meet the problems and needs that this project is intending to address. We first examined the non-structural measures (underkeel clearance and modifications to the Garden City Terminal), then the alternative terminal locations, followed by the minor modifications passing areas, bend wideners, aids to navigation, vessel traffic coordination, and straightening of the river).

NON-STRUCTURAL ALTERNATIVES

Tier II plan formulation has considered a wide variety of nonstructural measures to address navigation problems and opportunities in Savannah Harbor. Most of these measures were screened out due to technical or economic considerations. However, two nonstructural measures were carried forward for more detailed evaluation in this investigation: (1) reduce underkeel clearance requirements and (2) increase efficiency of landside operations to decrease turn-around time. Both of these measures could potentially reduce lightloading and/or tidal delay costs to vessels that are constrained by existing channel dimensions in Savannah Harbor.

1. Reduce underkeel clearance requirement.

Existing Conditions: Underkeel Clearance

Reducing underkeel requirements could potentially reduce lightloading and tidal delays experienced by commercial vessels calling at Savannah Harbor. If, as expected, design drafts of container ships continue to increase, lightloading and tidal delays could become increasingly prevalent during the 50-year period of analysis. Reductions of these problems would reduce transportation costs for commercial navigation through Savannah Harbor with consequent National Economic Development (NED) benefits.

Underkeel Guidelines of Port User's Workgroup

In 1996, a Port Users Workgroup was assembled to coordinate commercial navigation operations in Savannah Harbor. The Port Users Workgroup consisted of representatives of the SPA, GPA, shippers, terminal operators, towing companies, and other maritime industry professionals. Also included were the Corps, USCG, and other Federal agencies responsible for safe and efficient navigation on these waterways. The Workgroup discussed current underkeel and safe transit guidelines for the ports of Savannah and Brunswick. The intent of this cooperative partnership was to proactively implement proven guidelines and operating controls to promote marine safety and to prevent economic and environmental loss by not imposing overly restrictive government regulation and controls. As a result of this coordination, the Workgroup developed *Port of Savannah Minimal Underkeel Clearance Guidelines for Minimum Underkeel*

Clearances. The guidelines were adopted by parties to the Workgroup as minimum operational standards for vessels transiting Savannah Harbor. These guidelines may be modified in the future by a similar representative body of Savannah's port users. The purpose of the guidelines is to proactively prevent maritime accidents and casualties. They were also intended to remove ambiguity and inconsistency in the procedures necessary to ensure that commercial vessels do not ground during transit or while berthed at a Savannah facility.

The underkeel guidelines for commercial vessels are as follows. They are applicable to all vessels in excess of 1600 gross tons.

"The following minimum underkeel guidelines apply in all conditions of tide and weather.

1. *4 feet for transits in the navigation channel between the sea buoy, across the Savannah Bar, through Jones Island range, ACOE station -14, where the project depth of the channel increases 2 feet.*
2. *2 feet for transits between Jones Island range and the point in the navigation channel which is adjacent to the facility of destination.*
3. *When operating on waters outside the established navigation channel, and while moored at a facility pier, 1 foot for single-skin tank vessels greater than 5,000 gross tons and 6 inches for all other deep draft vessels. These guidelines are also applicable for vessels maneuvering outside the boundaries of the navigation channel."*

The underkeel clearance specified by the guidelines includes squat. Squat is the phenomenon whereby the ship's draft is increased in shallow water due to the hydrodynamic effects between the ship and the channel bottom causing an increase in draft. It effectively reduces the underkeel clearance in areas where clearance may be critical. It can also impair maneuverability. Squat is approximately proportional to the speed of the ship. Halving the speed reduces the squat effect by a factor of four. In general, squat effects typically commence in waters where the depth/draft ratio is less than four-to-one.

In addition to underkeel clearance, the guidelines identified the following operational responsibilities and controls necessary to meet these objectives.

- The guidelines request that the Corps conduct regular surveys of the navigation channel and provide reports of the channel condition to the pilots and all concerned parties. At a minimum interval of every 90 days, or within 30 days prior to the arrival of a deep draft vessel, terminal operators are asked to conduct soundings in their berths.
- A conference between a vessel's master and the appropriate pilot should occur prior to the vessel's inbound or outbound transit. This pre-transit conference allows pilots to discuss with vessel masters the transit route and any special risks that the transit may incur.

- If a vessel in transit, using "tidal lift" to assure its underkeel clearance should experience a steering failure or loss of power that requires the vessel to be anchored, it shall be assisted by tugs to a safe anchorage. This anchorage shall be either offshore or in the vicinity of a Savannah River range or facility that has depth sufficient to accommodate the vessel's draft. It is the responsibility of the vessel's agent and master to identify, in advance, the towing requirements necessary to ensure the aforementioned actions may take place in a timely manner.
- The SPA's Pilotage Regulations are the recognized standard for maximum deep draft of vessels crossing the Savannah Bar under normal weather and navigation channel conditions.
- If a vessel is using "tidal lift" to assure minimum underkeel clearance while moored at a facility, that vessel must have a contingency plan in place which provides the personnel necessary to move the vessel away from the facility prior to exceeding the clearance. Additional discussion on this subject is provided below.
- A waiver for any of the underkeel clearance guidelines may be applied for by sending a written request, with supporting documentation, to the Port User's Workgroup. In certain cases, a request for waiver may necessitate the specific approval of the USCG.

Discretion of Pilots

According to the Savannah Pilots Association, it is the pilot's decision whether conditions are adequate for a vessel to transit the river at a given time. The Savannah underkeel guidelines are minimum standards and are not intended to be limiting for pilots, operators, or owners that choose to require a higher degree of safety for their operations. It is also the owners/operators discretion to require that their vessels transit with underkeel clearance in excess of the minimum requirements established by the guidelines. For example, a major containership carrier line, P&O Nedlloyd, has a policy that underkeel clearance requirements for their vessels should equal 10% of the vessels' design drafts, which is more than four feet for the largest containerships calling at Savannah.

By riding the high tide up or down the river vessels that are depth-constrained by channel dimensions of Savannah Harbor can achieve additional underkeel clearance, allowing deeper loading of a given vessel or use of a larger vessel. The tradeoff is the additional time required to wait for a favorable tide (i.e., tidal delay), and any additional steaming time required to reach the dock when "drifting" the tide. As indicated above, the Pilotage Regulations of the SPA are the recognized standard for inbound and outbound transits for vessel that are depth-constrained. These regulations specify time windows in the tidal cycle when vessels of specific draft can initiate inbound/outbound transits (see Table 1). Vessels with operating drafts of 38 feet or less can transit the channel at any time, weather permitting. Vessels drawing up to 42 feet can transit the channel using tidal advantage consistent with the Pilotage Regulations.

Table 1
Pilotage Regulations of the
Savannah Pilots Association
(12/15/94)

Start		Deadlines
	Inbound	
LW + 3.0 hours	42'00"	HW – 1.0 hours
LW + 2.5 hours	41'00"	HW – .5 hours
LW + 1.5 hours	40"00"	HW
LW + 1.0 hours	39'00"	HW
LW---anytime	**38'00"**	**LW---anytime**
LW + 2.0 hours	39'00"	HW – 2.5 hours
LW + 2.5 hours	40'00"	HW – 2.0 hours
LW + 3.0 hours	41'00"	HW – 1.0 hours
LW + 3.0 hours	42'00"	HW – .5 hours
	Outbound	

LW = Low Water; HW=High Water
All Vessels GCT (General License)
Tides – Savannah River Entrance
Wind Factor – 0
Time Limits Subject To Change Due To Weather Conditions Or Low Powered Vessels Or Emergencies
FROM SAVANNAH RIVER TO TOWN
+ 1 hour - high water
+ 1-1/2 hours – low water

The pilots use every available means to safely transit the harbor. In pre-transit coordination, vessel masters provide the pilot with the characteristics and condition of their vessels, including: mean draft, trim and list, and speed/squat. In turn, pilots provide vessel masters with information about physical conditions in the harbor, including: tide, seas, wind conditions, facility depth, and transit depth. The pilots currently have real-time information about channel depths from National Oceanic and Atmospheric Administration (NOAA) tide gauges, which can be accessed by cell phone. The Corps and port facilities provide the pilots and vessel masters with up-to-date information on channel depths and berth depths, respectively. The pilots are also aware of areas subject to shoaling and the type of material accreted. Much of the substrate of the Savannah Harbor Federal channel is either hard sand or soft mud.

Commercial ships must keep up their speed to maintain steerage in the tidal currents, and squat can be significant at speeds typically maintained by vessels in the harbor. The underkeel guidelines assume the vessel has good maneuverability. At low water (LW), vessels with good maneuverability would have a 38-foot operating draft in the 42-foot channel. If the vessels have poor maneuverability, the pilots may require as much as five or six feet of clearance underkeel.

Without-Project Future Conditions: Underkeel Clearance

As expressed by Capt. Browne the Savannah pilots consider the Savannah underkeel guidelines to be the minimal underkeel clearance necessary to safely navigate Savannah Harbor and fully expect that the current underkeel clearance guidelines will prevail throughout the period of analysis. The Panamax container ships which call at Savannah can have lengths overall (LOA) of up to 950 feet. Post-Panamax ships are longer. The pilots consider the underkeel guidelines to be the absolute minimum for commercial vessels, given potential pitch and roll. As indicated above, it is the pilot's discretion at all times to delay in order to ensure additional clearance.

The Savannah underkeel guidelines are consistent with other deep-water ports in the United States. Specifically, the ports of New York – New Jersey, Delaware River, Norfolk – Hampton, and Los Angeles – Long Beach require a minimum of three feet underkeel in their harbors.

With-Project Conditions: Reduced Underkeel Clearance

The SPA is resolute in its defense of the Savannah Underkeel Guidelines. Although the guidelines indicate that modification is possible by the Port User's Workgroup or a similar body representative of the Savannah port community, the SPA cannot envision any circumstances under which those guidelines would be reduced.

Conclusion: Underkeel Clearance

At this time there is no potential for reduced underkeel clearance to address navigation problems and opportunities in Savannah Harbor. The underkeel clearance currently

stipulated by the guidelines does not offer any opportunity for reduction when vessel squat is included in the clearance calculation. In addition, the resolute opposition by the SPA on the basis of navigational safety indicates a lack of institutional support for this nonstructural measure. Based on coordination with GPA and USCG, the position of the Savannah Pilots Association is the most critical determinant of underkeel clearance in port operations in Savannah Harbor.

2. Modifications of Garden City Terminal (GCT).

As a nonstructural measure, modifications to Garden City Terminal would entail improvements to the container throughput capacity of the terminal, and would also be considered under the without-project conditions. The rationale for this particular nonstructural alternative is that increasing the efficiency of the terminal could potentially decrease the turn-around time for vessels calling at the terminal. Given the growth forecasts for containers moving through Savannah Harbor during the period of analysis, the decreased turn-around time could potentially reduce congestion and increase throughput in the port relative to the without-project conditions.

Specifically, it must be determined to what extent this nonstructural measure could address problems associated with channel dimensions which are insufficient to efficiently accommodate the fleet of container ships expected to call on Savannah during the period of analysis.

Existing Conditions: Facilities and Throughput Capacity

Garden City Terminal, which is a public terminal operated by GPA, is profiled in Table 1. At this terminal there are currently an average of approximately 16,000 picks (i.e., containers to/from a vessel) per week. During peak periods, there can be as many as 17,500 picks/week. This translates into approximately 830,000 picks/year (assuming a 365-day per year operation) and 1.5 million 20-foot equivalent units (TEUs) per year (assuming a 1.8 factor to account for the predominance of 40-foot boxes). In FY 2002, Garden City Terminal had 1,136,616 TEUs pass through this terminal. Garden City Terminal encompasses approximately 1,200 acres with 500 acres dedicated to container operations and storage. The remaining acreage is occupied by rail facilities, warehouses, tank farms, and buildings. At this time, all of the Garden City berths are maintained at 42 feet deep, consistent with the depth of the Savannah Harbor Federal channel

Table 2: Garden City Terminal Facilities
Cargo Handled: Containers, General Cargo, Ro/Ro, Project Cargo, and Liquid Bulk
Terminal Area: 1,120 acres
Container, RO/RO Berths Linear Feet: 7,726 Depth Alongside 42 ft. at mean low water Dock Height 15 ft. above mean low water Apron Width Up to 196 ft.
Liquid Bulk Berths Linear Feet: 682 Depth Alongside 36 ft. (10.9 m.) at mean low water Dock Height 15 ft. (4.5 m.) above mean low water Liquid Tank Farm 2.2 million barrel capacity
Container Cranes Total: 13 (2 super post-Panamax and 11 post-Panamax)
Equipment Rubber-Tired Gantries: (22) 45-st capacity Four-high loaded toplifts: (25) 67,400 lb. under spreader capacity; (7) 87,000 lb. under spreader capacity Three-high loaded toplifts (3) 87,000 lb. under spreader capacity Five-high empty stackers (6) 15,000 lb. capacity under spreader capacity Forklifts (43) 11,000 lb. - 52,000 lb. capacity with accessory attachments Over-height crane attachment (1) 45-st capacity spreader loader; (2) 56-st (50 lt) capacity spreader loader
Warehousing: Total 1,417,808 sq. ft., equipped with alongside rail/truck capabilities, includes 68,150 sq. ft. cold storage
Container Field Paved Area (acres) 405 Paved Area (hectares) 164 Parking Slots 12,345 TEU Stacking Slots 33,598
Rail Services: Norfolk Southern Railroad provides switching services; interchange and line haul services provided by Norfolk Southern Railroad and CSX Transportation. Newly-completed Mason Intermodal Container Transfer Facility (ICTF) is located adjacent to Garden City Terminal. ICTF spans over 150 acres. At final build-out, the ICTF will include 40,000 feet of lead track and 80 acres for container storage and marshaling. This facility now daily handles unit trains.

With its current facilities, Garden City Terminal currently has an annual throughput capacity of approximately 1.75 million TEUs. This capacity estimate is based on current container storage capacity at Garden City Terminal (500 acres of container storage with storage capacity of approximately 3,512 TEU's per acre per year).

Permits for construction of Container Berth 8 (CB-8) were received in November 2003. CB-8 will include approximately 2,100 linear feet of berthing space, and four high-speed super post-Panamax container cranes, and 80 acres of landside storage. As part of GPA's plans for development of CB-8, yard capacity will be augmented by an additional 75 acres of GPA-owned land south of Berths 7 and 8. It is anticipated that, of this area, 42 acres will be used for container storage; the remainder will be used for relocated gate operations and vehicle/trailer depots. Relocation of these activities will provide additional container storage near the terminal berths.

There are currently 2,500 to 3,000 TEU moves by rail per week through the Mason Intermodal Container Transfer Facility (ICTF). At this time, Norfolk Southern is the only railroad that operates from the ICTF. However, CSX is currently developing rail connection to this facility with completion expected in 2005-2006. Norfolk Southern provides service to Atlanta five days per week, effectively competing with truck transport. Norfolk Southern's access to ICTF is via the Foundation Lead track. Norfolk Southern currently loops eastward to its yard in Savannah and comes in the east side of ICTF. CSX and Norfolk Southern intend to construct connector rails from their tracks south of ICTF for more direct access to ICTF from the west side. Norfolk Southern owns Foundation Lead but is expected to reach agreement with CSX regarding their use of this track.

The ICTF can accommodate 8,000-foot unit trains. Through this facility, Norfolk Southern provides expedited, overnight rail service to Atlanta and offers users seamless 3-day delivery, or less, by rail to major American hubs in Chicago, Detroit, Dallas/Fort Worth, Memphis, Kansas City, St. Louis, Louisville, Houston, New Orleans, Mobile, as well as other key destinations throughout the United States. The Mason ICTF now handles daily unit trains.

Without-Project Conditions

GPA is making significant investments to maintain state-of-the-art container handling facilities at Garden City Terminal, and GPA is committed to providing the terminal facilities and landside infrastructure necessary to accommodate its future customer.

Facilities and Throughput Capacity

GPA's capital planning process will expand the throughput capacity of the terminal consistent with anticipated sizes and frequencies of container vessels calling at the terminal and with the expected volumes of containers to pass through the facility. GPA's capital planning horizon is 10 years. At this time, GPA anticipates that the volume of containers moving through Garden City Terminal will increase five to seven percent per year over the period of analysis. The capital planning process is designed to anticipate future commodity volumes with sufficient time to implement needed improvements to ensure that facility capacities always meet or exceed the total throughput needs of shippers utilizing this terminal.

Recent, ongoing, and planned improvements at Garden City Terminal include the installation in 2003 of two super post-Panamax cranes to augment the capacity of 11 post-Panamax cranes already in place. The development of the Mason ICTF, the ongoing realignment of container stacks to facilitate the faster movement of containers to/from ships and storage, and the pursuit of navigation improvements in Savannah Harbor.

At this time, GPA is pursuing increased efficiencies in landside handling and storage and new berths and facilities capable of handling post-Panamax container ships. In pursuit of increased efficiencies in container handling and storage, GPA intends to increase storage densities and thereby augment throughput capacity. GPA's goal is to increase storage utilization from the current level of 3,512 TEUs per acre per year to 5,500 TEUs per acre

per year. Achieving this level of storage utilization in the entire container operations would increase terminal capacity to 2,750,000 TEUs, not including additional capacity expected with CB-8. U.S. container ports typically handle 2,000 to 5,000 TEUs per acre per year. Consequently, the 5,500 per acre per year target is realistic with current technology.

Permits for construction of CB-8 have been obtained and development of these facilities has been initiated. CB-8 will add 2,100 linear feet of berth with 75 acres of yard, or approximately 0.04 acres (1,556 square feet) per linear foot of berth. The anticipated CB-8 yard area would be consistent with yard areas supporting existing container berths at Garden City Terminal. Currently, the container berths at Garden City are approximately 7,726 feet long with 405 acres of container yard, or approximately 0.05 acres (2,283 square feet) per linear foot of berth. If the 5,500 per acre per year storage utilization is applied to the CB-8 back area, implementation of CB-8 would augment terminal throughput by approximately 440,000 TEUs.

At this time, GPA does not have a precise date for achieving their target storage capacity 5,500 TEUs per acre per year. However, GPA is making ongoing improvements to storage capacity toward this goal. These improvements include: (1) continuing ongoing realignment of the container stacks to facilitate vessel loading/unloading, and (2) pavement work to increase the load-bearing capacity of container storage areas, allowing increased storage densities. The container stacks have been undergoing realignment from an orientation that was perpendicular to the dock, to an orientation that is parallel to the docks. Realignment and pavement work are taking place at Berths 1-5. Work on CB-1, CB-2 and CB-3 is complete. CB-4 and CB-5 are scheduled to occur in FY06 through FY10. Realignment has been completed on CB-6 and CB-7. These storage-related improvements could increase the terminal's throughput capacity to 2.0 million TEUs in the near future. No new equipment would be required to achieve this throughput capacity increase.

Toward the goal of 5,500 TEUs per acre per year, GPA is also increasing density and stacking heights for loaded and empty containers. This will open up more area for realignment. Currently containers at Garden City Terminal are stacked 4-high (loaded) and 5-high (empties). All of the handling equipment GPA has been purchasing can handle 5-high loaded and 7-high empties. However, GPA is not consistently stacking at these heights. The goal is to consistently stack 5-high (loaded) and 7-high (empties). GPA continues to budget for new equipment purchases through the end of their budgeting cycle – 2010.

Other actions to increase terminal capacity would entail incorporation of adjacent GPA properties into container operations. Additional storage capacity and terminal throughput capacity could be achieved by incorporating GPA-owned properties south and west of the terminal into terminal operations. The property associated with the anhydrous ammonia facilities south of Berth 7 should become available to GPA when the lease for this 16-acre property expires in December 2008. Incorporation of this acreage into terminal operations could occur in 2009. In a 2002 capacity analysis Moffett & Nichol estimated

incorporation of this property into terminal operations could increase annual throughput capacity by 75,000 TEUs. This addition to terminal throughput capacity would be consistent with the target storage utilization rate of 5,500 TEUs per acre per year.

The potential expansions of Garden City Terminal throughput capacity discussed above are summarized in Table 3. This table suggests the above measures, if implemented, could increase Garden City Terminal's capacity to 3.85 million TEUs per year.

TABLE 3
PLANNED AND EXPECTED MEASURES TO AUGMENT CAPACITY
GARDEN CITY TERMINAL

Improvements	Capacity Augmentation (TEUs)	Year
Current Throughput Capacity	1,750,000	2003
Increase Storage Utilization to 5,500 TEU per acre per year, Including: realigning stacks, improved pavement, increasing stack heights and densities	+ 1,000,000	Ongoing
Bring new berth (CB-8) on line	+ 440,000	2007
Incorporation of Anhydrous Ammonia Property at CB-7	+ 75,000	2008
Off-Site Storage of Long-Dwell Empties	+ 200,000	2015/2019
Incorporation of Garden City Triangle Property	+ 385,000	2015/2019
Total	3,850,000	

Table 4 presents container volumes in TEUs shipped annually through Garden City Terminal from Fiscal Year (FY) 1999 to 2003 (July to February). As indicated in this table, 1.5 million TEUs were shipped through this terminal in FY 2003. This suggests that Garden City Terminal is approaching its current throughput capacity of 1.75 million TEUs. It also explains why GPA is expanding capacity via development of CB-8 and increased storage efficiency.

TABLE 4
TEUs SHIPPED THROUGH
GARDEN CITY TERMINAL
1999-2003

Fiscal Year	TEUs Shipped Through Garden City Terminal	Annual Growth Rate (%)
1999	761,000	
2000	845,400	11%
2001	1,021,200	21%
2002	1,137,100	11%
2003	1,505,300	32%
	Average	19%

If a 5-percent growth rate is experienced for containers moving through the terminal, the 3.85 million TEU capacity in Table 3 could accommodate growth through 2023. If a 7-percent growth rate occurs, this capacity would be sufficient through 2017. As indicated in Table 3, there is some uncertainty about the timing of capacity expansion at Garden City Terminal. The most immediate capacity expansions will be achieved before the project's base year of 2010 through the ongoing realignment of container stacks and pavement work to allow higher stacking of loaded and empty boxes.

GPA has the last two measures shown in Table 3 in their Strategic Plan for the Garden City Terminal, but will not need to implement them until beyond the scope of their 5-year budgeting cycle, which presently extends to 2010. Based on a 5-percent growth rate, GPA would not need those two measures until 2019. With a 7-percent growth rate, GPA would need them in 2015. GPA presently owns the lands on which both measures would occur, so funding is the only factor that limits when these measures could be in place. GPA continuously monitors the throughput capacity of the terminal and actively manages the facilities to stay ahead of the volumes of TEUs expected to employ that capacity. Improvements are typically made so that the needed capacity is in place one-year prior to when it is actually needed. A one-year construction period would be adequate to implement these measures. Therefore, if implemented the same year, these measures would need to be included in GPA's 2017 budget, if a 5-percent growth rate occurs, or the 2013 budget if a 7-percent growth rate occurs. With GPA's 5-year budgeting cycle, these measures would be include in their budgets prepared in 2012 if a 5-percent growth rate occurs, or 2008 if a 7-percent growth rate occurs.

The last two measures shown in Table 3 would provide slightly more capacity than that required to accommodate the containers expected to be handled by the larger vessels that would use a deeper channel. Since GPA has already identified what measures it would take to provide that capacity, has acquired the land necessary to implement those measures, has identified when it would need to take further steps on those measures (beginning to budget for them), and has demonstrated a willingness and ability to make sufficient capacity improvements to stay ahead of the terminal throughput volume, Savannah District believes that GPA will implement these two measures even if harbor deepening does not occur.

Berth Utilization and Port Congestion

The viability of modifications to Garden City Terminal as a nonstructural measure depends in part on the level of current and future berth congestion. The premise of this measure is that if turn-around time for vessels could be decreased, there might be less berth congestion, allowing depth-constrained vessels greater opportunities to take advantage of the tides and transit the system more rapidly.

Garden City Terminal currently has a berth utilization of approximately 42 percent (based on a 24-hour operation, 365 days/year). Based on industry standards that typically describe 50 percent as full practical berth utilization, this level of berth utilization is approaching full utilization. A 2002 capacity analysis by Moffat & Nichol identified 30 percent capacity utilization as full utilization. However, according to GPA managers,

this relatively-low utilization rate was intended as a trigger point for development of additional berth capacity. Some berths are occupied more often than other berths depending on their locations relative to container stacks, as well as other considerations. Some shippers prefer to use specific berths because of the more direct access they provide to boxes slated for their ships. Garden City Terminal managers make every effort to accommodate the berth preferences of shippers. The need for additional berth space, as well as the increasing use of post-Panamax container ships, was the impetus for development of CB-8.

Berth utilization is typically calculated using the following formula:

Berth Utilization = [Time at Berth / Time Berth Available] x [(LOA + tie down) / Berth Length]

Container vessels calling at Garden City typically spend 8-12 hours at berth. The average container vessel arriving at Garden City is 965 feet in length overall (LOA). Container vessels arrive/depart Garden City Terminal at an average frequency of approximately 24 vessels per week.

GPA estimates that the addition of Container Berth 8 will reduce overall facility berth utilization by 6 percent to 37 percent. Depending on the vessels at dock, Berths 7 and 8 could accommodate up to three ships. The berth utilization at Garden City Terminal with the addition of CB-8 will still be relatively high. Berth congestion may require other measures during the period of analysis to increase berth capacity.

With-Project Conditions: Modification of Garden City Terminal

Based on discussions with GPA managers, modifications to Garden City Terminal as a non-structural measure would likely involve an acceleration of GPA's capital planning to create additional capacity to reduce turn-around time relative to without-project conditions. However, for several reasons the risks and rewards of accelerating the capital program would likely not be advantageous for GPA to pursue.

First, accelerating the capital program would be expensive. The goal of capital planning is to provide needed facilities when they are needed, not before or after. The financial investments required to significantly increase terminal throughput capacity are typically very large. If that equipment, which immediately begins to depreciate, is unutilized or underutilized, the costs would not be justifiable financially.

Second, even if such investments were made and berth utilization declined significantly, the rewards would be small. As discussed in the Tier I Economics Appendix, most of the draft-constrained container ships that enter/leave Savannah Harbor do so light-loaded. There is some riding of the tide by container ships for depth advantage, but in general liner services prefer to light-load rather than ride the tide due to their tight, multi-port schedules. The marginal benefit of deeper loading is not offset by the cost to customers of potentially slipping their service schedules. In addition, the increased availability of berths at Garden City would only affect a subset of depth-constrained vessels by marginally increasing their tidal window to transit the channel. It is also questionable

whether a minor reduction in time spent transiting the system would result in transportation time and cost savings for vessels calling at multiple ports, since they must maintain precise arrival / departure schedules at the prior and next ports of call.

The benefits of reduced turn-around time associated with facility improvements would likely not be offset by the financial cost of those improvements, particularly when they would be underutilized for a longer period of time than under without-project conditions.

Conclusion: Modification of the Garden City Terminal

Based on this investigation, the following conclusions can be drawn about modifications to Garden City Terminal as a non-structural measure. First, GPA is presently upgrading the facilities serving this terminal to increase its throughput capacity. Second, GPA has identified additional improvements that it would implement when needed. These improvements are expected to occur after the 2010 base year of the project. Third, there are likely to be some minor benefits associated with accelerating the capital planning process for the terminal. Fourth, these benefits will be difficult to measure in terms of time and expense. Fifth, the benefits are likely to be exceeded by the costs of implementing those improvements, since they would be underutilized for some period of time after they are in place. It should also be noted that, if there were any clear economic advantage to reduce turn-around time to increase tidal windows via measures to improve terminal capacity or efficiency, GPA would already be pursuing these actions, as they are already doing under without project conditions.

EVALUATION OF ALTERNATIVE TERMINAL LOCATIONS

The purpose of this investigation was to evaluate the potential for alternative terminal locations to address navigation problems and opportunities in Savannah Harbor. The evaluation of the alternative terminal locations is consistent with criteria established by Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (U.S. Water Resources Council, 1983) and the policies and procedures established by ER 1105-2-100, Planning Guidance Notebook, 22 Apr 2000. The evaluation of alternative terminal locations includes technical, economic, and environmental considerations.

Earlier Tier II plan formulation activities identified alternative terminal locations as having the potential to address navigation problems and opportunities in Savannah Harbor. The following alternative terminal locations were carried forward for more detailed evaluation in this phase of the investigation.

- Georgia
    - Garden City Terminal,
    - East Coast Terminal,
    - Ocean Terminal,
    - Elba Island,
    - Brunswick, and

- Other locations.

- South Carolina
  - Disposal Area 12A,
  - Disposal Areas 14A/B,
  - Tybee Island National Wildlife Refuge (NWR), and
  - Other locations.

The earlier plan formulation activities also recognized the potential for an offshore transshipment facility to serve depth-constrained container ships calling at Savannah Harbor and potentially other South Atlantic ports, such as Jacksonville or Charleston. An examination of the feasibility of offshore transshipment facility is included in the array of alternative terminals considered in this section.

SCOPE OF THIS INVESTIGATION

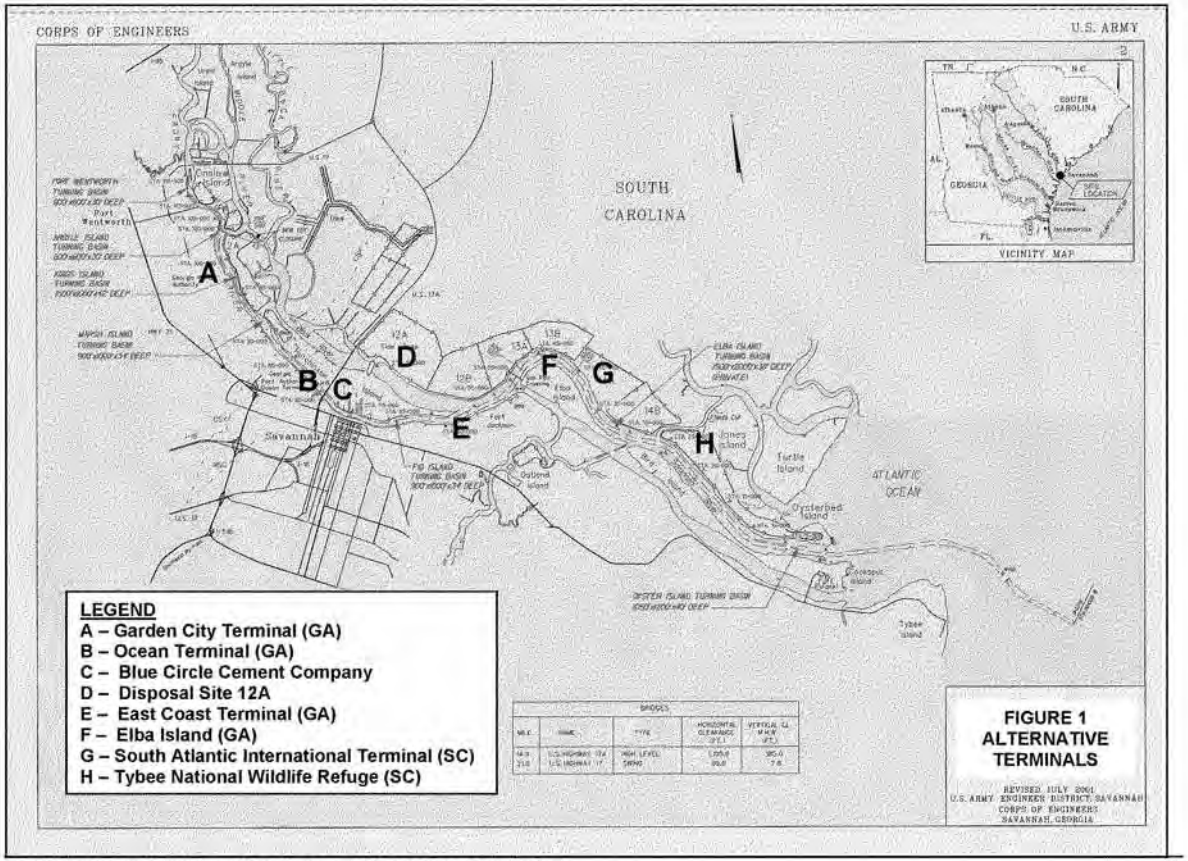
The Tier I Selected Plan consisted of deepening Savannah Harbor to 48-feet mean low water (MLW) from the Garden City Terminal to the sea. The premise for the alternative terminal locations is that they could be located downstream from the Georgia Port Authority's (GPA's) Garden City Terminal to reduce dredging costs and possible environmental impacts associated with saltwater intrusion. To address navigation problems and opportunities in Savannah Harbor, channel deepening would be implemented only as far as the single terminal that would serve the deeper vessels, but not beyond. If that terminal could be located closer to the ocean than the Garden City Terminal, perhaps the total economic and environmental costs would be less.

The concept is that no matter where the terminal serving the deeper-draft vessels is located, Savannah Harbor would have: (1) channel dimensions sufficient to accommodate fully loaded Post-Panamax (those with a beam greater than 106-feet) container ships, and (2) throughput capacity sufficient to accommodate the anticipated growth in the volume of containers expected over the period of analysis.

ALTERNATIVE CONTAINER TERMINALS

The alternative terminal locations considered in this investigation are illustrated in Figure 1, with the exception of the Colonel's Island terminal in Brunswick, Georgia. The locations considered include those identified early in Tier II plan formulation, as well as several others subsequently identified through coordination between Savannah District and GPA. As indicated in this figure, the terminals include: Garden City Terminal, Ocean Terminal, East Coast Terminal Company site, Elba Island, and Blue Circle Cement Company on the Georgia side of the Savannah River, and Disposal Area 12A, Disposal Sites 14A/B, and Tybee National Wildlife Refuge on the South Carolina side of the river.

Initial coordination between Savannah District and GPA identified Port Royal, South Carolina as an alternative terminal location. Port Royal is located approximately 10 miles north of Hilton Head Island along the Beaufort River. This site was eliminated from detailed investigation in this analysis due to geotechnical considerations. Savannah District's Engineering Division discovered that a freshwater aquifer lies close to the surface at Port Royal. This site was not carried forward for detailed investigation due to concerns that deepening the Beaufort River could result in saltwater intrusion into this important source of water supply.


CORPS OF ENGINEERS
U.S. ARMY
SOUTH CAROLINA
GEORGIA
VICINITY MAP
Savannah
ATLANTIC OCEAN
A
B
C
D
E
F
G
H
LEGEND
A – Garden City Terminal (GA)
B – Ocean Terminal (GA)
C – Blue Circle Cement Company
D – Disposal Site 12A
E – East Coast Terminal (GA)
F – Elba Island (GA)
G – South Atlantic International Terminal (SC)
H – Tybee National Wildlife Refuge (SC)
FIGURE 1
ALTERNATIVE
TERMINALS
REVISED JULY 2001
U.S. ARMY ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

ENVIRONMENTAL CONSIDERATIONS:

During the initial phases of Tier II, the Stakeholders Evaluation Group assisted the project in identifying other environmental issues that could be considered during Tier II. As a result of that and other input, the following issues are being considered during development of the GRR and Tier II EIS:

- Issues identified in Tier I as requiring further study:
    - Impacts to the wetlands from changes in salinity, particularly wetlands located in the Savannah National Wildlife Refuge
    - Impacts to the endangered shortnose sturgeon from changes in salinity and dissolved oxygen
    - Impacts to striped bass spawning and nursery habitat from changes in salinity and other factors
    - Impacts to the City of Savannah's water intake from changes in chloride levels
    - Impacts to dissolved oxygen levels
- Verification of the 3-Dimensional Hydrodynamic Model
- Salinity changes
- Dissolved oxygen
- Chloride levels
- Striped Bass
- Shortnose Sturgeon
- Freshwater Wetlands
- Salt Water Wetlands
- Tide Gate Restoration
- Cumulative Impacts from Previous Dredging
- Closing Middle River
- Fishery management Plans
- Anadromous Fish Populations
- Other Fish Species: Red Drum, American Shad, River Herring
- Essential Fish Habitat
- Endangered Species Act Compliance
- Management of Contaminated Sediments
- Beach Erosion
- Channel Slope Erosion
- Fort Pulaski Erosion
- Dissolved Oxygen/Fecal Coliform on Beaches
- Agitation Dredging
- Sand as a Resource
- Upstream Water Releases
- Project Economics
- US Army Corps of Engineers Section 1135 Restoration Study
- US Army Corps of Engineers Savannah River Comprehensive Study

- Bend Widener Impacts
- Fort Pulaski Impacts
- Dredged Material Disposal Capacity and Impacts
- Impacts on Adjacent South Carolina Properties
- Integration with COE Savannah River Basin Comprehensive Water Resource Management Study
- Tidal Amplitude
- Drinking Water Aquifer
- Ballast Water
- Cultural and Historic Resources
- CSS Georgia Impacts
- Old Fort Jackson Impacts
- Impacts on Adjacent Georgia Properties
- Environmental Justice
- Multiport Analysis
- Landside Infrastructure
- Alternate Methods to Improve Transportation Efficiencies
- Alternate Sites for Terminal Operations
- Consistency with Coastal Zone Management Plans

At this point in the process the study team believes that the following potential impacts have the potential to result in substantial mitigation costs to the proposed project:

- Direct impacts to wetlands along the river from construction activities.
- Secondary impacts to wetlands resulting from changes in salinity, particularly wetlands located near the Savannah National Wildlife Refuge.
- Impacts to the endangered shortnose sturgeon from changes in salinity and dissolved oxygen.
- Impacts to striped bass spawning and nursery habitat from changes in salinity and other factors.
- Impacts to the City of Savannah's industrial water intake from changes in chloride levels.
- Impacts to dissolved oxygen levels.
- Effects of increasing traffic volumes through the city.

Therefore to the extent possible, the scope of impacts expected to occur on these resources should be included while considering the likely feasibility of preliminary alternatives. Since the detailed studies that will identify the extent of the impacts to these resources are still underway, the study team decided to use the level of impacts identified during Tier I, since that would constitute the best information available at the time decisions need to be made.

Tier I estimated the extent of impacts expected if the navigation channel were deepened to the Garden City Terminal. Several resource agencies and members of the public have expressed a belief that impacts to natural resources would be less if the channel were not

deepened as far upstream. That is true to some extent. Based on the technical experience within the Savannah District, the following table was developed that displays the extent of impacts expected to the critical resources identified previously, when compared to the impacts identified if the channel were deepened to Garden City Terminal. As can be seen, fewer direct and secondary impacts are expected as the extent of construction is reduced to lower portions of the harbor.

TABLE 5
EXPECTED PERCENTAGE OF MITIGATION NECESSARY FOR ALTERNATIVE TERMINAL SITES WHEN COMPARED TO GARDEN CITY TERMINAL

Impact Category	Garden City Terminal	Ocean Terminal	Blue Circle Site	Disposal Area 12A	East Coast Terminal	Elba Island	Disposal Site 14A/14B	Tybee NWR
Chlorides at City's Industrial Water Intake	100	75	70	0	0	0	0	0
Dissolved Oxygen	100	75	70	20	20	0	0	0
Cultural/Historic	100	100	100	100	100	0	0	0
Direct Construction Impacts	100	75	70	65	55	30	25	10
Secondary Wetland Impacts	100	75	70	25	0	0	0	0
Shortnose Sturgeon Habitat	100	75	70	20	20	0	0	0
Striped Bass Habitat	100	100	100	0	0	0	0	0

However, those impacts do not include some impacts that would occur with specific alternative terminal site locations. Three sites that are considered are located within existing confined dredged material disposal facilities on the South Carolina Side of the river. That storage capacity would need to be restored to keep the government whole if those sites were no longer available for deposition of sediments excavated from the river. Both the tract size and its location are important when considering costs for sediment deposition. A standard terminal size was used to estimate development costs for such a facility, so the amount of land needed to replace lost sediment storage capacity is fairly straight forward. Loss of 375 acres from a disposal facility requires development of the same sized facility, at roughly the same location along the river, and at roughly the same distance from the navigation channel. Based on the extent of existing development along the river, no large tracts of undeveloped land appear to meet these requirements on the Georgia side. Therefore, this analysis assumed that land to replace the lost sediment storage capacity would be made available to extend the existing CDFs out into the marshes that lie along the northern side of those CDFs. This would result in impacts to an additional 375 acres of saltmarsh. The costs to mitigate for those losses are included in the evaluation of the alternate terminal locations at the same rate as for similar losses resulting from other projects.

One of the proposed alternate terminal locations is the Tybee National Wildlife Refuge. A higher level of mitigation could be necessary to compensate for the land lost from that refuge, but those costs are not included in this analysis.

The costs to mitigate for environmental impacts are described in the assessment of each separate alternate terminal location. The costs of increasing traffic volumes through the City have not been quantified. The effects of such impacts are discussed in a qualitative manner, but the District concluded that quantification of those impacts was not necessary to reach a decision of the feasibility of the sites that would produce those effects.

ANALYTICAL ASSUMPTIONS

The assumptions that underlie this analysis are discussed below. They encompass: features and facilities of alternative terminals, port maneuvering costs, joint terminal operations, distribution effects of benefits associated with alternative terminals, benefits of channel deepening, construction and operating costs, and maintenance dredging.

Features and Facilities at Alternative Terminals

To address the navigation problems and opportunities in Savannah Harbor, an alternative terminal would need sufficient capacity to handle the volume of containers anticipated to be carried on depth-constrained container ships (i.e., those container ships that would require more depth than currently provided by the 42-foot Savannah Harbor channel). These ships are typically post-Panamax-class vessels that are consistent with the Design Vessel used in the Tier II EIS and GRR: the *Susan Maersk*, a 6,600 TEU post-Panamax class container ship launched in 1997 (beam: 140 feet, length overall 1,138 feet; design draft: 47.6 feet).

The volume of containers anticipated to be carried on depth-constrained vessels during the period of analysis is approximately 500,000 TEUs. However, based on coordination between Engineering Division of the Savannah District and GPA it was concluded that a new container terminal would need to be significantly larger to achieve economies of scale in facility development, equipment purchase, and terminal operations. To achieve economies of scale, the following mix of facilities and equipment would represent the minimum features for a new state-of-the-art container facility to be an effective and efficient terminal. This mix of facilities and equipment, which are consistent with industry standards, would provide approximately 1.5 million TEU throughput capacity.

- Two berths with an assumed length of 1,250 feet per berth,
- Each will need a minimum of three Super Post-Panamax cranes (with a 72-95 long ton rated capacity),
- Other handling equipment to include: seven Rubber Tired gantries, 10 Five-high loaded Top lifts (87,000 lbs.), and two Seven-high empty stackers (15,000 lbs.),
- 150 acres of container parking needed per berth, or 300 acres total, including: 90 acres for container storage, 15 acres of parking space for vehicle storage, 10 acres for service drives and buffer, and 35 acres for container handling marshalling yard for rail loading,

- Annual throughput capacity commensurate with these facilities would be approximately 1.5 million TEUs,
- Dedicated rail access with intermodal rail connection within 10 miles,
- Sufficient landside area for potential future expansion, and
- For existing terminals that would be modified to handle containers or more containers (e.g., Garden City Terminal, Ocean Terminal, East Coast Terminal, Brunswick's Colonel Island Terminal), 90 acres of container parking would be needed per berth. For these terminals, no additional area would be needed for vehicle storage, service drives, or rail container marshalling.
- For Greenfield sites additional requirements include: heavy duty access road(s), water and electrical service, railroad ties and foundation, water storage tank (100,000 gallons), an intermodal transfer station, and a wastewater treatment facility.

Joint Terminal Operations

It is assumed in this analysis that a new terminal would not eliminate the need for the continued operation of the Garden City Terminal. Instead, the new facility would supplement container handling capacity to help meet the growth in future demand. For this analysis, it was assumed that the new terminal(s) would handle depth-constrained container vessels, and Garden City Terminal would handle container ships that are not depth-constrained. It is also assumed that the new terminal would not result in underutilization of Garden City facilities and that costs of such inefficiencies would not be incurred.

Benefits of Channel Deepening

This investigation assumes that channel deepening to either a new container facility or to Garden City Terminal would result in equivalent NED marine transportation benefits by reducing or eliminating transportation costs associated with tidal delays and lightloading of vessels constrained by current channel depths. As noted above, the differences between the alternatives will primarily consist of site development costs, dredging costs, and environmental mitigation costs as shown in Table 6 on the next page.

Construction Costs vs. Operating Costs

For this screening of alternative plans, the emphasis of this investigation is on construction costs. It is assumed that the operations and maintenance costs for a new terminal and for Garden City Terminal would be commensurate in dollars per TEU moving through the terminals, since the facilities would have similar facilities and equipment.

Maintenance Dredging

In addition, according to the Tier I analysis, channel deepening in Savannah Harbor should not generate significant additional maintenance dredging requirements relative to Without Project conditions. Differences in landside transportation costs between the alternative terminals will be discussed.

TABLE 6 FACILITY COSTS, MITIGATION COSTS, DREDGING COSTS, AND TOTAL COSTS ALTERNATIVE TERMINALS				
Alternative Terminals	**Facility Costs**	**Mitigation Costs**	**Dredging Costs**	**Total Costs**
Garden City Terminal	$0	$113,100,000	$213,600,000	$326,700,000
Ocean Terminal	$249,900,000	$89,200,000	$211,600,000	$550,700,000
Blue Circle Site	$361,100,000	$83,000,000	$207,000,000	$651,100,000
Disposal Site 12A	$334,400,000	$25,800,000	$162,700,000	$522,900,000
East Coast Terminal	$370,400,000	$23,600,000	$178,900,000	$572,900,000
Elba Island	$285,400,000	$1,400,000	$136,500,000	$423,300,000
Disposal Site 14A/14B	$357,400,000	$1,400,000	$125,600,000	$484,400,000
Tybee NWR	$384,900,000	$1,600,000	$79,100,000	$465,600,000
Colonel's Island, Brunswick	$292,600,000	Not Calculated	$137,500,000	$430,100,000

GARDEN CITY TERMINAL

The largest container facility in Savannah Harbor is Containerport, located within GPA's Garden City Terminal. Due to its existing container operations and its role in the Tier I Selected Plan, Garden City Terminal in this analysis serves as the benchmark terminal to which the alternative terminals are compared. A profile of Garden City Terminal is contained in Table 2, above. An assessment of its potential to address the problems and opportunities of a depth-constrained Federal channel in Savannah Harbor begins below.

Garden City Terminal Site Profile and Initial Assessment

Garden City Terminal, is a public terminal operated by GPA. For an extensive site profile and initial assessment of this terminal please refer to the evaluation of non-structural alternatives; Modifications of Garden City Terminal, discussed earlier in this report. An aerial photo of Garden City Terminal is provided in Figure 2.

FIGURE 2
GARDEN CITY TERMINAL – AERIAL PHOTO

Cost of Modifying Garden City Terminal

The costs of modifying Garden City Terminal to achieve the additional throughput capacity of the 1.5 million TEUs assumed in this analysis are presented in Table 7. These costs were coordinated between Savannah District and GPA. The costs reflect existing container facilities at Garden City Terminal, such as the two super Post-Panamax container cranes currently in service. As indicated in this table, cost estimates include demolition of the building and storage tanks associated with the anhydrous ammonia facilities behind CB-7. The costs identified in Table 3 are ones that GPA plans to incur to increase the throughput capacity of Garden City Terminal over the near future. As presently-planned actions and expenditures, these would be part of the Without Project Condition and not a component of the cost of deepening to Garden City Terminal.

TABLE 7
ESTIMATED COSTS OF MODIFICATIONS
GARDEN CITY TERMINAL

Site Demolition				
Asphalt pavement	10,000	sy	$3.48	$34,820
Storage tanks	1,288,872	cf	$0.21	$266,842
Building Demolition	242,500	cf	$0.21	$50,206
Building Foundation Demo	629	cy	$64.93	$40,817
Site Improvement				
Container Parking area	83	ac		
Dock Includes: Concrete Deck & Beam, concrete steel reinforcement, pilings, handrail	1,700	lf	$14,300	$24,310,000
Fender system				
Crane Tracks on concrete ties (assume length = 1.25 x dock length)	2,125	lf	$181.63	$385,956
Heavy Duty Pavement for container traffic	83	ac	$300,000	$24,900,000
Equipment				
72-95 Ton Cranes	4	ea	$6,500,000	$26,000,000
Rubber tire gantries	6	ea	$1,300,000	$7,800,000
Five High loaded top lifts (87,000 lbs)	8		$350,000	$2,800,000
Jockey Trucks	5	ea	$39,120	$195,600
Flatbed Trucks	2	ea	$28,980	$57,960
Contingency	25%			$21,710,550
			Subtotal	$108,552,750
E&D / S&A	20%			$21,710,550
			TOTAL=	$130,263,299

Dredging Costs: Garden City Terminal

Costs to deepen Savannah Harbor to 48 feet MLW from the sea to Garden City Terminal are presented in Table 8. Quantities to be dredged and unit costs of dredging and disposal were estimated based on the Tier I analysis and dredged material management plans (DMMP) prepared by the Savannah District for maintenance of the Savannah Harbor Federal channel. Cost estimates for disposal area site work and erosion control for Garden City Terminal (and all of the alternative sites) were also developed using a combination of the Tier I cost estimates and cost sheets prepared for the Savannah Harbor DMMP. Also included are costs to deepen Kings Island Turning Basin.

Other dredging-related costs are included in Table 8. These costs are based on the Tier I Feasibility Report, escalated to 2003 dollars. Lands, easements, relocations, rights-of-way (LERRRD) are self-explanatory; other costs are explained below.

- Debris removal: along river bottom and river banks,
- Aids to navigation: consistent with U.S. Coast Guard coordination,
- Chloride mitigation: refers to the potential relocation of the City of Savannah water intake in the Savannah River, if chloride impacts from channel deepening exceed the City's contracted standards for chloride levels.
- Dissolved oxygen mitigation: refers to mitigation required if channel deepening reduces average summer dissolved oxygen levels in the Savannah River.
- Cultural/historic mitigation: refers to mitigation required to protect Old Fort Jackson and the *CSS Georgia*. Both resources are located at the junction of Back River and the Savannah River.
- Channel modification mitigation: refers to mitigation required for direct wetland impacts of channel deepening on the river banks. Ten acres would be affected by deepening to Garden City Terminal. Wetland mitigation costs are estimated at $26,000 per acre, including $6,000 for real estate costs and $20,000 for mitigation activities ($10,000/acre plus a 2:1 replacement ratio).
- Secondary wetland mitigation: refers to secondary impacts to wetlands resulting from saltwater intrusion into the Savannah National Wildlife Refuge upstream of Garden City Terminal. Adverse secondary effects of saltwater intrusion could degrade up to 722 acres of wetlands, potentially requiring mitigation at $26,000 per acre as above.
- Shortnose sturgeon mitigation: refers to actions taken to compensate for impacts to habitat of shortnose sturgeon.
- Striped bass impact avoidance: refers to actions taken to avoid adverse effects to habitat of striped bass.

TABLE 8
ESTIMATED COSTS OF CHANNEL DEEPENING (48 FEET MLW)
TO GARDEN CITY TERMINAL

Mobilization				$2,683,845
Dredging				
-85+000 to -60+000	2,616,000	cy	$3.87	$10,123,920
-60+000 to -38+500	4,163,000	cy	$2.69	$11,188,063
-38+500 to -14+000	5,155,000	cy	$2.04	$10,529,088
-14+000 to 0+000	2,071,000	cy	$2.26	$4,675,283
0+000 to 24+000	3,506,000	cy	$2.37	$8,291,690
24+000 to 40+000	3,824,000	cy	$4.89	$18,704,140
40+000 to 50+000	2,963,000	cy	$2.96	$8,759,369
50+000 to 70+000	3,874,000	cy	$2.63	$10,203,148
70+000 to 79+000	1,817,000	cy	$4.03	$7,324,781
79+000 to 97+750	2,962,000	cy	$5.27	$15,602,335
97+750 to 102+000	2,220,000	cy	$4.57	$10,142,625
102+000 to 103+000	303,000	cy	$4.84	$1,465,763
Dredging for turning basin	600,000	cy	$4.84	$2,902,500
Berth Dredging	150,000	cy	$4.84	$725,625
Disposal Area Site Work and Erosion Control				$19,075,000
Contingency	25%			$35,599,293
E&D / S&A	20%			$35,559,293
Subtotal				$213,595,764
Debris Removal	100%		$2,449,764	$2,449,764
Aids to Navigation	100%		$871,691	$871,691
Chloride Mitigation - relocate City of Sav. Water intake	100%		$49,450,000	$49,450,000
DO Mitigation	100%		$25,800,000	$25,800,000
Cult/Historic Mitigation	100%		$15,424,449	$15,424,449
Lands, Easements, Relocations, Rights-of-Way	100%		$2,349,198	$2,349,198
Channel Mod Mitigation	100%		$260,000	$260,000
Salinity Intrusion on Wetlands (722 acres)	100%		$18,772,000	$18,772,000
Shortnose Sturgeon Mitigation	100%		$1,375,500	$1,375,500
Striped Bass Impact Avoidance	100%		$2,000,000	$2,000,000
			TOTAL	$326,677,713

Other Considerations: Garden City Terminal

There are some environmental concerns associated with channel deepening to Garden City Terminal. These concerns were identified in the Tier 1 process and are being evaluated in more detail during Tier II. The major environmental issues identified in Tier 1 consist of the following:

- Chloride impacts on the City of Savannah water intake,

- Seasonal reduction in dissolved oxygen levels in the Savannah River
- Cultural and Historic impacts on Old Fort Jackson and the *CSS Georgia*,
- Direct loss or riverbank wetlands as a result of the channel construction activities,
- Salinity intrusion on wetlands in the Savannah Wildlife Refuge,
- Impacts on Shortnose Sturgeon habitat, and
- Impacts to striped bass habitat.

Overall Assessment: Garden City Terminal

Garden City Terminal is viable as an alternative terminal due to the existing container operations at this location. Costs to develop additional terminal capacity would be minimized by usage of terminal facilities and landside infrastructure already in place. Shortcomings of Garden City Terminal as an alternative terminal are the high costs of dredging to this upstream location and potential adverse environmental effects associated with dredging.

OCEAN TERMINAL

The potential for modifying Ocean Terminal to serve as a dedicated container facility is assessed below. It includes a profile of the site, estimation of the costs to modify the facility, a discussion of required landside transportation, an evaluation of benefits of modifying this facility, discussion of other factors involved in conversion of this facility, and an overall assessment of its ability to address navigation problems and opportunities in Savannah Harbor.

Ocean Terminal Site Profile and Initial Assessment

As indicated in Figure 1, Ocean Terminal is located on Bay Street in the City of Savannah, immediately west of the Talmadge Memorial Bridge. A profile of Ocean Terminal is provided in Table 9, and an aerial view is provided in Figure 3. This 208-acre terminal primarily handles break-bulk, roll-on/roll-off (RoRo), and project cargo. As part of its RoRo operations, this facility handles an incidental amount of containers, approximately 150 TEUs per week. However, container movements through Ocean terminal are declining due to reductions in container cargo handled by a major RoRo carrier.

As an initial assessment, Ocean Terminal, which is only 2.5 miles downstream of Garden City Terminal, would not likely generate large benefits in terms of dredging costs avoided. However, the proximity to Garden City Terminal might allow complementary development and operation of these terminals. The 208 acres of this terminal is significantly smaller than the 300 acres that is assumed necessary for a container terminal with two berths. However, Ocean Terminal has over 6,000 feet of berth space, existing rail facilities, and seemingly good road connections to highways for truck transport of containers.

Cost of Modifying Ocean Terminal

Savannah District coordinated with GPA to identify improvements that would be required to convert Ocean Terminal to a dedicated container facility. To ensure a fair comparison, the analysis of Ocean Terminal is equivalent in level of detail to that used to evaluate development of a new terminal downstream along the Savannah River. Based on this coordination, the following assumptions were made about requisite modifications to this terminal.

- The location of the existing docks is too close to the Federal channel to allow sufficient beam for post-Panamax container ships to berth at this terminal. Consequently, it was assumed that existing docks would be demolished and rebuilt, thereby avoiding realignment of the Federal channel.
- Maintain the current function of this facility. If possible, RoRo operations at Ocean Terminal would be continued. RoRo parking located adjacent to the dock would be demolished and rebuilt outside of the container storage area to prevent any accidental damage from container traffic. This would leave 140 acres available as a container yard.
- The load-bearing capacity of existing storage areas at this terminal would not be sufficient to support container operations. Consequently, the 140 acres of open storage would need to be demolished, strengthened, and repaved (at an approximate cost of $300,000 per acre).
- Buildings located adjacent to the dock to store materials will be demolished and rebuilt farther away from dock and outside of the container storage area.
- Although Ocean Terminal currently has rail service, it is assumed that a significant upgrade would be needed to serve a large container facility.

Container handling equipment is consistent with the assumptions listed above. These assumptions are incorporated into the costs estimates for converting Ocean Terminal into a dedicated container facility contained in Table 10. Estimation of the cost estimates for Ocean Terminal and for the other terminals considered in this investigation was initiated by Engineering Division of Savannah District.

As indicated in Table 10, it is estimated that conversion of Ocean Terminal to a container facility would cost approximately $250 million. Demolition costs, construction costs, and container handling equipment costs are included in this estimate.

In 2002, GPA contracted with Lockwood Greene to assess the feasibility of converting Ocean Terminal into a container facility. The study estimated the cost of conversion of Ocean Terminal to be $284 million. This estimate included the assumption that the docks would be demolished and set back (landward) to provide for additional berth width, thereby avoiding encroaching into the Federal channel or realigning the Federal channel.

TABLE 9
OCEAN TERMINAL FACILITIES

Cargo Handled: General Cargo, Containers, RoRo, and Project Cargo

Terminal Area: 208 acres

Berths
Berths Linear Feet: 6,674 total. [This total includes Slip 2, which is not practical for container vessels. The total usable berth length is 4,503 feet, with approximately 300 feet of additional distance across Slip 2 that could be closed off for wharf area.]
Depth Alongside Berths 1,2,12,13,18,19: 42 ft.; Berth 20 38 ft.
Dock Height 15 ft. at mean low water
Apron Width From 53 ft. to 200 ft.

Cranes
Gantry Cranes:
Kocks (Berths 12-20) 100-st capacity under main hook at a 65 ft. radius
Diamond (Berths 12-20) 50-st capacity under main hook at a 40 ft. radius
Diamond (Berths 1-2) 35-st capacity under main hook at a 40 ft. radius
Clyde (Berth 13) 175-st capacity under main hook at a 45 ft. radius
Container Cranes:
Kone (Berths 13-20) (1) 45-st capacity under spreader/56-st capacity
Link Belt Mobile Crane 45-st capacity with 100' boom

Equipment
Three-high loaded toplifts (3) 67,400 lb. capacity under spreader
Forklifts (51) 11,000-50,000 lb. capacity with accessory attachments
Clay Bagging Facility -Capacity: 25 tons per hour
Reefer Outlets Warehouse 2

Rail Services: Norfolk Southern Railroad provides switching services; interchange and line haul services provided by Norfolk Southern Railroad and CSX Transportation.

Warehousing: total 1,621,868 sq. ft.

Open Storage: 83 acres

Container Field Paved Area: 47 acres

FIGURE 3
OCEAN TERMINAL

Based on the findings of the Lockwood Greene study, GPA concluded that conversion of Ocean Terminal to a container facility would not be feasible at this time. The high costs of demolishing and reconstructing the docks, warehouses, and paved areas and the limited container storage area (140 acres) made modification of this terminal prohibitively expensive under current circumstances.

TABLE 10
ESTIMATED COSTS OF MODIFICATIONS
OCEAN TERMINAL

Site Demolition				
Asphalt pavement	822,800	sy	$3	$2,864,951
Building Demo (assume 18' high buildings)	42,168,568	cf	$0.21	$8,730,371
Building foundation removal	60,069	cy	$65	$3,900,515
Railroad track removal, ties and track	15,000	lf	$8.0	$120,692
Site Improvement				
Container Parking area	140	ac		
Heavy Duty Pavement for container traffic	140	ac	$300,000	$42,000,000
Dock Includes: Concrete Deck & Beam, concrete steel reinforcement, pilings, handrail, Fender system	2,500	lf	$21,300	$53,250,000
110 lb Railroad track w/ wooden ties and ballast		lf	$78	$0
110 lb Railroad track w/ concrete ties in container yard	5,000	lf	$182	$908,131
Administration Building	10,000	sf	$168	$1,675,102
storage building	20,000	sf	$10	$198,565
Equipment				
72-95 Ton Cranes	6	ea	$6,500,000	$39,000,000
Rubber tire gantries	7	ea	$1,300,000	$9,100,000
Five High loaded top lifts (87,000 lbs)	10	ea	$350,000	$3,500,000
Seven High empty stackers ((15,000 lbs)	2	ea	$200,000	$400,000
Jockey Trucks	20	ea	$39,120	$782,400
Flatbed Trucks	6	ea	$28,980	$173,880
Contingency	25%			$41,651,152
			Subtotal	$208,255,758
E&D / S&A	20%			$41,651,152
			TOTAL=	$249,906,910

Landside Transportation: Ocean Terminal

Ocean Terminal has good transportation access. However, Bay Street in Savannah is very congested, since it serves as an important east-west corridor through the city and the principal access of visitors to the Historic District. The additional truck traffic associated with a container facility of the size under consideration here would significantly exacerbate this congestion.

Regarding rail access to/from the site, currently only Norfolk Southern has access to Ocean Terminal. Development of a container port at Ocean Terminal that is served by only one railroad could be a competitive (cost) disadvantage for a container port. It is likely that some arrangements would need to be made to allow CSX to serve Ocean Terminal as well. It might be feasible to truck containers to/from the Mason Intermodal Container Transfer Facility (ICTF) at Garden City Terminal, since it is within the 10-mile drayage limit assumed as part of this analysis. However, if rail facilities at Ocean Terminal were not upgraded and used by the container operations, this would result in even more trucks using Bay Street.

Dredging Costs: Ocean Terminal

Dredging-related costs associated with Ocean Terminal are presented in Table 11. Since Ocean Terminal is 2.5 nautical miles downstream of Garden City Terminal, dredging costs would be less than those of Garden City Terminal. Other dredging-related costs shown in the last nine rows of Table 10 (from Debris Removal through Striped Bass Impact Avoidance) would also be expected to be less than for Garden City Terminal. Based on the distance downstream, it was assumed that most of these costs would be 75 percent of costs developed for Garden City Terminal in the Tier I analysis. Mitigation costs for cultural/historic impacts and channel modification would be expected to consistent with Garden City costs. Regarding cultural/historic costs, sites upstream of Old Fort Jackson and the *CSS Georgia* would require the full cost of mitigation.

A turning basin for Ocean Terminal required detailed investigation. The Savannah River is relatively narrow in this reach of the river. Construction of a turning basin consistent with the Tier I analysis (1,600 feet wide, 1,675 feet long, and 48 feet deep MLW) would require excavation of a portion of Hutchinson Island at very high cost. A preliminary cost analysis was conducted to compare these costs against deepening of the channel further upriver to existing turning basins, which would need to be modified to be consistent with the above Tier I specifications.

The nearest existing turning basin is Marsh Island Turning Basin, which has dimensions of: 900 feet wide, 1,000 feet long, and 34 feet deep. Marsh Island Turning Basin is approximately 1.9 miles upstream from Ocean Terminal on the north side of the channel. This turning basin is located adjacent to Hutchinson Island at the location of the International Paper aeration lagoon. The landward edge of the turning basin is approximately 150 feet from the shore, and the containment dike for the lagoon is approximately 125 feet beyond. According to the Tier I Feasibility Report, the width of the Kings Island Turning Basin, which is 1,600 feet long, would be expanded from 1,500 feet wide to 1,675 feet wide to accommodate the post-Panamax container ship that serves as the Design Vessel. There is insufficient room to expand the Marsh Island Turning Basin to dimensions sufficient to accommodate the Design Vessel without encroaching on the aeration lagoon and triggering the economic and environmental consequences of disturbing an active industrial waste treatment lagoon.

TABLE 11
ESTIMATED COSTS OF CHANNEL DEEPENING (48 FEET MLW)
TO OCEAN TERMINAL

Mobilization				$2,683,845
Dredging				
-85+000 to -60+000	2,616,000	cy	$3.87	$10,123,920
-60+000 to -38+500	4,163,000	cy	$2.69	$11,188,063
-38+500 to -14+000	5,155,000	cy	$2.04	$10,529,088
-14+000 to 0+000	2,071,000	cy	$2.26	$4,675,283
0+000 to 24+000	3,506,000	cy	$2.37	$8,291,690
24+000 to 40+000	3,824,000	cy	$4.89	$18,704,140
40+000 to 50+000	2,963,000	cy	$2.96	$8,759,369
50+000 to 70+000	3,874,000	cy	$2.63	$10,203,148
70+000 to 79+000	1,817,000	cy	$4.03	$7,324,781
79+000 to 97+750	473,920	cy	$5.27	$2,496,374
Dredging/Excavation of turning basin				$26,275,430
Berth Dredging	150,000	cy	$4.84	$725,625
Disposal Area Site Work and Erosion Control				$19,075,000
Contingency	25%			$35,263,938
E&D / S&A	20%			$35,263,938
Subtotal				$211,583,630
Debris Removal	75%		$2,449,764	$1,837,323
Aids to Navigation	75%		$871,691	$653,768
Chloride Mitigation - relocate water intake	75%		$49,450,000	$37,087,500
Dissolved Oxygen Mitigation	75%		$25,800,000	$19,350,000
Cultural/Historic Mitigation	100%		$15,424,449	$15,424,449
Lands, Easements, Relocations, Rights-of-Way	75%		$2,349,198	$1,761,898
Channel Modification Mitigation	75%		$260,000	$195,000
Salinity Intrusion on Wetlands (722 ac)	75%		$18,772,000	$14,079,000
Shortnose Sturgeon Mitigation	75%		$1,375,500	$1,031,625
Striped Bass Impact Avoidance	100%		$2,000,000	$2,000,000
			TOTAL	$305,004,194

The next turning basin upriver is Kings Island, located above Garden City Terminal approximately 2.8 nautical miles above Ocean Terminal. Deepening to Kings Island Turning Basin would result in dredging and related costs consistent with deepening to Garden City Terminal.

The costs of constructing a turning basin adjacent to Ocean Terminal were found to be cost-effective compared to deepening to Kings Island Turning Basin. The turning basin costs in Table 11 are associated with this location.

Overall Assessment: Ocean Terminal

Based on the high costs of renovating Ocean Terminal and the lack of any significant dredging savings relative to deepening to Garden City Terminal, it is concluded that conversion of Ocean Terminal to a container facility is not feasible at this time. The desirable aspects of such a conversion in terms of minimal environmental impacts and efficient access to landside transportation would be insufficient to outweigh the costs of facility renovation and channel dredging and the congestion related impacts on local area roadways.

BLUE CIRCLE CEMENT COMPANY

The potential for modifying Blue Circle Cement Company's site on Hutchinson Island to serve as a dedicated container facility is assessed below. As for the discussion of all the alternative facilities, the analysis includes a profile of the site, estimation of the costs to modify the facility, a discussion of required landside transportation infrastructure, an evaluation of benefits of modifying this facility, discussion of other factors involved in conversion of this facility, and an overall assessment of its ability to address navigation problems and opportunities in Savannah Harbor.

Blue Circle Cement Site Profile and Initial Assessment

As indicated in Figure 1, the Blue Circle Cement site is located on Hutchinson Island, immediately east of the Talmadge Memorial Bridge. Figure 5 provides a more detailed aerial view. Blue Circle Cement Company uses this facility for receipt of bulk cement. This facility has approximately 400 feet of berthing space and 36-foot depth MLW at berth. Landside facilities include four 12-inch, pneumatic pipelines extending from wharf via trestle (over approach from shore) to 16 concrete storage silos located in the rear of the site (north).

The polygon in Figure 5 provides visual scale for the aerial photo. This box represents the 300 acres that are would be necessary for development of a new container facility.

As an initial assessment of the viability of developing a container facility at this location, two characteristics of this site are evident. First, there may not be sufficient area for the purposes considered between the bridge (to the west), the Marine Trade Center (to the east), and the golf course (to the north). This issue alone might be sufficient to eliminate this site from further consideration. Second, landside transportation could be problematic, given the site's location on Hutchinson Island.

Costs Of Modifying Blue Circle Terminal

The costs required to construct a container terminal at the Blue Circle site are contained in Table 12. As indicated in this table, it is estimated that $361 million would be required to develop a container terminal at this site. It is anticipated that the facilities currently on this site would need to be demolished prior to construction of the container terminal. The terminal would require installation of the full set of facilities assumed above, and new docks would be needed. Other assumptions about this site include: a water storage tank

for fire protection, a package wastewater treatment facility, and approximately 50 acres (of 300) would require wetland mitigation.

To achieve the area required for development of a new container facility at the Blue Circle site, some or all of the adjacent property owned by Powell Dufferin Terminals, Inc. may be required. This adjacent site previously contained a liquid bulk terminal and tank farm, which was operated by Powell-Dufferin Oil. The site is currently used by TIC Construction Company. It is anticipated that properties to the north around the golf course and along the Back River will be converted to upscale residential developments. A new container terminal in this area may not be compatible with these uses, and nearby residential developments could raise acquisition costs.

The cost estimates in Table 12 do not include the replacement costs of Blue Circle Cement operations at another location. If a detailed evaluation of this site is to be conducted, these associated costs would need to be included.

FIGURE 5
BLUE CIRCLE CEMENT SITE

TABLE 12
ESTIMATED COSTS OF BLUE CIRCLE TERMINAL

Site Demolition				
Asphalt pavement	48,400	sy	$3	$148,636
Building Demo	745,342	cf	$0	$136,099
Building foundation removal	28,667	cy	$57	$1,641,759
Site Improvement				
Land purchase	375	ac	$100,000	$37,500,000
Heavy Duty Pavement for container traffic	300	ac	$300,000	$90,000,000
Administration Building	10,000	sf	$168	$1,675,102
storage building	20,000	sf	$10	$198,565
Building foundation	3,333	sy	$22	$73,717
110 lb Railroad track w/ wooden ties and ballast	8,000	lf	$78	$621,105
RR foundation	19,200	sy	$13	$257,664
110 lb Railroad track w/ concrete ties in container yard	20,000	lf	$182	$3,632,524
Electrical service to terminal	21,000	lf	$60	$1,260,000
Dock (includes: concrete deck & beam, concrete steel reinforcement, 18" square precast concrete piling, expn joint & misc const items, handrail, fender system)	2,500	lf	$14,300	$35,750,000
Crane Tracks on concrete ties(assume length = 1.25 x dock length)	3,125	lf	$182	$567,582
100,000 Gallon Water Storage Tank for fire protection	1	ea	$250,000	$250,000
Intermodal Transfer Station	1	ea	$5,304,817	$5,304,817
Wetlands Mitigation	60	ac	$26,000	$1,560,000
Wastewater Treatment Facility	1		$10,000,000	$10,000,000
Equipment				
72-95 Ton Cranes	6	ea	$6,500,000	$39,000,000
Rubber tire gantries	7	ea	$1,300,000	$9,100,000
Five High loaded top lifts (87,000 lbs)	10		$350,000	$3,500,000
Seven High empty stackers ((15,000 lbs)	2		$200,000	$400,000
Jockey Trucks	20	ea	$39,120	$782,400
Flatbed Trucks	6	ea	$28,980	$173,880
Contingency	25%			$60,178,462
			Subtotal	$300,892,313
E&D / S&A	20%			$60,178,462
			TOTAL	$361,070,775

It is assumed for all of the alternative sites that are located in industrial areas along the Savannah River (i.e., Blue Circle, East Coast, and Elba Island) that $100,000 is representative of real estate purchase costs per acre. This cost per acre is based on a sample of such properties using real estate property assessments of Chatham County. However, in areas that are undergoing upscale residential waterfront development, real estate could be significantly more expensive, approximately $150,000 to $200,000 per acre. The real estate acquisition costs for a new container facility could significantly increase over time as upscale residential development occupies more of the riverfront.

It is also assumed for those alternative sites that would require a new intermodal container transfer facility that 75 acres would be required. Consequently, land purchases in Table 12 contain 375 acres (i.e., 300 for the container terminal and 75 acres for the intermodal facility).

Based on aerial photos, U.S.G.S. quadrangle maps, and preliminary site reconnaissance, it is assumed that 50 acres of this site (i.e., 25 percent of the 300 acres) would be wetlands. As noted above, it is assumed that wetland mitigation activities (in addition to land purchases) would be approximately $20,000 per acre ($10,000/acre plus a 2:1 replacement ratio).

Landside Transportation: Blue Circle Terminal

Relative to Garden City Terminal, trucks coming to/from the Blue Circle site may have marginally better access to major highway routes to the northwest toward Macon and Atlanta and the rest of Savannah's economic hinterland. Truck traffic to/from a terminal at the Blue Circle site would have convenient access to Route 17 and Interstate 16. However, it is not expected that this would translate into significant savings in trucking costs.

In contrast, rail movements to/from the Blue Circle site would likely be at a significant disadvantage relative to Garden City Terminal's Mason ICTF. A Seaboard Coast Line (SCL, now CSX) rail line is located on Hutchinson Island and runs east-west along the northern edge of the red square in Figure 5. In 1899, a rail bridge across the Savannah River was constructed approximately 1.8 miles upstream of the Talmadge Bridge. The Blue Circle tracks tied into this bridge, which connected SCL's Savannah rail yard across the Savannah River with the main CSX tracks north of Ridgeland, a distance of approximately 27 miles (from Savannah to Ridgeland.

The Savannah River rail bridge no longer exists. The bridge suffered ship collisions in 1952, 1966, 1967, and 1971. In the 1971 collision, the south tower was struck and collapsed causing the main span to fall. Subsequently, the bridge was removed, and the existing railroad bridge across the Back River to Hutchinson Island was upgraded. As part of this work, the railroad installed 7.5 miles of new line to connect the former SCL line to the main CSX line approximately 2.5 miles northeast of Interstate 95's crossing of the Savannah River, near Hardeeville, South Carolina. This rail connection, was known as the Hardeeville Spur.

The result is that train access/egress from the Blue Circle site would be via the rail bridge from the island north across Back River. It is assumed that an intermodal rail facility would need to be located on the island, likely west of the bridge. The acreage needed for the facility would be in addition to the 300 acres needed for the terminal.

The former SCL rail route through Jasper County and the Hardeeville Spur were formally abandoned by CSX in 1997. In the late 1990s, the County considered purchasing the SCL corridor from CSX for a rails-to-trails project, and conducted preliminary negotiations toward this purchase. The County subsequently decided not to pursue the rails-to-trails project, apparently having concluded that the rail line could be an important resource for economic development. Although the line is not operational at this time, it could be re-activated if a container terminal was developed on the north side of the Savannah River, either on Hutchinson Island or in Jasper County. CSX continues to own this SCL corridor through Jasper County.

For Norfolk Southern, which sends unit trains from the Mason ICTF, a track-sharing arrangement with CSX would need to be reached. The potential for such an agreement is uncertain at this time. It is also conceivable that a rail connection would need to be made near Interstate 95 northwest of the City of Savannah to allow Norfolk Southern trains to turn to the west and northwest without going into the City of Savannah.

The Blue Circle site is approximately 8 miles from Garden City's Mason intermodal facility. Containers could conceivably be trucked to this facility, eliminating the need for rail access to the Blue Circle site. However, drayage costs would be very significant. Although drayage contracts are usually confidential, it is assumed that drayage rates for a 5 to 10 mile haul could be in the range of $100-125/dray for a one-way trip. Use of the Mason ICTF would create another set of problems by forcing large amounts of trucks onto local Savannah roadways, many of which are already congested.

Whatever the origin/destination, it is likely that rail service from the Blue Circle site would be somewhat less efficient than service to Garden City Terminal, assuming that the existing rail line to Hutchinson Island could be reactivated. However, these inefficiencies, manifested as time delays and increased costs, would be incurred for medium and long hauls, for which rail transport is the preferred mode of transport.

Dredging Costs: Blue Circle Terminal

Dredging-related costs associated with the Blue Circle site are presented in Table 13. The costs are similar to those of Ocean Terminal, which is located on the other side of the Talmadge Bridge on the south side of the Savannah River. As for Ocean Terminal, the costs of constructing a new turning basin are high due to required excavation of Hutchinson Island but less than dredging to King Island Turning Basin. As a result, it is assumed that a turning basin for Blue Circle Terminal would be the same as for Ocean Terminal, on the western side of the Talmadge Bridge adjacent to Ocean Terminal. Consequently, the costs of a turning basin in Table 13 are the same as in Table 11.

TABLE 13
ESTIMATED COSTS OF CHANNEL DEEPENING (48 FEET MLW)
TO BLUE CIRCLE TERMINAL

Mobilization				$2,683,845
Dredging				
-85+000 to -60+000	2,616,000	cy	$3.87	$10,123,920
-60+000 to -38+500	4,163,000	cy	$2.69	$11,188,063
-38+500 to -14+000	5,155,000	cy	$2.04	$10,529,088
-14+000 to 0+000	2,071,000	cy	$2.26	$4,675,283
0+000 to 24+000	3,506,000	cy	$2.37	$8,291,690
24+000 to 40+000	3,824,000	cy	$4.89	$18,704,140
40+000 to 50+000	2,963,000	cy	$2.96	$8,759,369
50+000 to 70+000	3,874,000	cy	$2.63	$10,203,148
70+000 to 79+000	1,817,000	cy	$4.03	$7,324,781
79+000 to 97+750 (Assume end of port located at station 79+000)	473920	cy	$5.27	$2,496,374
Dredging for turning basin				$26,275,430
Berth Dredging	600,000	cy	$4.03	$2,418,750
Disposal Area Site Work and Erosion Control				$14,310,309
Contingency	25%			$34,496,047
E&D / S&A	20%			$34,496,047
			Subtotal	$206,976,281
Debris Removal	70%		$2,449,764	$1,714,835
Aids to Navigation	70%		$823,038	$576,127
Chloride Mitigation - relocate water intake	70%		$46,690,000	$32,683,000
Dissolved Oxygen Mitigation	70%		$24,360,000	$17,052,000
Cultural/Historic Mitigation	100%		$14,563,550	$14,563,550
Lands, Easements, Relocations, Rights-of-Way	70%		$2,349,198	$1,644,438
Channel Modification Mitigation	70%		$260,000	$182,000
Salinity Intrusion on Wetlands (722 ac)	70%		$18,772,000	$13,140,400
Shortnose Sturgeon Mitigation	70%		$1,375,500	$962,850
Striped Bass Impact Avoidance	100%		$2,000,000	$2,000,000
			TOTAL	$291,495,480

Based on the distance downstream, it was assumed that most of the dredging-related costs in the bottom rows of Table 13 (Debris Removal to Striped Bass Impact Avoidance) would be 70 percent of costs developed for Garden City Terminal in the Tier I analysis. Mitigation costs for cultural/historic impacts and channel modification would be expected to consistent (i.e., 100 percent) with Garden City costs. Regarding cultural/historic costs, sites upstream of Old Fort Jackson and the *CSS Georgia* would require the full cost of mitigation.

Other Considerations: Blue Circle Terminal

Development of a container terminal at the Blue Circle site would appear to encroach on 60 acres of wetlands, for which mitigation would be required. The costs for such mitigation are included in Table 12. No other natural areas would be impacted by this

development. Since the site is presently an industrial facility, there is the potential for problems associated with hazardous, toxic, and radioactive wastes (HTRW).

A portion of the traffic from a container facility is generated by deliveries to and from distribution centers (DCs). Currently there are 12 DCs located in proximity to the GCT. Rates for draying containers to and from the DC's are based on an individual basis. Anything that would generate longer delivery times, such as longer dray distances, will affect the number of deliveries that can be made. As the number of deliveries per driver decreases, the cost per dray will increase. If the number of containers stays constant, more trucks will be required to handle the same number of containers, generating more traffic on the road. There is a potential to relocate the DC's to alleviate this cost, but it won't happen in the short term. Also, the DC's would be reluctant to pick up any additional cost, as would the shipping lines.

Overall Assessment: Blue Circle Terminal

The Blue Circle site has very limited potential as a container facility. It is unlikely there is sufficient space for facility operations and potential expansion. In addition, dredging savings relative to deepening to Garden City Terminal are limited by its upstream location.

DISPOSAL SITE 12A

The potential for developing a new container facility at Disposal Site 12A is assessed below. As for the discussion of all the alternative facilities, the analysis includes a profile of the site, estimation of the costs to modify the facility, a discussion of required landside transportation infrastructure, an evaluation of benefits of modifying this facility, discussion of other factors involved in conversion of this facility, and an overall assessment of its ability to address navigation problems and opportunities in Savannah Harbor.

Disposal Site 12A Profile and Initial Assessment

As indicated in Figure 1, Disposal Site 12A is located on the northern bank of the Back River, east of the tidal gate, in Jasper County, South Carolina. Figure 6 provides a more detailed aerial view of Disposal Site 12A. As for the Blue Circle site, the polygon in Figure 6 provides visual scale for the aerial photo, representing the 300 acres that are

FIGURE 6
DISPOSAL SITE 12A

assumed to be necessary for development of a new container facility.

As an initial assessment, Disposal Site 12A would have the following assets and liabilities. First, the site appears to have sufficient room for the necessary port and landside facilities required for a container terminal. Second, all of the infrastructure would need to be brought to the site, including rail and road connections. Third, the Back River east of the tidal gate is not part of the Federal channel. This backwater area is intended to capture sediment. Consequently, project construction could be expensive. In addition, this backwater area could be subject to significant sediment accretion, resulting in significant increases in maintenance dredging costs.

Construction Costs: Disposal Site 12A

The cost estimated to construct a container terminal at Disposal Site 12A are contained in Table 14. As indicated in this table, it is estimated that $334 million would be required to develop a container terminal at this site. Since the site is undeveloped, a new container terminal would require new construction of all of the facilities assumed to be necessary for such a facility. It is assumed that an intermodal rail facility would need to be located onsite, since Garden City's intermodal terminal is beyond the 10-mile practical limit assumed in this analysis. As previously mentioned, 75 acres would be required for this facility. Consequently, land purchases in Table 14 contain 375 acres (i.e., 300 for the container terminal and 75 acres for the intermodal facility). Other assumptions about this site include: a water storage tank for fire protection and a package wastewater treatment facility.

It is also assumed for all of the alternative sites that are located in undeveloped areas along the Savannah River (i.e., Disposal Area 12A, Disposal Sites 14A/B, and Tybee National Wildlife Refuge) that $6,000 is representative of real estate purchase costs per acre. This cost per acre is based on a sample of such properties using real estate property assessments of Chatham County.

As indicated in Table 14, the Federal Government would need to be compensated for disposal capacity lost when this site is developed. It is assumed that this compensation would be in the form of replacement disposal capacity elsewhere (preferably nearby) along the river. The Compensation for Lost Disposal Capacity cost category includes 375 acres of replacement disposal capacity to compensate for capacity lost with development of the terminal and the intermodal facility. It is assumed that one-half of the new disposal capacity would be located in wetlands, which would require mitigation. Consequently, the $7.1 million cost estimate is based on: [(375 acres x $6,000 per acre) + (187.5 acres * $26,000 per acre for land/mitigation costs)].

Based on aerial photos, U.S.G.S. quadrangle maps, and preliminary site reconnaissance, it is assumed that two acres of wetland would be impacted by the transportation corridor (rail and road), assuming one-half of the corridor passes through wetlands. As noted above, it is assumed that wetland mitigation activities (in addition to land purchases) would be approximately $20,000 per acre ($10,000/acre plus a 2:1 replacement ratio).

TABLE 14
ESTIMATED COSTS OF DISPOSAL SITE 12A TERMINAL

Site Improvement				
Land purchase	375	ac	$6,000	$2,250,000
Heavy Duty Pavement for container traffic	300	ac	$300,000	$90,000,000
Heavy Duty Access Drive Pavement for container traffic	2.5	mi	$2,000,000	$5,000,000
8" PVC Water service from Hardeeville (10 miles)	52,800	lf	$13	$663,340
Administration Building	10,000	sf	$168	$1,675,102
storage building	20,000	sf	$10	$198,565
Building foundation	3,333	sy	$22	$73,717
110 lb Railroad track w/ wooden ties and ballast	26,000	lf	$78	$2,018,592
RR foundation	62,400	sy	$13	$837,408
110 lb Railroad track w/ concrete ties in container yard	20,000	lf	$182	$3,632,524
Railroad track bridge crossing	300	lf	$1,132	$339,488
Electrical service from Hardeeville, SC	71,280	lf	$60	$4,276,800
Dock (includes: concrete deck & beam, concrete steel reinforcement, 18" square precast concrete piling, expn joint & misc const items, handrail, fender system)	2,500	lf	$14,300	$35,750,000
Crane Tracks on concrete ties(assume length = 1.25 x dock length)	3,125	lf	$182	$567,582
Hwy 17 railroad & semi flyover				$3,299,524
100,000 Gallon Water Storage Tank for fire protection	1	ea	$250,000	$250,000
Intermodal Transfer Station	1	ea	$5,304,817	$5,304,817
Compensation for Lost Disposal Capacity				$7,125,000
Wetlands Mitigation	2	ac	$26,000	$63,030
Wastewater Treatment Facility	1		$10,000,000	$10,000,000
Equipment				
72-95 Ton Cranes	6	ea	$6,500,000	$39,000,000
Rubber tire gantries	7	ea	$1,300,000	$9,100,000
Five High loaded top lifts (87,000 lbs)	10		$350,000	$3,500,000
Seven High empty stackers ((15,000 lbs)	2		$200,000	$400,000
Jockey Trucks	20	ea	$39,120	$782,400
Flatbed Trucks	6	ea	$28,980	$173,880
Contingency	25%			$55,729,804
			Subtotal	$278,649,018
E&D / S&A	20%			$55,729,804
			TOTAL	$334,378,823

Landside Transportation: Disposal Site 12A

Truck traffic to/from this site would have access to Route 17 along an existing access road that connects with Route 17 approximately 1.25 miles north of Back River. Access to Interstate 16 would be approximately equivalent to Garden City Terminal. A heavy-duty access road would need to be built to accommodate truck traffic to/from the site. Approximately one-half of this access road would pass through wetlands, requiring significant foundation work and mitigation.

This facility would need to utilize the Hardeeville Spur to access the CSX system north of its intersection with Route 17. This would require approximately five miles of new track, much of it through wetlands. A rail bridge would be needed to cross Salt Water Creek approximately two miles north of Disposal Site 12A.

The rail issues would be the same as for the other sites north of Savannah River, as discussed above for the Blue Circle site, exacerbated by the additional travel time to reach the former SCL line and the Hardeeville Spur. Use of the Garden City intermodal terminal would not be practical, since it is more than 10 miles away.

Dredging Costs: Disposal Site 12A

Dredging-related costs associated with Disposal Site 12A are presented in Table 15. Dredging costs would include deepening Back River to access the terminal and construction of a turning basin in Back River near the site. As indicated in this table, dredging to 48 feet MLW from the sea to Disposal Site 12A would cost approximately $192 million.

Based on the distance downstream, it was assumed that most of the dredging-related costs in the bottom rows of Table 15 (Debris Removal to Striped Bass Impact Avoidance) would be 65 percent of costs developed for Garden City Terminal in the Tier I analysis. Mitigation costs for cultural/historic impacts and channel modification would be expected to consistent (i.e., 100 percent) with Garden City costs. Secondary effects of salinity intrusion on wetlands would be expected to be significantly less (25 percent).

TABLE 15
ESTIMATED COSTS OF CHANNEL DEEPENING (48 FEET MLW)
TO DISPOSAL SITE 12A TERMINAL

Mobilization				$2,683,845
Dredging				
-85+000 to -60+000	2,616,000	cy	$3.87	$10,123,920
-60+000 to -38+500	4,163,000	cy	$2.69	$11,188,063
-38+500 to -14+000	5,155,000	cy	$2.04	$10,529,088
-14+000 to 0+000	2,071,000	cy	$2.26	$4,675,283
0+000 to 24+000	3,506,000	cy	$2.37	$8,291,690
24+000 to 40+000	3,824,000	cy	$4.89	$18,704,140
40+000 to 50+000	2,963,000	cy	$2.96	$8,759,369
50+000 to 70+000 (Assume end of port located at station 60+000)	1,937,000	cy	$2.63	$5,101,574
Back River Dredging	3,000,000	cy	$2.37	$7,095,000
Dredging for turning basin	2,382,222	cy	$2.63	$6,274,178
Berth Dredging	600,000	cy	$4.03	$2,418,750
Disposal Area Site Work and Erosion Control				$12,652,407
Contingency	25%			$27,124,326
E&D / S&A	20%			$27,124,326
			Subtotal	$162,745,957
Debris Removal	65%		$2,449,764	$1,592,346
Aids to Navigation	75%		$871,691	$653,768
Chloride Mitigation - relocate water intake	0%		$49,450,000	$0
Dissolved Oxygen Mitigation	20%		$25,800,000	$5,160,000
Cultural/Historic Mitigation	100%		$15,424,449	$15,424,449
Lands, Easements, Relocations, Rights-of-Way	65%		$2,349,198	$1,526,978
Channel Modification Mitigation	65%		$260,000	$169,000
Salinity Intrusion on Wetlands (722 ac)	25%		$18,772,000	$4,693,000
Shortnose Sturgeon Mitigation	20%		$1,375,500	$275,100
Striped Bass Impact Avoidance	0%		$2,000,000	$0
			TOTAL	$192,240,599

Other Considerations: Disposal Site 12A

Development of a container terminal at Disposal Site 12A would not have significant environmental effects associated with the facility footprint, given its current use for disposal of dredged material. However, as discussed above, installation of a new marine terminal at this site would entail development of equivalent disposal capacity at another location. It is likely that this disposal capacity would be located in saltmarsh wetlands that lie along the north shore of the Savannah River. In addition, rail and road access to the site would likely traverse wetlands. This could require significant efforts in planning the rail route to avoid, minimize, and mitigate adverse environmental effects. Wetland mitigation costs for landside transportation corridors are included in Table 14.

Vessel traffic associated with a new terminal may increase tidal velocities in Back River, thereby reducing the effectiveness of the area as a sediment trap. The reduced effectiveness would increase the cost of removing that sediment from other portions of the harbor. In addition, deepening of Back River could increase salinity intrusion up Back River, resulting in adverse impacts to wetlands and fishery habitats. Costs of such secondary impacts have not been included in this analysis.

As discussed above, a portion of the traffic from a container facility is generated by deliveries to and from distribution centers. Anything that would generate longer delivery times, such as longer dray distances, will affect the number of deliveries that can be made. As the number of deliveries per driver decreases, the cost per dray could increase. If the number of containers stays constant, more trucks will be required to handle the same number of containers, generating more traffic on the road. Since Disposal Site 12A is approximately six miles downstream of Garden City Terminal, the drayage distance from this site would be at least that much more than the distance from Garden City Terminal.

Overall Assessment: Disposal Site 12A

Disposal Site 12A has potential as a site for a new container terminal. There is sufficient space for a terminal and highway access is relatively efficient. However, the costs of developing this facility would be more than twice the expected benefits, in terms of dredging costs avoided. In addition, environmental impacts associated with rail and road access to the site could be significant.

EAST COAST TERMINAL

The potential for modifying East Coast Terminal to serve as a dedicated container facility is assessed below. The analysis includes a profile of the site, estimation of the costs to modify the facility, a discussion of required landside transportation infrastructure, an evaluation of benefits of modifying this facility, discussion of other factors involved in conversion of this facility, and an overall assessment of its ability to address navigation problems and opportunities in Savannah Harbor.

East Coast Site Profile and Initial Assessment

As indicated in Figure 1, the East Coast Terminal site is located on the south bank of the Savannah River east of downtown Savannah, approximately 1.2 miles below the foot of Bull Street.

This site is operated by the East Coast Terminal Company. This marine terminal handles conventional and containerized general cargo, steel products, linerboard, and woodpulp; receipt of cement clinker, bauxite, gypsum, and liquid sulfur. Rail service to this terminal is provided by CSX. This marine terminal currently has 1,800 feet of berth space with berths that are 34 - 36 feet MLW. Approximately 28 acres of open storage area are located in the rear of the site.

Figure 7 provides a more detailed aerial view. The polygon in Figure 7, which illustrates the 300 acres assumed necessary for a new container terminal, provides visual scale for the aerial photo. As evident in this figure, to achieve 300 acres, the new terminal would need to incorporate adjacent properties, as well as the East Coast Terminal site.

As an initial assessment, East Coast Terminal would be more downstream than other terminals considered thus far. Consequently, its benefits in terms of dredging costs avoided would be larger. However, East Coast might be too small to serve as a container facility. In addition, landside transportation appears to present a problem for truck and rail movement of containers. The site is on the east side of the City of Savannah and the transportation connections are on the west side. Moving the containers through the city could be problematic.

Costs of Modifying East Coast Terminal

The costs estimated to construct a container terminal at the East Coast site are contained in Table 16. As indicated in this table, it is estimated that $370 million would be required to develop a 300-acre container terminal at this site. It is anticipated that much of this site would need to be demolished prior to construction of the container terminal. As in the case of the Blue Circle site, the associated costs of relocating current East Coast Terminal operations to another facility would need to be included in a detailed analysis of this site. The terminal would require the full array of container handling facilities described above, and it is assumed that the existing docks would be inadequate for the container facility under consideration in this investigation.

Based on aerial photos, U.S.G.S. quadrangle maps, and preliminary site reconnaissance, it is assumed that 100 acres of this site (i.e., one-third of the 300 acres) would be wetlands. As noted above, it is assumed that wetland mitigation activities would be approximately $26,000 per acre, including land purchased for mitigation at $6,000 per acre.

FIGURE 7
EAST COAST TERMINAL

TABLE 16
ESTIMATED COSTS OF EAST COAST TERMINAL

Site Demolition				
Asphalt pavement	121,000	sy	$3	$421,316
Building Demo	10,707,122	cf	$0	$2,216,749
Building foundation removal	22,409	cy	$65	$1,455,083
Railroad track removal, ties and track	8,000	lf	$8	$64,369
Site Improvement				
Land purchase	375	ac	$100,000	$37,500,000
Heavy Duty Pavement for container traffic	300	ac	$300,000	$90,000,000
Administration Building	10,000	sf	$168	$1,675,102
storage building	20,000	sf	$10	$198,565
Building foundation	3,333	sy	$22	$73,717
110 lb Railroad track w/ wooden ties and ballast	-	lf	$78	$0
110 lb Railroad track w/ concrete ties in container yard	20,000	lf	$182	$3,632,524
Dock (includes: concrete deck & beam, concrete steel reinforcement, 18" square precast concrete piling, expn joint & misc const items, handrail, fender system)	2,500	lf	$21,300	$53,250,000
Crane Tracks on concrete ties(assume length = 1.25 x dock length)	3,125	lf	$182	$567,582
100,000 Gallon Water Storage Tank for fire protection	1	ea	$250,000	$250,000
Upgrade of Intermodal Facilities				$2,652,409
Wetlands Mitigation	100		$26,000	$2,600,000
Equipment				
72-95 Ton Cranes	6	ea	$6,500,000	$39,000,000
Rubber tire gantries	7	ea	$1,300,000	$9,100,000
Five High loaded top lifts (87,000 lbs)	10		$350,000	$3,500,000
Seven High empty stackers ((15,000 lbs)	2		$200,000	$400,000
Jockey Trucks	20	ea	$39,120	$782,400
Flatbed Trucks	6	ea	$28,980	$173,880
Contingency	25%			$61,728,424
			Subtotal	$311,892,119
E&D / S&A	20%			$61,728,424
			TOTAL	$370,370,544

Landside Transportation: East Coast Terminal

Detailed examination of transportation issues in the City of Savannah suggest that development of a large container facility at East Coast Terminal would be problematic with respect to landside transportation of containers. Coordination with Metropolitan Planning Commission (MPC) identified several pertinent studies. In addition, MPC staff characterized east-west freight transportation issues in the City of Savannah. Among the studies identified by MPC staff was the *East-West Corridor Feasibility Study*, prepared by HNTB Corporation for MPC. This study was initiated in 1997 in order to assess and address capacity deficiencies in east-west travel through the City of Savannah. In particular, the study focused on Bay Street and on DeRenne Avenue as the principal east-west corridors through the city. Traffic counts by MPC along these corridors support the findings of this study that they are already operating well beyond their efficient carrying capacity. In 2002, some portions of DeRenne Avenue had average daily volumes in excess of 50,000 vehicles, and average daily volumes for Bay Street through the Historic District of downtown Savannah exceeded 25,000 vehicles.

As established by the *East-West Corridor Feasibility Study*, these volumes clog the major east-west corridors through Savannah. This congestion has adverse implications for residents in neighborhoods along these corridors, city residents, and residents in communities east of the city, including Tybee Island. Increased commuting times, reduced air quality, impeded hurricane evacuation (of areas east of the city), and impeded movement of commercial vehicles are among the adverse effects of this east-west congestion.

Trucks moving to/from East Coast Terminal (or other potential container terminals east of the City) would likely use DeRenne Avenue and the Truman Parkway, the north-south corridor on the eastern side of the city. Under existing conditions, terminal-related trucks would experience significant delays and would increase congestion significantly. Assuming that 15 percent of the containers are moved by rail with the remainder by truck (generally consistent with Garden City Terminal), a container facility with the capacity under consideration in this analysis (500,000 TEUs annually) would generate approximately 600 trucks per day.

The *East-West Corridor Feasibility Study* recommended that the following actions as important near-term relief measures: (1) construction of a new, limited-access, six-lane freeway along DeRenne Avenue and (2) reduction of Bay Street through the Historic District from four to two lanes. According to MPC staff, the proposed DeRenne Avenue freeway is a source of great controversy in the neighborhoods along its route. Local residents resent the noise implications, loss of neighborhood properties from road widening, and the physical division of the neighborhoods. It is doubtful whether such a project could be implemented at this time due to neighborhood opposition. The unrelieved congestion on DeRenne Avenue could make it impractical to reduce the width of Bay Street, as recommended. The result is that the east-west congestion problems in

Savannah are likely to continue, and according to MPC planners, they will be exacerbated by new development (planned or pending) east of the city.

As long-term measures, the *East-West Corridor Feasibility Study* identified two additional options to relieve east-west congestion in Savannah: (1) a Gwinnett Street tunnel or (2) a Bay Street bypass route consisting of a bridge to Hutchinson Island from the south bank of the Savannah River near the East Coast Terminal and a freeway along the island connecting with the Houlihan Bridge upstream of Garden City Terminal. These congestion relief measures are too uncertain for consideration in this analysis.

Dredging Costs: East Coast Terminal

Dredging-related costs associated with the East Coast Terminal are presented in Table 17. Costs in this table include deepening Fig Island Turning Basin, which has the following dimensions: 900 feet wide, 1,000 feet long, and 34 feet deep. This turning basin would need to be enlarged as well as deepened to be consistent with Kings Island Turning Basin, which would be 1,600 feet by 1,675 feet under the Tier I Selected Plan. As indicated in this table, dredging to 48 feet MLW from the sea to the East Coast Terminal site would cost approximately $203 million.

Based on the distance downstream, it was assumed that most of the dredging-related costs in the bottom rows of Table 17 (Debris Removal to Striped Bass Impact Avoidance) would be 55 percent of costs developed for Garden City Terminal in the Tier I analysis. Mitigation costs for cultural/historic impacts and channel modification would be expected to consistent (i.e., 100 percent) with Garden City costs. Secondary effects of salinity intrusion on wetlands would be expected to be drop to insignificance, and dissolved oxygen mitigation costs for East Coast Terminal would be expected to 20 percent of the costs of Garden City Terminal.

Other Considerations: East Coast Terminal

The East Coast Terminal site could be affected by the development of a Hutchinson Island bridge, as discussed in the preceding section. This bridge could significantly affect this site and/or landside transportation in this part of the City of Savannah. The outcome for this site could be positive in terms of transportation access, negative if some portion of the site is lost to the bridge or its approaches, or some combination.

As discussed above, a portion of the traffic from a container facility is generated by deliveries to and from distribution centers. Anything that would generate longer delivery times, such as longer dray distances, will affect the number of deliveries that can be made. As the number of deliveries per driver decreases, the cost per dray could increase. If the number of containers stays constant, more trucks will be required to handle the same number of containers, generating more traffic on the road. Since East Coast Terminal is approximately seven miles downstream of Garden City Terminal, the drayage distance from this site would be at least that much more than the distance from Garden City Terminal.

TABLE 17
ESTIMATED COSTS OF CHANNEL DEEPENING (48 FEET MLW)
TO EAST COAST TERMINAL

Mobilization				$2,683,845
-85+000 to -60+000	2,616,000	cy	$3.87	$10,123,920
-60+000 to -38+500	4,163,000	cy	$2.69	$11,188,063
-38+500 to -14+000	5,155,000	cy	$2.04	$10,529,088
-14+000 to 0+000	2,071,000	cy	$2.26	$4,675,283
0+000 to 24+000	3,506,000	cy	$2.37	$8,291,690
24+000 to 40+000	3,824,000	cy	$4.89	$18,704,140
40+000 to 50+000	2,963,000	cy	$2.96	$8,759,369
50+000 to 70+000	3,874,000	cy	$2.63	$10,203,148
Deepening Fig Island Turning Basin		cy	$2.63	$18,995,817
Berth Dredging	600,000	cy	$2.63	$1,580,250
Disposal Area Site Work and Erosion Control				$13,524,987
Dredging Contingency	25%			$29,814,899
E&D / S&A	20%			$29,814,899
Subtotal				$178,889,396
Debris Removal	55%		$2,449,764	$1,347,370
Aids to Navigation	55%		$871,691	$479,430
Chloride Mitigation - relocate water intake	0%		$49,450,000	$0
Dissolved Oxygen Mitigation	20%		$25,800,000	$5,160,000
Cultural/Historic Mitigation	100%		$15,424,449	$15,424,449
Lands, Easements, Relocations, Rights-of-Way	55%		$2,349,198	$1,292,059
Channel Modification Mitigation	55%		$260,000	$143,000
Salinity Intrusion on Wetlands (722 ac)	0%		$18,772,000	$0
Shortnose Sturgeon Mitigation	20%		$1,375,500	$275,100
Striped Bass Impact Avoidance	0%		$2,000,000	$0
			TOTAL	$203,010,803

Overall Assessment: East Coast Terminal

The East Coast Terminal site has little potential as a container terminal. The benefits from dredging costs avoided are significantly outweighed by the costs of developing this facility. In addition, the site is likely too small for long-term use as an efficient container terminal. Even if these issues were not of concern, difficulties in east-west landside transportation of containers through the city by truck or by rail would likely be sufficient to eliminate this site from further consideration.

The conclusion is that landside transportation would be problematic for a new container terminal east of the City, including East Coast Terminal and Elba Island (the next alternative location discussed). The assumed 1.5 million TEUs per year would generate tremendous volumes of truck traffic to/from these terminals. According to MPC staff, rail movement of a significant portion of these containers would likely generate significant neighborhood opposition. The CSX rail line to areas east of the city, including the East Coast Terminal passes through residential neighborhoods in Savannah. This line is active, but according to MPC staff a dramatic increase in traffic could stimulate opposition from trackside neighborhoods.

ELBA ISLAND TERMINAL

The feasibility of developing a new container facility on Elba Island is assessed below. As for the discussion of all the alternative facilities, the analysis includes a profile of the site, estimation of the costs to modify the facility, a discussion of required landside transportation infrastructure, an evaluation of benefits of modifying this facility, discussion of other factors involved in conversion of this facility, and an overall assessment of its ability to address navigation problems and opportunities in Savannah Harbor.

Elba Island Site Profile and Initial Assessment

As indicated in Figure 1, Elba Island is located approximately half way between Garden City Terminal and the sea. Figure 8 provides a more detailed aerial view. The polygon in Figure 8 provides visual scale for the aerial photo, representing the 300 acres that are assumed to be necessary for development of a new container facility.

Elba Island is owned by Southern Gas which operates a liquefied natural gas (LNG) facility on the northeastern portion of the island. The facility has a marine terminal for receipt of LNG tankers. There is approximately 1,255 feet of berth space, maintained at a depth of 39 feet MLW. Adjacent to the terminal is a privately-maintained turning basin constructed by Southern Gas for its LNG ships. The remainder of the island, shown in Figure 8, serves as an active dredged material disposal site that Southern Gas uses for its maintenance dredging of the LNG berths and of the turning basin. Elba Island is accessed by a service road which includes a bridge over South Channel. There is currently no rail service to the island.

FIGURE 8
ELBA ISLAND

The LNG facility on Elba Island was re-activated in 2001, after being mothballed since 1982. As part of its re-activation, Southern Gas re-dredged the facility berths and the turning basin. Based on the re-activation of the facility, the planned expansion of the facility in 2005, and the rising importation of LNG, Southern Gas is likely to be operating the Elba Island facility for the foreseeable future.

As an initial assessment, Elba Island is far enough downstream of Garden City Terminal to generate significant savings in dredging costs avoided. In addition, there appears to be sufficient space on the island for a container facility consistent with the above assumptions. However, there does not appear to be much opportunity for future expansion. Although there is no rail service to the island, it is conceivable that a rail terminal could be developed on the south side of South Channel with convenient drayage. The previously mentioned difficulties of moving containers east-west through the City of Savannah would apply to an Elba Island container terminal.

Construction Costs: Elba Island Terminal

The costs required to construct a container terminal on Elba Island are contained in Table 18. As indicated in this table, it is estimated that $285 million would be required to develop a container terminal at this site. It is assumed that the container terminal site would not adversely affect the LNG terminal. It is assumed that an intermodal rail facility would need to be located on the south shore of South Channel. Trucks would access the site via the existing service road and bridge. However, significant improvements to this road and bridge would likely be necessary to accommodate the volume of truck traffic associated with a new container terminal; these costs are uncertain at this time and are not included in Table 18. Other assumptions about this site include: a water storage tank for fire protection and approximately 50 acres (of 300) would require wetland mitigation. It is assumed that City of Savannah's President Street Municipal Wastewater Treatment Plant would service a new terminal at Elba Island.

Based on aerial photos, U.S.G.S. quadrangle maps, and preliminary site reconnaissance, it is assumed that 50 acres of this site (i.e., one-sixth of the 300 acres) would be wetlands. As noted above, it is assumed that wetland mitigation activities (in addition to land purchases) would be approximately $20,000 per acre ($10,000/acre plus a 2:1 replacement ratio).

Landside Transportation: Elba Island Terminal

A container terminal on Elba Island would face the same landside transportation difficulties that face East Coast Terminal. Congestion on the east-west corridors through Savannah are severe and likely to worsen. Truck and rail transport of large volumes of containers to/from an Elba Island terminal could encounter significant community opposition in neighborhoods along those routes. The landside transportation problems associated with developing this site would likely greatly diminish if, separate from this project, a tunnel under downtown or a new bridge and bypass were constructed across the Savannah River, as discussed in the *East-West Corridor Feasibility Study*. Measures to reduce the rail problems are not readily foreseeable for this area and that - if true, operation of a terminal based solely on truck transit of the containers would greatly limit its potential efficiency and cost effectiveness.

As discussed above, a portion of the traffic from a container facility is generated by deliveries to and from distribution centers. Anything that would generate longer delivery times, such as longer dray distances, will affect the number of deliveries that can be made. As the number of deliveries per driver decreases, the cost per dray could increase. If the number of containers stays constant, more trucks will be required to handle the same number of containers, generating more traffic on the road. Since Elba Island is approximately 11 miles downstream of Garden City Terminal, the drayage distance from this site would be at least that much more than the distance from Garden City Terminal.

TABLE 18
ESTIMATED COSTS OF ELBA ISLAND TERMINAL

Site Improvement				
Land purchase	375		$6,000	$2,250,000
Heavy Duty Pavement for container traffic	300	ac	$300,000	$90,000,000
Administration Building	10,000	sf	$168	$1,675,102
storage building	20,000	sf	$10	$198,565
Building foundation	3,333	sy	$22	$73,717
110 lb Railroad track w/ wooden ties and ballast	-	lf	$78	$0
RR bed prep	-	lf		$0
110 lb Railroad track w/ concrete ties in container yard	-	lf	$182	$0
Electrical service to terminal	21,000	lf	$60	$1,260,000
Dock (includes: concrete deck & beam, concrete steel reinforcement, 18" square precast concrete piling, expn joint & misc const items, handrail, fender system)	2,500	lf	$14,300	$35,750,000
Crane Tracks on concrete ties(assume length = 1.25 x dock length)	3,125	lf	$182	$567,582
100,000 Gallon Water Storage Tank for fire protection	1	ea	$250,000	$250,000
Intermodal Transfer Station	1	ea	$5,304,817	$5,304,817
Wetlands Mitigation	50	ac	$26,000	$1,300,000
Equipment				
72-95 Ton Cranes	6	ea	$6,500,000	$39,000,000
Rubber tire gantries	7	ea	$1,300,000	$9,100,000
Five High loaded top lifts (87,000 lbs)	10		$350,000	$3,500,000
Seven High empty stackers ((15,000 lbs)	2		$200,000	$400,000
Jockey Trucks	20	ea	$39,120	$782,400
Flatbed Trucks	6	ea	$28,980	$173,880
Contingency	25%			$47,571,516
			Subtotal	$237,857,579
E&D / S&A	20%			$47,571,516
			TOTAL	$285,479,094

Dredging Costs: Elba Island Terminal

Dredging-related costs associated with the Elba Island site are presented in Table 19. As indicated in this table, dredging to 48 feet MLW from the sea to Elba Island would cost approximately $138 million.

TABLE 19
ESTIMATED COSTS OF CHANNEL DEEPENING (48 FEET MLW) TO ELBA ISLAND TERMINAL

Mobilization			$2,683,845
-85+000 to -60+000	2,616,000 cy	$3.87	$10,123,920
-60+000 to -38+500	4,163,000 cy	$2.69	$11,188,063
-38+500 to -14+000	5,155,000 cy	$2.04	$10,529,088
-14+000 to 0+000	2,071,000 cy	$2.26	$4,675,283
0+000 to 24+000	3,506,000 cy	$2.37	$8,291,690
24+000 to 40+000	3,824,000 cy	$4.89	$18,704,140
40+000 to 50+000 (Assume end of port located at station 45+000)	2,963,000 cy	$2.96	$8,759,369
Dredging for turning basin	992,593 cy	$2.96	$2,934,352
Berth Dredging	600,000 cy	$2.96	$1,773,750
Disposal Area Site Work and Erosion Control			$11,343,537
Contingency	25%		$22,751,759
E&D / S&A	20%		$22,751,759
Subtotal			$136,510,553
Debris Removal	30%	$2,449,764	$734,929
Aids to Navigation	30%	$871,691	$261,507
Chloride Mitigation - relocate water intake	0%	$49,450,000	$0
Dissolved Oxygen Mitigation	0%	$25,800,000	$0
Cultural/Historic Mitigation	0%	$15,424,449	$0
Lands, Easements, Relocations, Rights-of-Way	30%	$2,349,198	$704,759
Channel Modification Mitigation	30%	$260,000	$78,000
Salinity Intrusion on Wetlands (722 ac)	0%	$18,772,000	$0
Shortnose Sturgeon Mitigation	0%	$1,375,500	$0
Striped Bass Impact Avoidance	0%	$2,000,000	$0
		TOTAL	$138,289,749

Based on the distance downstream, it was assumed that most of the dredging-related costs in the bottom rows of Table 19 (Debris Removal to Striped Bass Impact Avoidance) would be 30 percent of costs developed for Garden City Terminal in the Tier I analysis. Mitigation costs for cultural/historic impacts would be insignificant, since the Elba Island site is downstream of Old Fort Jackson and the *CSS Georgia*. Dissolved oxygen mitigation , shortnose sturgeon mitigation, and striped bass impact avoidance would not be necessary for this site.

Other Considerations: Elba Island Terminal

At Elba Island the Federal channel makes a sharp turn. This bend constitutes a challenge for commercial navigation. According to the Savannah Pilots, the pilots actively avoid passing commercial ships at this location. Consequently, a container facility on the undeveloped portion of the island might not be a safe location for a marine terminal if berthing areas would be located on or near the bend. This assumes that the LNG terminal would not be involved in development of a container facility. As stated above, it is likely that the LNG period would operate through the 50-year period of analysis.

A new terminal at Elba Island would fall into the current "blast zone" for the LNG facility. This raises the issue of whether Elba Island is a practical or safe location for a container terminal given the activities on the adjoining LNG facility. In addition, the Coast Guard regulates movements of LNG vessels in the harbor and movements of other vessels when LNG vessels are in transit. Specifically, movements of LNG tankers require a regulated navigation area (RNA) that extends from Fort Jackson (upriver from the LNG terminal) downstream to the channel entrance offshore (i.e., the Savannah River Channel Entrance Sea Buoy). Currently, when LNG ships are transiting the channel, vessels greater than 1,600 gross tons are prohibited from operating in the RNA without express permission of the USCG Captain of the Port. A revision to this RNA has been proposed by USCG. The proposed rulemaking [33 CFR Part 165] would allow vessels greater than 1,600 gross tons to operate in the RNA when LNG tankers are transiting Savannah Harbor, provided that a separation distance of two nautical miles is maintained. Under both current and proposed navigational rules, movements of LNG vessels could significantly constrain marine operations at an Elba Island container terminal.

The loss of sediment placement capacity that would result from use of the Elba Island disposal site would necessitate procurement of disposal capacity elsewhere along the river. It is assumed that the Georgia Department of Transportation and the Corps would allow Southern Energy to place their dredged material into contained disposal facilities (CDFs) on the north side of the river. The additional pumping costs and/or costs of constructing additional storage capacity have not been included in this analysis.

Overall Assessment: Elba Island Terminal

Elba Island has little potential as a container facility. The costs significantly exceed the benefits from avoided dredging costs. In addition, landside transportation would pose a significant challenge to the viability of this terminal, as for East Coast Terminal. Lastly, safe navigation practices may not allow location of a marine terminal at this sharp bend in the Savannah River.

DISPOSAL SITES 14A/B

The feasibility of developing a new container facility at Disposal Sites 14A/B in Jasper County, South Carolina is assessed on the next page. As for the discussion of all the alternative facilities, the analysis includes a profile of the site, estimation of the costs to modify the facility, a discussion of required landside transportation infrastructure, an evaluation of benefits of modifying this facility, discussion of other factors involved in

conversion of this facility, and an overall assessment of its ability to address navigation problems and opportunities in Savannah Harbor.

Disposal Sites 14A/B Profile and Initial Assessment

As indicated in Figure 1, the Disposal Sites 14A/B is located in Jasper County, South Carolina downstream of Elba Island. Figure 9 provides a more detailed aerial view. As with the other sites, the polygon in Figure 9 provides visual scale for the aerial photo. This box represents the 300 acres that are assumed to be necessary for development of a new container facility. This site is currently a dredged material disposal site operated by the Corps.

The consideration of the Disposal Sites 14A/B in this investigation is distinct from the South Atlantic International Terminal proposal being forwarded by Stevedoring Services of America (SSA). The SSA proposal, which would include some portions of Disposal Sites 14A/B, would occupy 500 acres and is expected to cost more than $400 million. This proposal is currently embroiled in a legal and political controversy. Legal issues concern the attempted condemnation of the site by Jasper County and lease to SSA for terminal development. Political issues include a lack of support by the State of Georgia or shipping interests in Charleston. This analysis is not evaluating the SSA proposal. Instead, it is evaluating Disposal Sites 14A/B for potential placement of a container facility that is commensurate with the other facilities being considered in this investigation.

As an initial assessment, Disposal Sites 14A/B are located toward the mouth of the Savannah River and would therefore generate significant benefits in terms of avoided dredging costs. There is also ample room for the terminal and its potential expansion.

Construction Costs: Disposal Sites 14A/B

The costs required to construct a container terminal at Disposal Sites 14A/B are contained in Table 20. As indicated in this table, it is estimated that $357 million would be required to develop a container terminal at this location.

As with Disposal Site 12A, the Compensation for Lost Disposal Capacity cost category includes 375 acres of replacement disposal capacity to compensate for capacity lost with development of the terminal and the intermodal facility. As for Disposal Site 12A it is assumed that one-half of the new disposal capacity would be located in wetlands, which would require mitigation.

Based on aerial photos, U.S.G.S. quadrangle maps, and preliminary site reconnaissance, it is assumed that 61 acres of this site (i.e., 50 percent of the landside transportation corridor and the intermodal facility) would be wetlands. As previously mentioned, it is assumed that a new intermodal container transfer facility that 75 acres would be required for this terminal. Consequently, land purchases in Table 20 contain 375 acres (i.e., 300 for the container terminal and 75 acres for the intermodal facility). As noted above, it is also assumed that wetland mitigation activities (in addition to land purchases) would be approximately $20,000 per acre ($10,000/acre plus a 2:1 replacement ratio).

FIGURE 9
DISPOSAL SITES 14A/B

TABLE 20
ESTIMATED COSTS OF TERMINAL AT DISPOSAL SITES 14A/B

Site Improvement				
Land purchase	375	ac	$6,000	$2,250,000
Access drive Heavy Duty Pavement for container traffic	47	ac	$300,000	$14,100,000
Heavy Duty Pavement for container traffic	300	ac	$300,000	$90,000,000
8" PVC Water service from Hardeeville (10 miles)	52,800	lf	$13	$663,340
Administration Building	10,000	sf	$168	$1,675,102
storage building	20,000	sf	$10	$198,565
Building foundation	3,333	sy	$22	$73,717
110 lb Railroad track w/ wooden ties and ballast	48,000	lf	$78	$3,726,630
RR bed foundation	117,333	sy	$13	$1,574,609
110 lb Railroad track w/ concrete ties in container yard	20,000	lf	$182	$3,632,524
Railroad track bridge crossing	300	lf	$1,132	$339,488
Electrical service from Hardeeville, SC	79,200	lf	$60	$4,752,000
Dock (includes: concrete deck & beam, concrete steel reinforcement, 18" square precast concrete piling, expn joint & misc const items, handrail, fender system)	2,500	lf	$14,300	$35,750,000
Crane Tracks on concrete ties(assume length = 1.25 x dock length)	3,125	lf	$182	$567,582
Hwy 17 railroad & semi flyover				$3,299,524
100,000 Gallon Water Storage Tank for fire protection	1	ea	$250,000	$250,000
Intermodal Transfer Station	1	ea	$5,304,817	$5,304,817
Compensation for Lost Disposal Capacity				$7,125,000
Wetlands Mitigation	24	ac	$26,000	$611,000
Wastewater Treatment Facility	1		$10,000,000	$10,000,000
Equipment				
72-95 Ton Cranes	6	ea	$6,500,000	$39,000,000
Rubber tire gantries	7	ea	$1,300,000	$9,100,000
Five High loaded top lifts (87,000 lbs)	10		$350,000	$3,500,000
Seven High empty stackers (15,000 lbs)	2		$200,000	$400,000
Jockey Trucks	20	ea	$39,120	$782,400
Flatbed Trucks	6	ea	$28,980	$173,880
Contingency	25%			$59,559,795
			Subtotal	$297,798,793
E&D / S&A	20%			$59,559,795
			TOTAL	$357,358,767

As for Disposal Site 12A, the Federal Government would need to be compensated for disposal capacity lost when this site is developed. It is assumed that this compensation would be in the form of replacement disposal capacity elsewhere along the river. The Compensation for Lost Disposal Capacity cost category includes 375 acres of replacement disposal capacity. It also includes wetland mitigation for one-half of that area that is assumed to be wetlands.

Landside Transportation: Disposal Sites 14A/B

A container facility at Disposal Sites 14A/B would have similar landside issues as the other terminals considered that are on the north side of the Savannah River. In particular, there could be significant environmental impacts and consequent mitigation costs associated with road and rail access to the terminal.

Dredging Costs: Disposal Sites 14A/B

Dredging-related costs associated with Disposal Sites 14A/B are presented in Table 21. As indicated in this table, dredging to 48 feet MLW from the sea to Disposal Sites 14A/B would cost approximately $127 million. It is assumed that ships calling at the Disposal Sites 14A/B container facility would use the Elba Island turning basin constructed by Southern Gas to serve the LNG marine terminal.

Based on the distance downstream, it was assumed that most of the dredging-related costs in the bottom rows of Table 21 (Debris Removal to Striped Bass Impact Avoidance) would be 25 percent of costs developed for Garden City Terminal in the Tier I analysis. Chloride mitigation, dissolved oxygen mitigation, cultural/historic mitigation, lands, easements, relocations, rights-of-way, channel modification mitigation, and salinity intrusion on wetlands would not be necessary.

Other Considerations: Disposal Sites 14A/B

Environmental considerations associated with Disposal Sites 14A/B include potential wetlands disturbances associated with rail and road access routes. The use of the site as a dredged material disposal site minimizes direct wetlands impacts. However, the lost dredged material disposal capacity would need to be replaced elsewhere along the river, preferably in the lower reaches of the river, which are currently served by the impacted disposal areas. Replacement of that capacity through expansion of the CDFs to the north into existing saltmarsh would result in extensive secondary wetland impacts which would need to be mitigated.

As discussed above, a portion of the traffic from a container facility is generated by deliveries to and from distribution centers. Anything that would generate longer delivery times, such as longer dray distances, will affect the number of deliveries that can be made. As the number of deliveries per driver decreases, the cost per dray could increase. If the number of containers stays constant, more trucks will be required to handle the same number of containers, generating more traffic on the road. Since Disposal Sites 14A/B are approximately 11 miles downstream of Garden City Terminal, the drayage distance from this site would be at least that much more than the distance from Garden City Terminal.

TABLE 21
ESTIMATED COSTS OF CHANNEL DEEPENING (48 FEET MLW)
TO TERMINAL AT DISPOSAL SITES 14A/B

Mobilization			$2,683,845
-85+000 to -60+000	2,616,000 cy	$3.87	$10,123,920
-60+000 to -38+500	4,163,000 cy	$2.69	$11,188,063
-38+500 to -14+000	5,155,000 cy	$2.04	$10,529,088
-14+000 to 0+000	2,071,000 cy	$2.26	$4,675,283
0+000 to 24+000	3,506,000 cy	$2.37	$8,291,690
24+000 to 40+000	3,824,000 cy	$4.89	$18,704,140
40+000 to 50+000 (Assume end of port located at station 42+000)	592,600 cy	$2.96	$1,751,874
Dredging for turning basin	992,593 cy	$2.96	$2,934,352
Berth Dredging	600,000 cy	$2.96	$1,773,750
Disposal Area Site Work and Erosion Control			$11,081,763
Contingency	25%		$20,934,442
E&D / S&A	20%		$20,934,442
Subtotal			$125,606,650
Debris Removal	25%	$2,449,764	$612,441
Aids to Navigation	25%	$871,691	$217,923
Chloride Mitigation - relocate water intake	0%	$49,450,000	$0
Dissolved Oxygen Mitigation	0%	$25,800,000	$0
Cultural/Historic Mitigation	0%	$15,424,449	$0
Lands, Easements, Relocations, Rights-of-Way	25%	$2,349,198	$587,299
Channel Modification Mitigation	25%	$260,000	$65,000
Salinity Intrusion on Wetlands (722 ac)	0%	$18,772,000	$0
Shortnose Sturgeon Mitigation	0%	$1,375,500	$0
Striped Bass Impact Avoidance	0%	$2,000,000	$0
		TOTAL	$127,089,313

Overall Assessment: Disposal Sites 14A/B

Disposal Sites 14A/B have potential as a container facility. Although the location of this facility would be sufficiently downstream to generate significant benefits in terms of avoided dredging costs, the costs of facility development are substantially in excess of dredging costs avoided. However, the potential for extensive secondary wetland impacts could be a significant factor in the ultimate feasibility of this site.

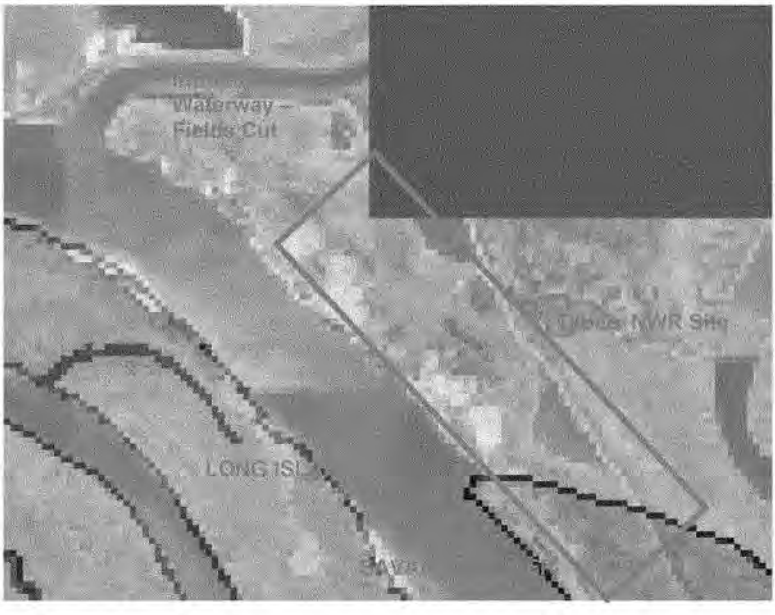
TYBEE NATIONAL WILDLIFE REFUGE

The feasibility of developing a new container facility in Tybee National Wildlife Refuge in Jasper County, South Carolina is assessed below. As for the discussion of all the alternative facilities, the analysis includes a profile of the site, estimation of the costs to modify the facility, a discussion of required landside transportation infrastructure, an evaluation of benefits of modifying this facility, discussion of other factors involved in conversion of this facility, and an overall assessment of its ability to address navigation problems and opportunities in Savannah Harbor.

Tybee National Wildlife Refuge Site Profile and Initial Assessment

As indicated in Figure 1, the Tybee NWR site is located in Jasper County, South Carolina approximately four miles upstream of mouth of the Savannah River. Figure 10 provides a more detailed aerial view. As for the other sites discussed above, the polygon in Figure 10 provides visual scale for the aerial photo. This box represents the 300 acres that are assumed to be necessary for development of a new container facility. It is assumed for this investigation that the Tybee NWR container facility would straddle the border between the wildlife refuge and the Corps' dredged material disposal facility (Jones/Oysterbed Island Disposal Area), with 50 percent of the facility footprint in each of these areas.

FIGURE 10
TYBEE NWR SITE



As an initial assessment, the Tybee NWR would have similar assets and liabilities as Disposal Sites 14A/B discussed above. There would be ample room for the terminal and its potential expansion. There would be significant benefits from avoided dredging costs by its location close to the mouth of the river. One challenge for the Tybee NWR site would be the need to cross the Fields Cut portion of the Intracoastal Waterway.

Construction Costs: Tybee NWR Terminal

The costs required to construct a container terminal at the Tybee NWR site are contained in Table 22. As indicated in this table, it is estimated that $385 million would be required to develop a container terminal at this site. Train access/egress from the Tybee NWR site would be via the Hardeeville Spur; road access would be via Route 17. It is assumed that an intermodal rail facility would need to be located near the site west of Fields Cut to avoid the expense of a rail bridge over the Intracoastal Waterway. As previously mentioned, it is assumed that a new intermodal container transfer facility that 75 acres would be required for this terminal. Consequently, land purchases in Table 20 contain 375 acres (i.e., 300 for the container terminal and 75 acres for the intermodal facility). Other assumptions about this site include: a water storage tank for fire protection and a package wastewater treatment facility.

As for Disposal Site 12A and Disposal Sites 14A/B, the Federal Government would need to be compensated for disposal capacity lost when this site is developed. It is assumed that this compensation would be in the form of replacement disposal capacity elsewhere along the river. As mentioned previously, it is assumed in the Compensation for Lost Disposal Capacity cost category that one-half of the site would be located in the Jones/Oysterbed Island Disposal Area. Since the compensatory disposal capacity would likely be located somewhere in the Tybee NWR, a 2:1 ratio of mitigation to loss was used for this site. Consequently, the $6.0 million cost estimate is based on: [(187.5 acres x $6,000 per acre) + (93.75 acres x 2:1 ratio x $26,000 per acre for land/mitigation costs)]. Based on aerial photos, U.S.G.S. quadrangle maps, and preliminary site reconnaissance, it is assumed that 51 acres of wetland would be impacted by the transportation corridor (rail and road), assuming one-half of the corridor passes through wetlands. As noted above, it is assumed that wetland mitigation activities (in addition to land purchases) would be approximately $20,000 per acre ($10,000/acre plus a 2:1 replacement ratio).

Landside Transportation: Tybee NWR Terminal

The need to cross Fields Cut could be a significant issue for this site. For the Norfolk to Miami section of this waterway, the U.S. Coast Guard (USCG) requires that all bridges provide 65 feet of vertical clearance. This would make the bridge expensive.

TABLE 22
ESTIMATED COSTS OF TYBEE NWR TERMINAL

Site Improvement				
Land purchase	375		$6,000	$2,250,000
Heavy Duty Pavement for container traffic	300	ac	$300,000	$90,000,000
Heavy Duty Access Drive Pavement for container traffic	101	ac	$300,000	$30,440,771
8" PVC Water service from Hardeeville (10 miles)	52,800	lf	$13	$663,340
Administration Building	10,000	sf	$168	$1,675,102
storage building	20,000	sf	$10	$198,565
Building foundation	3,333	sy	$22	$73,717
110 lb Railroad track w/ wooden ties and ballast	48,000	lf	$78	$3,726,630
RR foundation	117,333	sy	$13	$1,574,609
110 lb Railroad track w/ concrete ties in container yard	20,000	lf	$182	$3,632,524
Railroad track bridge crossing	300	lf	$1,132	$339,488
Electrical service from Hardeeville, SC	131,700	lf	$60	$7,902,000
Dock (includes: concrete deck & beam, concrete steel reinforcement, 18" square precast concrete piling, expn joint & misc const items, handrail, fender system)	2,500	lf	$14,300	$35,750,000
Crane Tracks on concrete ties(assume length = 1.25 x dock length)	3,125	lf	$182	$567,582
Hwy 17 railroad & semi flyover				$3,299,524
Bridge over Fields Cut				$3,299,524
100,000 Gallon Water Storage Tank for fire protection	1	ea	$250,000	$250,000
Intermodal Transfer Station	1	ea	$5,304,817	$5,304,817
Compensation for Lost Disposal Capacity				$6,000,000
Wetlands Mitigation	51	ac	$26,000	$1,319,100
Wastewater Treatment Facility	1		$10,000,000	$10,000,000
Equipment				
72-95 Ton Cranes	6	ea	$6,500,000	$39,000,000
Rubber tire gantries	7	ea	$1,300,000	$9,100,000
Five High loaded top lifts (87,000 lbs)	10		$350,000	$3,500,000
Seven High empty stackers ((15,000 lbs)	2		$200,000	$400,000
Jockey Trucks	20	ea	$39,120	$782,400
Flatbed Trucks	6	ea	$28,980	$173,880
Contingency	25%			$64,151,237
			Subtotal	$320,756,186
E&D / S&A	20%			$64,151,237
			TOTAL	$384,907,423

Dredging Costs: Tybee NWR Terminal

Dredging-related costs associated with the Tybee NWR site are presented in Table 23. As indicated in this table, dredging to 48 feet MLW from the sea to the Tybee NWR Terminal site would cost approximately $80 million.

Based on the distance downstream, it was assumed that most of the dredging-related costs in the bottom rows of Table 23 (Debris Removal to Striped Bass Impact Avoidance) would be 10 percent of costs developed for Garden City Terminal in the Tier I analysis. Channel modification mitigation costs for the Tybee NWR site would also be expected to 10 percent of Garden City costs. Chloride mitigation, dissolved oxygen mitigation, cultural/historic mitigation, lands, easements, relocations, rights-of-way, channel modification mitigation, and salinity intrusion on wetlands would not be necessary.

Other Considerations: Tybee NWR Terminal

A Tybee NWR container terminal would have adverse impacts on the wildlife refuge, assuming that one-half of the facility would located within the refuge. In addition, truck and rail access routes would likely impact wetlands. These impacts would need to be carefully designed to avoid, minimize, and mitigate wetland impacts.

As discussed above, a portion of the traffic from a container facility is generated by deliveries to and from distribution centers. Anything that would generate longer delivery times, such as longer dray distances, will affect the number of deliveries that can be made. As the number of deliveries per driver decreases, the cost per dray could increase. If the number of containers stays constant, more trucks will be required to handle the same number of containers, generating more traffic on the road. Since the Tybee NWR site is approximately 15 miles downstream of Garden City Terminal, the drayage distance from this site would be at least that much more than the distance from Garden City Terminal.

These adverse environmental effects on the refuge would under most circumstances be sufficient to preclude this site from further investigation. However, U.S. Fish and Wildlife Service has concerns about the effects of the Tier I Selected Plan (i.e., 48-foot MLW channel deepening to Garden City Terminal) on the Savannah National Wildlife Refuge and offered the Tybee NWR site for consideration in order to limit environmental impacts in the upper harbor.

As with Disposal Site 12A and Disposal Sites 14A/B, the loss of dredged material disposal capacity would need to be compensated elsewhere along the river, preferably in the same reach as this site. A plan for such compensation and the costs for such an action, have been included in this evaluation.

TABLE 23
ESTIMATED COSTS OF CHANNEL DEEPENING (48 FEET MLW)
TO TYBEE NWR TERMINAL

Mobilization			$2,683,845
-85+000 to -60+000	2,616,000 cy	$3.87	$10,123,920
-60+000 to -38+500	4,163,000 cy	$2.69	$11,188,063
-38+500 to -14+000	5,155,000 cy	$2.04	$10,529,088
-14+000 to 0+000	2,071,000 cy	$2.26	$4,675,283
0+000 to 24+000 (Assume end of port located at station 4+000)	584,333 cy	$2.37	$1,381,948
Dredging for turning basin	1,250,000 cy	$2.37	$2,956,250
Berth Dredging	600,000 cy	$2.37	$1,419,000
Disposal Area Site Work and Erosion Control			$7,765,960
Contingency	25%		$13,180,839
E&D / S&A	20%		$13,180,839
Subtotal			$79,085,034
Debris Removal	10%	$2,449,764	$244,976
Aids to Navigation	10%	$871,691	$87,169
Chloride Mitigation - relocate water intake	0%	$49,450,000	$0
Dissolved Oxygen Mitigation	0%	$25,800,000	$0
Cultural/Historic Mitigation	0%	$15,424,449	$0
Lands, Easements, Relocations, Rights-of-Way	10%	$2,349,198	$234,920
Channel Modification Mitigation	10%	$260,000	$26,000
Salinity Intrusion on Wetlands (722 ac)	0%	$18,772,000	$0
Shortnose Sturgeon Mitigation	0%	$1,375,500	$0
Striped Bass Impact Avoidance	0%	$2,000,000	$0
		TOTAL	$79,678,099

Other potential impacts would be lights from the facility adversely affecting sea turtles. This site is near the Atlantic beaches which are nesting grounds for sea turtles. The turtles can be disoriented by lights from shore. A large container terminal approximately two and one-half miles away could have adverse effects in this regard.

Overall Assessment: Tybee NWR Terminal

The Tybee NWR has limited potential as a container facility. Although the location of this facility would be sufficiently downstream to generate significant benefits in terms of avoided dredging costs, the costs of facility development are substantially in excess of dredging costs avoided. Finally, the environmental effects of a Tybee NWR container terminal would severely diminish the feasibility of this site.

COLONEL'S ISLAND, BRUNSWICK

Based on coordination between Savannah District and GPA, Colonel's Island was identified as having the greatest potential among the Brunswick marine terminals for development of a container terminal commensurate in channel depth and throughput capacity with the alternative Savannah River terminals discussed above. The feasibility of developing a new container facility at Colonel's Island in Brunswick is assessed below. The analysis of Colonel's Island includes a profile of the site, estimation of the costs to modify the facility, an evaluation of benefits of modifying this facility, discussion of other factors involved in conversion of this facility, and an overall assessment of its ability to address navigation problems and opportunities in Savannah Harbor.

Colonel's Island Site Profile and Initial Assessment

Figure 11 provides an aerial view of the Colonel's Island facility. As for the other sites discussed above, the polygon in Figure 11 provides visual scale for the aerial photo. This box represents the 300 acres that are assumed to be necessary for development of a new container facility consistent with the above facility parameters.

The existing Colonel's Island marine terminal is approximately 1,700 acres. It is served by a Federal navigation channel that is 400 feet wide with a depth of 30 feet MLW. Deepening of the Federal channel to 36 feet MLW has been authorized and is presently under construction. This marine terminal primarily handles bulk agricultural commodities and RoRo cargo. The existing Colonel's Island facility has three berths with lengths of 550, 750, and 550 feet. The terminal is located three miles from Interstate 95, and rail service is provided by CSX and Norfolk Southern Railroad.

As an initial assessment, a new container facility at Brunswick, which is approximately 80 miles from Savannah, may be of little help in addressing navigation problems and opportunities in Savannah Harbor. As evident in Figure 11, there appears to be sufficient space for a container terminal at Colonel's Island, but much of the site consists of wetlands. In the past, the Georgia Department of Natural Resources has strongly discouraged GPA from developing that site because of those wetlands. Mitigation costs would need to be included if this site were developed. Such costs are not included in this analysis. In addition, the existence of only a 36-foot channel (yet to be constructed) would likely result in significant cost disadvantages relative to alternative Savannah terminals given the assumed need to deepen to 48 feet MLW.

FIGURE 11
COLONEL'S ISLAND

Cost Of Modifying Colonel's Island Terminal

The estimated costs to construct a container terminal at Colonel's Island is contained in Table 24. As indicated in this table, it is estimated that $304 million would be required to develop a container terminal at this site. It is assumed that a new intermodal facility would be required. As previously mentioned, 75 acres would be required for this facility. Consequently, land purchases in Table 24 contain 375 acres (i.e., 300 for the container terminal and 75 acres for the intermodal facility). It is also assumed that all of this acreage would be wetlands (based on aerial photo interpretation) and that wetlands impacts would require mitigation at $20,000 per acre ($10,000/acre plus a 2:1 replacement ratio).

TABLE 24
ESTIMATED COSTS OF COLONEL'S ISLAND TERMINAL
BRUNSWICK, GA

Site Improvement				
Land purchase	375		$6,000	$2,250,000
Heavy Duty Pavement for container traffic	300	ac	$300,000	$90,000,000
Administration Building	20,000	sf	$168	$3,350,203
storage building	50,000	sf	$10	$496,414
110 lb Railroad track w/ wooden ties and ballast	10,000	lf	$78	$776,381
110 lb Railroad track w/ concrete ties in container yard	20,000	lf	$182	$3,632,524
Dock Includes items listed below:	2,500	lf	$14,300	$35,750,000
Crane Tracks on concrete ties(assume length = 1.25 x dock length)	3,125	lf	$182	$567,582
Intermodal Transfer Station	1	ea	$5,304,817	$5,304,817
Disposal Area Site Work and Erosion Control	0			
Wetlands Mitigation	375		$20,000	$7,500,000
Equipment				
72-95 Ton Cranes	6	ea	$6,500,000	$39,000,000
Rubber tire gantries	7	ea	$1,300,000	$9,100,000
Five High loaded top lifts (87,000 lbs)	10		$350,000	$3,500,000
Seven High empty stackers ((15,000 lbs)	2		$200,000	$400,000
Jockey Trucks	20	ea	$39,120	$782,400
Flatbed Trucks	6	ea	$28,980	$173,880
Contingency	25%			$50,646,050
			Subtotal	$253,230,251
E&D / S&A	20%			$50,646,050
			TOTAL	$303,876,301

Dredging Costs: Colonel's Island Terminal

Dredging-related costs associated with the Colonel's Island site are presented in Table 25. As indicated in this table, dredging to 48 feet MLW from the sea to Colonel's Island would cost approximately $138 million. According to recent discussions with Hydraulics Branch of Savannah District, the ongoing deepening of the Brunswick channel to 36 feet MLW is proving to be significantly more expensive than expected, due to the amount of rock encountered in the channel substrate. Consequently, the dredging estimates in Table 25 are likely to be unrealistically low for the same reason. As more geotechnical information about the Brunswick channel substrate becomes available, dredging costs in Table 25 will require adjustment.

TABLE 25
ESTIMATED COSTS OF CHANNEL DEEPENING (48 FEET MLW)
TO COLONEL'S ISLAND TERMINAL
BRUNSWICK, GA

Mobilization			$2,496,600
Dredging by Reach			
-6+250 to 19+000	**9,912,963** cy	$3.47	$34,410,868
19+000 to 32+500	5,300,000 cy	$3.50	$18,559,275
32+500 to 34+000	588,889 cy	$3.77	$2,217,549
34+000 to 46+350	4,848,519 cy	$5.11	$24,753,869
Dredge South Brunswick River	2,748,148 cy	$3.14	$8,619,154
Berth Dredging	200,000 cy	$3.14	$627,270
Contingency	25%		$22,921,147
		Subtotal	$114,605,733
E&D / S&A (dredging only)	20%		$22,921,147
		TOTAL	$137,526,879

Other Considerations: Colonel's Island Terminal

In 2002, GPA commissioned Booz, Allen, and Hamilton to prepare a strategic plan for the Port of Brunswick. This plan noted that cargo volumes of forest products shipped through Brunswick have been declining. These commodities, which were previously shipped primarily as break-bulk cargo, are increasingly being shipped in containers through Savannah, rather than Brunswick. Booz, Allen, and Hamilton estimated that the container hinterland of Brunswick would generate approximately 70,000-75,000 TEUs per year. Brunswick was expected to capture only a small portion of this volume (20-30 percent). The analysis indicated that Brunswick could develop a small, specialized niche in container services but could not be competitive in liner service with the major South Atlantic ports, including Savannah, Charleston, and Jacksonville. The reason cited was channel depth constraints resulting from rock in the channel substrate. The strategic plan did not consider Brunswick to be viable even for container barge feeder service to the major South Atlantic ports, noting that trucking would be more cost-effective for the distances involved.

The Booz, Allen, Hamilton study concluded that the container hinterland for Brunswick is too small to support a major container facility. This analysis studied the potential of Brunswick as an adjunct to Savannah, rather than a replacement. However, Savannah is approximately 60 miles closer to Atlanta and other more-distant inland origin/destinations.

Overall Assessment: Colonel's Island Terminal

Colonel's Island and the Port of Brunswick have little potential for development of a major container facility such as considered in this investigation. The port is not well situated to serve customers currently served by Savannah. In addition, the cost of deepening the channel appears to be prohibitive.

OFFSHORE TRANSSHIPMENT FACILITY

The investigation also evaluated an offshore container transshipment terminal. The premise of such a facility is that depth-constrained container ships would utilize the offshore terminal to load/unload either to: (1) the extent necessary to transit the channel upstream (i e., lightering the vessel offshore) or (2) fully pick up and discharge cargo destined for the inland port thereby avoiding the transit altogether. As part of the operation of an offshore terminal, it is assumed that barges or non-depth-constrained ships would provide feeder service from the terminal to local or regional ports.

Development of an offshore terminal would allow Savannah to serve the largest container ships and avoid the full costs of channel deepening to Garden City Terminal. The feasibility for an offshore transshipment facility is assessed below. The discussion differs from those of the alternative landside terminals, since the design and operation of such a facility is very speculative at this time. The analysis includes discussions of: conceptual design and profile of the facility, costs and benefits, other considerations, and an overall assessment of its ability to address navigation problems and opportunities in Savannah Harbor.

As part of this investigation extensive coordination was conducted with proponents of Seahub, a conceptual offshore terminal that has evolved from Department of Defense (DOD) research into floating offshore military bases. As discussed below, some engineering feasibility investigations were conducted as part of this research. However, the research focused on military applications of offshore platforms. Costs were not developed. The costs or viability for a commercial container transshipment operation are unknown at this time.

As discussed below, research into an offshore transshipment terminal raises more questions than answers. However, based on work done to date on Seahub and current operations of landside transshipment terminals, an assessment of an offshore facility can be made.

Larger Ships and Increasing Interest in Transshipment

As larger container ships have been adopted for liner services, the larger loads and deeper drafts of these vessels has stimulated interest in and development of transshipment terminals. The concept of transshipment facility is a hub-and-spokes system, where transshipment facilities serve as regional hubs with feeder services by ship, barge, and landside transport to regional ports.

Transshipment activity is on the rise. In 1980 approximately 12 percent of worldwide container movements underwent transshipment. In 2002, 23 percent were transshipped. This trend is expected to continue as increasingly large container ships continue to be of interest to liner services, as evidenced by anticipation in the container industry that 10,000 to 15,000-TEU Malaccamax vessels may be in world service in the foreseeable future.

The adoption of larger container ships has been driven by pursuit of economies of scale, particularly over long trade routes. However, there is a trade-off with transshipment in the additional cost required to handle and store the transshipped containers, the time required for transshipment, and the potential for delays in making connections with feeder services.

Conceptual Design and Operations: Offshore Transshipment Facility

As part of this investigation, a literature search was conducted into container transshipment terminals. Several transshipment terminals are in operation around the world including Freeport, Bahamas; Kaohsiung, Taiwan; Aden, Yemen; Salalah, Oman, Singapore, and Manzanillo, Panama. To some extent, Garden City Terminal currently serves as a transshipment facility, with container barge fed services to regional (South Atlantic) ports moving containers to/from this central collection point served by the major container lines. In the Booz, Allen, Hamilton strategic plan for the Port of Brunswick discussed above, coastwise container barge service was considered more efficient than trucking for distances in excess of 300 miles.

At this time, all transshipment terminals are land-based. There are no offshore container transshipment terminals such as considered in this investigation for Savannah. Consequently, there is not a template upon which to base the design for an offshore container transshipment terminal at Savannah or to estimate the costs, benefits, and other effects. Following are discussions of the parameters for design and operation of an offshore container transshipment terminal at Savannah.

Regional or Local Scale?

Based on the limited experience with container transshipment terminals around the world, the geographic location of a transshipment terminal is a critical determinant of its success. Whether a Savannah facility would serve just the Port of Savannah or other South Atlantic ports would shape its design in terms of physical size and throughput capacity and its operation. The development of a regional offshore terminal would require cooperative planning between the South Atlantic ports, which are typically locked into a competitive struggle to serve overlapping economic hinterlands. For an offshore transshipment facility to address navigation problems and opportunities in Savannah Harbor, it is assumed that it would serve depth-constrained container ships with an annual throughput capacity of approximately 1.5 million TEUs.

Another issue of scale is the amount of container storage required on the offshore facility. Even if most containers were moved to/from ships to barges, some facility storage would

be required as part of repositioning operations. The load bearing capacity of an offshore facility and the surface area would be critical cost parameters.

Floating or Fixed?

As part of this investigation, several coastal/offshore engineering experts were consulted about the feasibility of an offshore container transshipment facility. The engineering challenges of an offshore terminal are significant. The most immediate challenge would be how to load/unload container ships in an offshore environment. In an unprotected berth, the movement of a ship in this wave environment would be problematic in terms of loading/unloading. Container transfers to/from vessels would be inefficient, potentially dangerous, and under certain wave conditions, impossible (see discussion below). If the transshipment platform was also moving (as for a floating platform), these difficulties become much more challenging, suggesting a fixed platform or artificial island would be required.

According to one offshore engineering expert, the wave uplift on a fixed crane platform would exceed engineering capabilities, and a platform would need to be at least 100 feet above sea level. A floating "tension leg" platform, which remains at a constant elevation due to the tension, might be suitable. Another option would be an artificial island. Feasibility studies are being conducted on an offshore container platform in Apra Harbor, Guam. The platform being studied is a tension leg design. This platform would be protected from wave action by a breakwater.

Whether the terminal is floating or fixed, the technical feasibility of offshore transshipment of containers is uncertain at this time. As part of this DOD research into Seahub, some simulation studies were conducted into the challenges of cargo transfer to/from a floating transshipment facility. Results were not conclusive.

The U.S. Navy performs Logistics Over-the-Shore (LOTS) operations where transport ships are offloaded at anchor in deep water. LOTS operations are part of amphibious capabilities, allowing for cargo movement in areas where ports are not available. LOTS operations handle containers, RoRo, and break-bulk cargo. Navy safety guidelines prohibit LOTS operations during strong winds and high seas, as defined by the Beaufort Scale for sea state. Adverse weather conditions during cargo handling greatly increase the danger to personnel and equipment through loss of control of the cranes and excessive relative movement between the container ship and lightering vessels. Operations are prohibited at Beaufort Scale Sea State of three (3) which describes wind speeds between 7 and 10 knots and "large wavelets with some breaking crests."

Safety limitations to offshore military cargo handling will also be inherent to commercial offshore cargo handling. Although the types of ships and lightering vessels may differ in size and capability between military and commercial operations, the limiting factor for safe cargo handling operations will always depend on the condition of the sea and prevailing weather. Landside commercial operations are also not immune from weather conditions. For example, Super Post-Panamax container cranes must be shut down when winds exceed 40 miles per hour.

The National Oceanographic and Atmospheric Administration (NOAA) maintains a network of weather sea buoys along the eastern seaboard of the continental U.S. The sea buoy that is located near to the mouth of the Savannah River is buoy number 41008. This buoy measures and records ocean currents, atmospheric pressure, water temperature, wind speed, wave height and wave period. Buoy 41008 is located 40 nautical miles Southeast from Savannah, Georgia at a mean water depth of 60 feet. Historic data trends recorded by buoy 41008 shows the average sea swell and wind speed that can be expected off the coast of Georgia.

- The average monthly wind speed is approximately 10 knots with a 5 knot mean deviation from standard; the wind speed measured range is from light and variable (zero knots) to over 45 knots of average speed during the peak hurricane month of September.
- The average monthly significant wave height is approximately 3 feet with a one-and-a-half foot mean deviation from standard; the significant wave height measured range is from less than one-foot to approximately 19 feet during the peak hurricane month of September.
- The average monthly wave period at buoy 41008 is approximately 5 seconds with a one-second mean deviation from standard; the wave period measured range is from 3 seconds to approximately 13 seconds during the month of December.

As evident in the buoy data, the average monthly conditions of the sea and wind are at the upper limit or exceed the maximum conditions for safe offshore cargo handling operations as defined by the Navy for its LOTS operations. If average conditions are at the upper limit of operation tolerances, the facility would be inoperable under many weather conditions. This would be a significant shortcoming from the perspective of container liner services which are schedule-driven and have little tolerance for significant delays at any port along their rotation.

Storage Requirements

If container transshipment was directly from ship to ship or ship to barge, a platform could be constructed similar to an offshore oil drilling facility. However, it is unlikely that the need for some storage capacity could be entirely avoided. Repositioning requirements would dictate that some storage capacity would be required.

Costs and Benefits: Offshore Transshipment Facility

Based on the above considerations, it is likely that an offshore transshipment facility would require an artificial island and some sort of breakwater. It is also likely that a regional facility would be most economical, allowing several different ports to share the capital costs of constructing this facility. Constructing an artificial island in 50 to 60 feet of water would be technically feasible, but the costs would be enormous. It is unlikely that use of dredged material would be permitted, which raises the question of where the material would come from at any kind of affordable cost.

In addition, the environmental effects of such a facility constructed in the coastal zone could be prohibitive. Offshore islands would require mitigation, as they would cover the sea bottom. A floating facility may also require mitigation, as its large size would likely

shade a substantial acreage of ocean bottom. If the permitting requirements for an offshore dredged material disposal site are an indication, the requirements for construction of an offshore transshipment facility are likely to be lengthy, difficult, and uncertain in their final result. National Marine Fisheries Service and Environmental Protection Agency policies militate heavily against any covering of the sea bottom, which typically cannot be mitigated.

Coastal/offshore engineering experts were consulted about the potential costs of an offshore transshipment facility, either platform or artificial island. As noted above, there was no template for which to estimate costs, and no conclusions about costs could be made. The Seahub proponents did not have cost estimates for a floating or fixed facility. At this point in their undertaking, they are trying to develop sufficient interest in an offshore container transshipment facility to undertake the feasibility studies that would generate cost estimates.

Conclusions about costs and benefits can be made by considering the costs of double handling during transshipment. Currently, GPA's rate structure for Garden City Terminal operations includes charges to re-stow containers, such as would be required at minimum for an offshore platform to transfer containers between mother ships and feeder vessels. Cell-to-cell transfers are $15 per container, and cell-to-dock-to-cell transfers are $30.00 per container. Although rates and costs are not equivalent, it can be assumed that the rates are representative of handling costs (crane and labor) associated with transfers of containers. If 1.5 million TEUs were transferred at the cell-to-dock-to-cell rate ($30.00/container), this would translate into $22.5 million in additional handling costs per year, with a present value of $375 million (50 years at prevailing Federal discount rate 5 5/8 percent). The additional handling costs alone exceed deepening costs to Garden City Terminal. Consequently, the economic feasibility of an offshore transshipment terminal are in doubt even before the costs of the facility are included.

It is unlikely that a deep-water facility would result in larger vessels calling at Savannah, since the other ports on the U.S. east coast rotations are depth-constrained. There are currently no predictions that Malaccamax-class container ships would call at U.S. east coast ports. In fact, the 8,000-TEU vessels currently under construction are not expected to call at east coast ports in the foreseeable future.

Other Considerations: Offshore Transshipment Facility

A variety of uncertainties surround the concept of an offshore terminal besides the issues of cost, down time due to weather and sea conditions, and environmental effects discussed above. In particular, the hazards posed by hurricanes could be particularly challenging in terms of design and operations. One asset of an offshore terminal that warrants attention is that this terminal could promote homeland security by allowing offshore inspection of containers before entering the country. For these reasons, it does not appear that an offshore transshipment facility meets the test of engineering feasibility and is not, at this stage of its development, a proven technology that could form the basis of a reliable plan.

Overall Assessment: Offshore Transshipment Facility

Based on interviews conducted around the port as part of this investigation, the prevailing view by members of the port community to the concept of an offshore transshipment facility is that it is a concept whose time has not yet arrived. The major problem of transshipment is that it introduces added transfer, storage, and transaction costs and times which often exceed the cost and time saving introduced by faster, larger container and feeder vessels. The major problem with an offshore facility would be the enormous development cost and potential delays associated with weather. Liner services have shown repeatedly that they would rather travel lightloaded than incur significant scheduling delays waiting for tides or fair weather.

EVALUATION OF PROPOSED ALTERNATIVE TERMINAL SITES.

GENERAL DISCUSSION:

Tier II plan formulation activities identified alternative terminal locations as having the potential to address navigation problems and opportunities in Savannah Harbor. The following alternative terminal locations were carried forward for more detailed evaluation in this phase of investigation.

Garden City Terminal
Ocean Terminal
Blue Circle Site
Disposal Area 12A
East Coast Terminal
Elba Island Site
Disposal Area 14A/14B
Tybee NWR
Colonel's Island

The main goal for an alternative terminal location is that it be located closer to the ocean than the Georgia Port Authority's (GPA's) Garden City Terminal to reduce dredging costs and possible environmental impacts associated with saltwater intrusion. To address navigation problems and opportunities in Savannah Harbor, channel deepening would be implemented only as far as a single terminal that would serve the deeper vessels, but not beyond. If that terminal could be located closer to the ocean than Garden City Terminal, perhaps the total economic and environmental costs could be less.

Once the list of alternative terminal sites was completed; costs for facilities, environmental mitigation, and dredging were developed for each of the sites. The costs were developed in order to put all of the sites on an equal basis. At the same time the costs were being developed, the team established a methodology by which the sites would be screened. Four categories were established. These were: (1) safety/social problems, (2) transportation problems, (3) environmental problems, and (4) economic cost of infrastructure. Of these categories, the first two were considered major problems. The definitions for these categories are:

Safety/social problems: Location of a terminal at this site would expose it to dangers above those encountered in the daily operation of a terminal. The development of a terminal at this location would cause major problems due to land use conflicts.

Transportation problems: Location of a terminal is at this site would negatively affect traffic patterns within the City of Savannah according to the Savannah East-West Corridor Feasibility Study.

Environmental problems: Location of a terminal at this site would cause secondary environmental impacts above and beyond those already being considered as part of the environmental mitigation problems. This raises a question of efficiency versus environmental acceptability.

Economic cost of infrastructure: The location of a terminal at a greenfield site, as opposed to one that already pre-exists, requires that the site be developed from scratch. This increases the cost of this alternative due to the need to develop basic infrastructure (roads, electricity, water and sewage, etc.).

The screening process involved running two screens based on the major problem areas. The first screen was run to weed out sites with safety and/or social problems. The second screen was to weed out the remaining sites with transportation problems. The results of this screening are shown in Table 26 and summarized as follows:

- The Elba Island and Blue Circle sites were eliminated in the first screening due to major safety/social problems.
- The Ocean Terminal, the East Coast terminal and the Colonel's Island sites were screened out in the second round due to transportation problems. The selection of sites located east of the City of Savannah - East Coast Terminal and Elba Island Site, would require that rail and truck traffic pass through the center of the City on its way to the inland sites served by the Port. As stated in the Savannah East-West Corridor Feasibility Study, completed in 2002, none of the major roads in their present condition could support this amount of traffic.
- Of the remaining sites, Disposal Site 12A and Disposal Site 14A/14B are located entirely on dredged sediment placement sites, while the Tybee NWR site is located half on a sediment placement site and half in a National Wildlife Refuge. These sites were carried forward for further investigation since there wasn't a major safety hazard at any of these sites, nor was there a major impact to transportation in the City of Savannah. While these sites made it to the next level, there are still several questions that need to be answered such as whether the soils at these sites could support a container terminal and the environmental impacts brought about by the requirement for replacement of lost sediment storage capacity.

Sensitivity of assumptions:

When developing the requirements for alternative terminal sites it was important to achieve economies of scale in facility development, equipment purchase, and terminal

operations. This included a 300-acre size requirement for the terminals and the ability to have throughput of 1.5M TEUs, rather than the minimum capacity of 500,000 TEUs required to obtain the economic benefits of a deeper channel. At some of the Alternative Terminal Sites, the 300-acre minimal size was unable to be met, but they would still be able to handle a minimum of 500,000 TEUs, so under the completeness category they were given a "Yes" designation. Recent real estate sales ($400,000 to $450,000/acre) in areas where the purchase of land would be required to bring the terminal up to adequate size indicate that land costs may be considerably higher than those used in calculating construction costs. However, for the purpose of this evaluation we left the land costs at the lower value ($6 - $100,000/acre). Construction costs also did not include the costs of buying out an existing business, they only included the costs of developing the site into a container port.

TABLE 26 SUMMARY OF SCREENING OF ALTERNATIVE SITES				
Site	**Major Safety/Social Problem**	**Transportation Problems**	**Environmental Problems**	**Economic costs of Infrastructure**
Garden City Terminal			Mitigation Req't = 100%	Infrastructure already in place.
Ocean Terminal		Additional truck traffic on Bay St., already a congested area.	Mitigation Req't = 75%	Demolition of facilities already on-site in order to make it acceptable for a container port. Available area too small to meet minimal footprint.
Blue Circle Site	New terminal in area would be incompatible with Chatham County land use plan.		Mitigation Req't = 70%	Demolition of facilities already on-site in order to make it acceptable for a container port. Cost of obtaining land required for minimal facility.
Disposal Area 12A			Mitigation Req't = 65% Replacement for 375 acres of disposal area lost for terminal development.	All infrastructure would have to be brought on site including rail and road connections, water and electricity.
East Cost Terminal		Location East of the City, creates major east-west transportation problem.	Mitigation Req't = 55%	Demolition of facilities already on-site in order to make it acceptable for a container port. Cost of obtaining land required for minimal facility.
Elba Island	Terminal would fall under "Blast Zone" for LNG Terminal.	Location East of the City, creates major east-west transportation problem.	Mitigation Req't = 30%	
Disposal Areas 14 A/B			Mitigation Req't = 25% Replacement for 375 acres of disposal area lost for terminal development.	All infrastructure would have to be brought on site including rail and road connections, water and electricity.
Tybee NWR			Mitigation Req't = 10% Replacement for 375 acres of disposal area lost for terminal development. A National Wildlife Refuge.	All infrastructure would have to be brought on site including rail and road connections, water and electricity.
Colonel's Island		Container services could not be made competitive in liner service with other South Atlantic ports.	Georgia DNR has strongly discouraged GPA from further developing this site due to the predominance of wetlands.	

Environmental Mitigation Costs:

Mitigation costs were developed for each proposed terminal location, as described previously. In general, the level of impact is expected to be less if the channel improvement does not occur as far upstream.

The mitigation costs were described for each alternate terminal location, but are summarized in this section. The mitigation costs were put into the following categories and are shown by site in Table 27:

- Chloride mitigation: Refers to the potential relocation of the City of Savannah water intake in the Savannah River if chloride impacts from channel deepening exceed the City's contracted standards for chlorine levels. The cost for this measure was the same as that used in the Tier I report for this feature.

- Dissolved oxygen mitigation: Refers to mitigation if channel deepening reduces average summer dissolved oxygen levels in the Savannah River. The cost for this measure was the same as that used in the Tier I report for this feature.

- Cultural/Historic mitigation: Refers to mitigation to protect Old Fort Jackson and the *CSS Georgia*. Both resources are located at the junction of Back River and the Savannah River. The cost for this measure was the same as that used in the Tier I report for this feature.

- Channel modification mitigation: Refers to mitigation for direct wetland impacts of channel deepening on the river banks. Ten acres would be affected by deepening to Garden City Terminal. Wetland mitigation costs are estimated at $32,000 per acre, including $6,000 for real estate costs and $20,000 for mitigation activities ($10,000/acres plus a 2:1 replacement ratio),

- Secondary wetland mitigation: Refers to secondary impacts to wetlands resulting from saltwater intrusion into brackish or freshwater marshes located upstream of Garden City Terminal. Adverse secondary effects of saltwater intrusion could degrade up to 722 acres of wetlands, potentially requiring mitigation at $32,000 per acre as above.

- Shortnose sturgeon mitigation: Refers to actions taken to avoid adverse effects to habitat of the shortnose sturgeon. The cost for this measure was the same as that used in the Tier I report for this feature.

- Striped bass impact avoidance: Refers to actions taken to avoid adverse effects to habitat of the striped bass. The cost for this measure was the same as that used in the Tier I report for this feature.

- Site Development: Wetlands Mitigation: The number of acres of wetlands affected on the 375-acre site designated for the alternative terminal.

Using the information just described, the team then evaluated the extent to which each of the alternative terminal locations met the four criteria contained in the Principles and Guidelines for alternative plans. Those criteria are described below using the definitions contained in P&G:

- **Completeness** – The extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plans to other types of public and private plans if the other plans are crucial to realization of the contributions to the objective.

- **Effectiveness** – The extent to which an alternative plan alleviates the specific problems and achieves the specified opportunities.

- **Efficiency** – The extent to which an alternative plan is the most cost effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.

- **Acceptability** – The workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

The alternative terminal locations met the Principles and Guidelines criteria as follows:

Garden City Terminal:

Completeness – Yes.

Effectiveness – Yes.

Efficiency – Yes. Although there may be some questions with regard to environmental effects.

Acceptability – Yes. GPA is already in the process of doing things that will allow the port to meet the requirements for future traffic without having to deepen.

Ocean Terminal:

Completeness – Yes.

Effectiveness – Yes. While it is not 300 aces, it can still handle the 500,000 TEUs as required.

Efficiency – No, because of the increased traffic and the cost of additional land to make the site adequate. Renovation costs for this site are rather high.

Acceptability – Marginal. It is questionable whether the public will accept the additional traffic created by the movement of additional trucks through that are of the City.

TABLE 27
Mitigation Costs by Category

Mitgation Category	Garden City Terminal	Ocean Terminal	Blue Circle Site	Disposal Area 12A	East Coast Terminal	Elba Island Site	Disposal Area 14A/14B	Tybee NWR
Chloride Mitigation	$49,450,000.00	$37,087,500.00	$32,683,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
DO Mitigation	$25,800,000.00	$19,350,000.00	$17,052,000.00	$5,160,000.00	$5,160,000.00	$0.00	$0.00	$0.00
Cult/Historic Mitigation	$15,424,449.00	$15,424,449.00	$15,424,449.00	$15,424,449.00	$15,424,449.00	$0.00	$0.00	$0.00
Channel Modification Mitigation	$260,000.00	$195,000.00	$182,000.00	$169,000.00	$143,000.00	$78,000.00	$65,000.00	$26,000.00
Secondary Wetland Mitigation (722 Ac)	$18,772,000.00	$14,079,000.00	$13,140,400.00	$4,693,000.00	$0.00	$0.00	$0.00	$0.00
Shortnose Sturgeon Mitigation	$1,375,500.00	$1,031,625.00	$962,850.00	$275,100.00	$275,100.00	$0.00	$0.00	$0.00
Striped Base Impact Avoidance	$2,000,000.00	$2,000,000.00	$2,000,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
Site Develoment. Wetlands Mitigation	$0.00	$0.00	$1,560,000.00	$52,000.00	$2,600,000.00	$1,300,000.00	$624,000.00	$1,326,000.00
Total Cost for Mitigation	$113,081,949.00	$89,167,574.00	$83,004,699.00	$25,773,549.00	$23,602,549.00	$1,378,000.00	$1,391,000.00	$1,612,000.00

Blue Circle:

Completeness – Marginal, because of the size of the site and the surrounding land use. You would need to purchase land for the terminal from the Golf Club.

Effectiveness – Yes, because you could establish a terminal with a capacity of 500,000 TEUs at the site.

Efficiency – No, because of the high cost of renovating the site (tear down old facilities) in order to establish a container facility.

Acceptability – No, because of land issues, the acceptability of having a container terminal on a golf course or in the area of an exclusive development.

Disposal Site 12A:

Completeness – Yes. However, there is a question as to whether a dredged sediment placement site will have the necessary soil strength to support the needed infrastructure for a terminal. This would also apply to the Disposal Site 14A/14B, and the Tybee NWR Site.

Effectiveness – Yes, a new terminal could be constructed at the site to move the required number of TEUs.

Efficiency – No, because of the cost to build a terminal at the site and to bring in the necessary transportation requirements. The increased impact to the environment with the requirement to provide replacement sediment storage capacity when the surrounding area is marsh.

Acceptability – No. Not acceptable from the point of view of the environment and the transportation costs (road and rail access to the site). Easement held by the Corps of Engineers/GADOT.

East Coast:

Completeness – Marginal based the acreage available to the terminal.

Effectiveness – Marginal because the area is too small to handle the required container traffic.

Efficiency – No, because of the additional land costs to bring up the area to the minimally-acceptable size and the cost of turning the facility into a container port.

Acceptability – No, because traffic to and from the terminal, both rail and truck would, would have to pass through the city to access inland areas served by the port.

Elba Island:

Completeness – No, the terminal berths would be on a dangerous bend in the River which would affect navigation. The lack of affordable road and rail access.

Effectiveness – No, because of its location with respect to the channel and safety questions with regard to its co-location with the LNG Terminal.

Efficiency – No, because of transportation costs.

Acceptability – No, because of the increased transportation costs, the location of the berths with respect to the channel, and the fact that the terminal would be in the blast zone for the LNG Terminal, a navigation safety problem.

Disposal Area 14A/14B:

Completeness – Yes, same as Disposal Area 12A.
Effectiveness – Yes, same as Disposal Area 12A.
Efficiency – No, same as Disposal Area 12A.
Acceptability – No, same as Disposal Area 12A.

Tybee NWR:

Completeness – Yes, same as Disposal Area 12A.
Effectiveness – Yes, same as Disposal Area 12A.
Efficiency – No, because of the cost to build a terminal at the site and to bring in the necessary transportation requirements. Environmental effects because of the requirement to obtain a replacement disposal area when all of the surrounding area is marsh. Also is a National Wildlife Refuge.
Acceptability – No, not acceptable from the point of view of the environment and the transportation costs. Development of a National Wildlife Refuge includes consideration of an the apparent tradeoff between the Savannah NWR and the Tybee NWR.

Colonel's Island:

Completeness – Yes.
Effectiveness – Marginal, because of the distances involved with respect to the port and the inland customers it serves.
Efficiency – No, because the entire property is wetland: the cost of dredging - unknown at this time - may be prohibitive; and transportation costs.
Acceptability – No, it is unacceptable to Ga. DNR because of the wetlands involved.

Offshore Transport Facility:

Completeness – No, because of the size of the structure required to handle the proposed 500,000 TEUs, and its establishment in an open ocean environment. While there is one such facility in a closed harbor (Hong Kong), and oil rigs exist in the Gulf of Mexico (too small), this is too experimental for this project.
Effectiveness – No, while it would alleviate some problems it would cause more than it would solve. The environmental variables, i.e., the minimal wave environment, under which such a facility could operate is on the low end; therefore most of the time the facility would be unable to operate.
Efficiency – No, the costs for a facility to handle the required TEU's would be exorbitant, and the facility would only be able to operate less than 24% of the time.
Acceptability – No, because the cost to build and the operating conditions under which the facility could operate would make it unacceptable.

Summary:

Table 28 contains a summary of the extent to which the alternative terminal sites meet the Principle and Guidelines criteria for alternative plans.

TABLE 28
Evaluation of Alternative Terminal Sites

Site	Completeness	Effectiveness	Efficiency	Acceptability
Garden City	Yes	Yes	Yes	Yes
Ocean Terminal	Yes	Yes	No	Marginal
Blue Circle	Marginal	Yes	No	No
DA 12A	Yes	Yes	No	No
East Coast	Marginal	Marginal	No	No
Elba Island	No	No	No	No
DA 14A/14B	Yes	Yes	No	No
Tybee NWR	Yes	Yes	No	No
Colonel's Island	Yes	Marginal	No	No
Offshore	No	No	No	No

Conclusion:

Table 29 on the next page contains a summary of the assessment of the alternative terminal sites. Based on the factors described in the analysis and highlighted in the table, the team rated the overall rating of the sites as a potential deep-draft container terminal. The Garden City Terminal was the only one that received a ranking of HIGH. The team gave three sites a MEDIUM ranking, while six sites - which had been screened out because of major problems - were judged as having a LOW potential. The extent to which the sites could meet the criteria for an alternative plan was heavily considered in this assessment.

The four sites that were judged as having either a MEDIUM or HIGH potential as a terminal were then compared just on their economics. Table 30 shows that comparison. The cost of the next most economically efficient alternative was 45 percent more than the lowest cost site. Therefore, only the lowest cost site (Garden City Terminal) will be considered in the detailed evaluations.

TABLE 29 SUMMARY ASSESSMENT OF ALTERNATIVE TERMINALS

	Screening Result	Positive Features	Negative Features	Overall Potential
Garden City Terminal	In	- Ongoing Container Operation - Access to Rail and Highway - Sufficient area	- Distance upstream - Associated dredging costs and potential environmental impacts	High
Ocean Terminal	Out	- Close to Garden City - Access to Rail and Highway	- Inadequate size - High cost of renovation - Lack of dredging savings	Low
Blue Circle Site	Out	- Highway access	- Inadequate size - Lack of dredging savings - Difficult rail connection - Relocate existing operation	Low
Disposal Area 12A	In	- Sufficient area - Highway access	- Need to develop rail connection - Loss of sediment storage capacity - Environmental effects: access & replacement sediment storage capacity	Medium
East Coast Terminal	Out	- Rail access	- Inadequate size - East-west landside transport - Relocate existing operation	Low
Elba Island	Out	- Sufficient area - Downstream location	- Adjacent to LNG facility - Inadequate size - East-west landside transport - Navigation safety issues	Low
Disposal Areas 14A/14B	In	- Sufficient area - Downstream location	- Need to develop rail/road connection - Loss of sediment storage capacity - Environmental effects: access & replacement sediment storage capacity	Medium
Tybee NWR	In	- Sufficient area - Downstream location	- Need to develop rail/road connection - Environmental effects: site, access, replacement sediment storage capacity - Potential Intracoastal waterway impacts	Medium
Colonel Island, Brunswick	Out	- Sufficient area	- Distance from inland markets - High dredging costs	Low
Offshore Terminal	Out	- Potential for regional service - No channel deepening	- High costs of facility - Environmental effects - High costs of double handling - Delays due to weather	Low

TABLE 30 Evaluation of Higher Ranked Alternative Terminal Sites ($20K/acre Mitigation)				
Site	**Initial Construction Costs**	**Mitigation Cost**	**Total Cost**	**Incremental Cost (Percentage)**
Garden City Terminal	$213,600,000	$113,100,000	$326,700,000	
Tybee NWR	$464,000,000	$1,600,000	$465,600,000	43
DA 14A/14B	$483,000,000	$1,400,000	$484,400,000	48
DA 12A	$497,100,000	$25,800,000	$522,900,000	53

Sensitivity Tests:

A. To examine the sensitivity of the plan formulation conclusions to wetland mitigation costs, we evaluated the effects of raising the wetland mitigation from $20,000 per acre to $100,000 per acre. The results of this increase can be seen in Table 31. The increase did not alter the rankings of the top sites, but it did narrow the cost difference between the alternate sites. However, since the cost difference would still be 23-percent, the team felt that detailed studies were not likely to eliminate that large a differential, so the likelihood of the next best site becoming less expensive than the presently identified lowest cost site was remote. Therefore, the team again agreed that deepening only to the lowest cost site – the Garden City Terminal – be evaluated in detail.

TABLE 31 Evaluation of Higher Ranked Alternative Terminal Sites ($100K/acre Mitigation)				
Site	**Initial Construction Costs**	**Mitigation Cost**	**Total Cost**	**Incremental Cost (Percentage)**
Garden City Terminal	$213,600,000	$167,200,000	$380,800,000	
Tybee NWR	$464,000,000	$5,200,000	$469,200,000	23
DA 14A/14B	$483,000,000	$2,650,000	$485,650,000	28
DA 12A	$497,100,000	$68,600,000	$565,700,000	46

B. All three MEDIUM rated alternative terminal sites (Tybee NWR, DA 12A, and DA 14A/14B) are CDFs or -- in the case of the Tybee NWR -- contain a major part of a CDF. This being the case, the sediment storage capacity that would be lost if those sites were used as terminals would need to be replaced elsewhere along the river. Replacement in the lower reaches of the river very close to the existing site is preferred to keep pumping costs the same. Replacement of that capacity through expansion of the CDFs to the north into existing saltmarsh may be the easiest to construct, but would result in extensive secondary wetland impacts which would need to be mitigated. To avoid these extensive secondary impacts, the U.S. Fish and Wildlife Service requested that we consider taking the O&M sediments to the ODMDS, instead of putting them in the CDF. Two previous studies in Savannah Harbor compared the cost of normal dredging and deposition operations to that of ocean disposal for the same reach and sediments. Based on that information and using our most recent costs for O&M dredging, we developed the cost estimates shown in Table 32. These costs are planning-level estimates useful for sensitivity analyses and screening of scenarios.

TABLE 32
Dredging Costs: CDF vs. Ocean Disposal

Confined Disposal Facility	Annual Dredge Volume (CY)	Cost/CY	Annual Cost	Difference CDF vs. Ocean	Capitalized Cost
DA 12A					
To CDF	1,510,000	$3.87	$ 5,843,700		
To Ocean	1,510,000	$8.82	$13,318,200	$ 7,474,500	$124,263,563
DA 14A/14B					
To CDF	2,228,500	$3.87	$ 8,624,295		
To Ocean	2,228,500	$8.82	$19,655,370	$11,031,075	$183,391,622
Tybee NWR					
To CDF	619,500	$3.87	$ 2,397,465		
To Ocean	619,500	$8.82	$ 5,463,990	$ 3,066,525	$ 50,980,978

To best evaluate the information in this table, one should compare the capitalized costs for ocean placement shown in the last column with the mitigation costs (shown below from Table 30) that are expected from re-establishing sediment storage capacity near the existing CDF.

Confined Disposal Facility	Total Mitigation Costs
DA 12A	$32,900,000
DA 14A/14B	$ 7,800,000
Tybee NWR	$ 7,300,000

Conclusion: The capitalized costs of transporting O&M sediments to the ocean far exceed the costs of keeping the existing CDF functioning and replacing sediment storage capacity that would be lost if portions of those sites were taken and used for a new terminal. Therefore, the total costs for developing a new terminal at an existing CDF would be even higher if the CDF were unavailable for use and the O&M sediments were transported offshore.

MINOR MODIFICATIONS

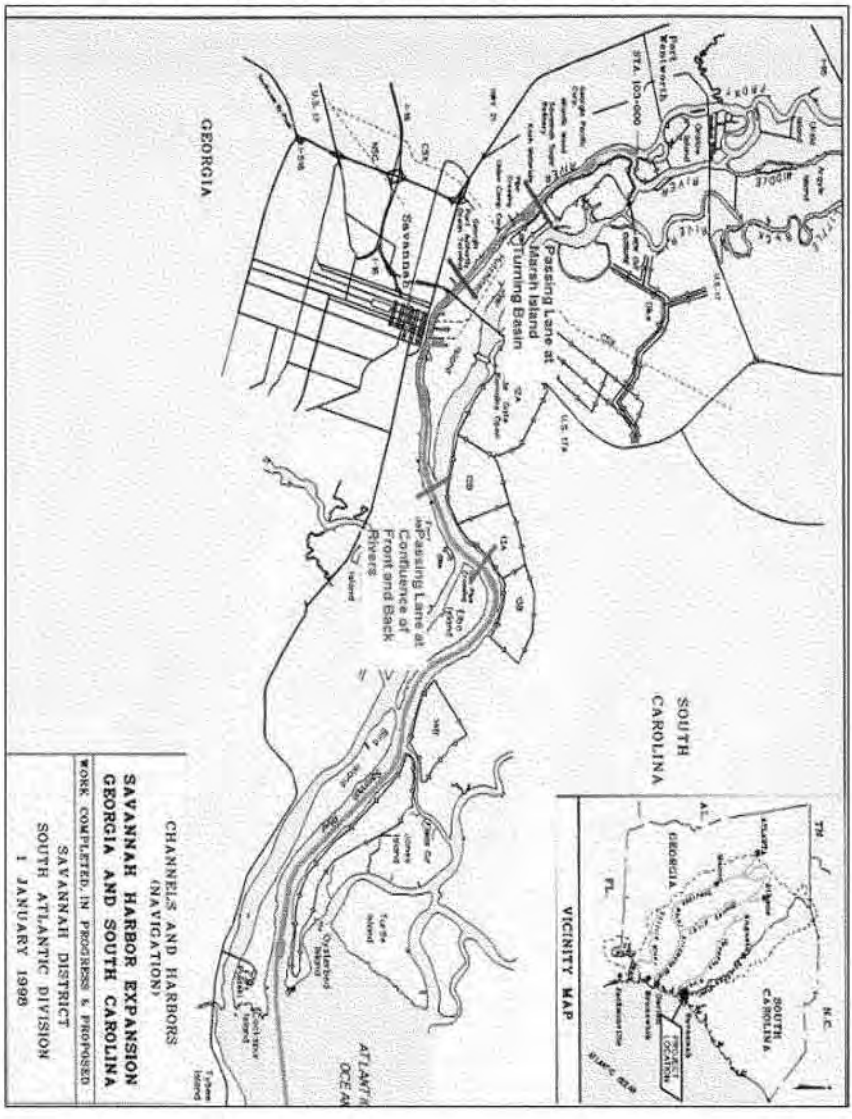
PASSING AREAS

The current design of the Savannah Harbor navigation channel (500-foot minimum width) does not provide sufficient width to accommodate two-way traffic of post-Panamax vessels at any time in the tidal cycle. With the channel design being considered in this Expansion Project, the width of the deeper channel would only be 450-feet, so the situation would become more of a problem. According to the Harbor Pilots, it is necessary to have fifty feet of clearance between the edge of the navigation channel and the container vessel and one hundred and fifty feet of clearance (the width of another post Panamax vessel) between passing vessels. Adding the width of the vessels and the required clearance shows a minimum required channel width of 514 feet (50+132+150+132+50). The addition of an appropriately sized passing area (a widening of the navigation channel to 600 feet for approximately 6,000 feet) would allow two post-Panamax vessels to pass, as well as the passing of a post-Panamax and Panamax vessel. The addition of a smaller passing area could allow passing of a post-Panamax and Panamax vessel, but would not facilitate the passing of two post-Panamax vessels in the harbor.

Design trends for the World fleet show a continued growth in the size of individual container vessels over time. The increase in the proportion of these larger vessels in the world fleet and the probability of some of these larger vessels calling on the harbor in the future suggests the need to examine a mid-harbor passing area. Future design of the harbor needs to support the fleet that is expected to call at the harbor. If it doesn't, when large ships start calling at the port on a regular basis there could be safety concerns or traffic delays.

The two potential sites suggested for placement of the proposed passing area are the Marsh Island Range which is above the Talmadge Bridge and near the Marsh Island turning basin and the Old Fort Jackson Range at the confluence of the Front and Back Rivers over the current site of the CSS Georgia. Proposed passing area sites are indicated in Figure 12. It should be noted that those markings exhibited in Figure 12; indicating proposed passing areas are not intended to suggest the width or length of the passing area, but are presented only as a general reference for potential location.

Figure 12 - Proposed Site Locations for Harbor Passing Lanes



After reviewing trends in the World Fleet and harbor requirements for maintaining the level of service, the study team decided to locate the passing area in the Old Fort Jackson Range, over the current site of the CSS Georgia. That site was selected, because siting one in the Marsh Island Range could result in impacts to the north bank of the river and require real estate acquisition.

BEND WIDENERS:

Ship Simulation studies were performed using the Design Vessel, *Susan Maersk*. This vessel is a 6,600 TEU, post-Panamax class container ship launched in 1997. It has a beam of 140 feet, a length overall 1,138 feet, and a design draft: 47.6 feet. Several bend wideners necessary to the transit of the Design Vessel were included in the design of the 48-foot channel. The Ship Simulation Report identified nine areas where bend wideners will be needed to allow safe transit of that sized vessel. Therefore, bend wideners will be included in the final channel designs that undergo detailed analyses.

AIDS TO NAVIGATION:

According to the Harbor Pilots, additional navigation aid improvements such as buoys and/or navigation markers would not be helpful given the present condition of the harbor and the current configuration of existing navigation aids. They mark the channel and where you are in it, but would not improve the efficiency of cargo movement through the harbor. Therefore this minor modification will not be included as a component of the final channel designs.

VESSEL TRAFFIC COORDINATION:

It was stated that the movement of vessels within the harbor system are coordinated by the Harbor Pilots (achieved mostly thru hand held communication and a queuing system) and as such, no further coordination or system to facilitate coordination would be helpful given current or expected conditions in the harbor. Therefore, this minor modification will not be included as a component of the final channel designs.

STRAIGHTENING OF THE RIVER:

The Harbor Pilots did not identify any portion of the channel where straightening would markedly increase the efficiency of transit. Additionally, Savannah District design staff did not identify a specific area that imposes an undue degree of difficulty in vessel handling necessitating a major straightening of the river. Therefore, this minor modification will not be included as a component of the final channel designs.

DEVELOPMENT OF DETAILED PLANS

The study team reviewed the information developed on non-structural measures (underkeel clearance and modifications to the Garden City Terminal), alternative terminal locations, offshore transshipment facility, and minor modifications passing areas, bend wideners, aids to navigation, vessel traffic coordination, and straightening of the river). Although the conclusions for those evaluations were included at the end of each separate section, they are summarized here to aid the reader in understanding the rationale for the decisions that the team reached.

Modifications to the underkeel clearances used in the harbor will not be pursued as a means of increasing vessel transit efficiency because the Harbor Pilots do not believe they could operate safely with less clearance. The guidelines used by the Pilots comply with channel design and safety criteria, so there is no need to pursue this feature further.

GPA regularly improves the facilities at the Garden City Terminal, increasing its container throughput capacity. The Ports Authority has several improvements in various stages of planning and indicates it will continue to add to the capacity of that facility as the traffic levels increase. Based on the schedule of improvements already identified and actions the Ports Authority has taken to allow it to expand the capacity of the site even further in the future, Savannah District believes that additional improvements at Garden City Terminal are not warranted as part of this project.

Based on the assessment of the alternate terminal locations, the Garden City Terminal is the most economically feasible location to which a channel deepening should be considered. Although dredging costs would be lower to most of the other sites considered, the total costs including both dredging and site development costs would be higher. All the other locations would be more costly methods of serving the expected growth in container volumes. In addition, the expected reduction in environmental impacts with the alternate locations is less than some probably envisioned, when all the effects of developing the alternate site are included.

A passing area should be included in the final plans. This feature is needed to address the effects that ships the size of the design vessel will have on traffic movements in the interior portion of Savannah Harbor. The entrance channel is wide enough to accommodate the larger vessels. When Post-panamax vessels call on Savannah regularly, they will likely have an adverse effect on the movement of other vessels transiting the harbor. That effect will be more pronounced with the effective narrowing of the proposed deeper channel. The Harbor Pilots identified the locations of two passing areas that they would like to see in place in the interior portion of the harbor. However, one of those sites is in a constructed reach of the river. Adding a passing area in that reach would result in the taking of developed land on the northern side of the river, so the team deleted further consideration of that location due to the expected high implementation costs. However, a passing area in the other location – near the junction of Front and Back Rivers – will be included as a component of the final channel designs.

Channel design criteria indicate the need to include bend wideners to accommodate the larger design vessel. This need was supported by the Ship Simulation Study. Therefore, the nine bend wideners identified as being needed for safe transit of that sized vessel in that study will be included as features of the final channel designs.

No new navigation aids were deemed to be needed to enhance the efficiency of vessel transits through the harbor. However, the detailed deign of the deeper channel will include an analysis of whether additional buoys or range makers will be needed to make the deeper channel, and whether the existing aids need to be moved to accommodate the new channel.

Neither vessel traffic coordination nor major straightening of the river were found to be needed, so they will not be included in the final channel design.

No channel modifications features were identified as being needed at this time to enhance Homeland Security. Inbound vessels are presently required to provide 96-hour advance notice, including a manifest of the cargo and crew. The Harbor Pilots already board the vessels offshore, before the vessels reach the coastline. So a separate boarding area is not considered needed. Therefore, the final channel design will not contain any features to enhance Homeland Security.

An important factor in the Tier I channel design was the concept of leaving the existing side slopes untouched as the channel is deepened. In this approach, the side slopes are continued further down toward the center of the river. The deeper channel is then narrower than the existing 500-foot navigation channel at low water. This approach was used before to minimize the taking of additional (valuable) land along the riverbank. The team agreed that this approach was valid and should be followed in the Tier II channel design. Therefore, the final Tier II channel design will include continuation of the side slopes toward the center of the river, resulting in a 16-foot narrowing of the channel with each 2-foot of depth added.

All vessels presently calling at the Garden City Terminal presently use the Kings Island Turning Basin. It is the largest turning basin in the harbor and is located at the upstream end of the Garden City Terminal. That turning basin would need to be deepened to accommodate the larger vessels using the deeper navigation channel. To safely serve vessels the size of the Design Vessel, the turning basin would also have to be expanded to 1,600 feet long by 1,600 feet wide. This expansion and deepening will be included in the final channel design.

The team agreed to continue the Project's existing advance maintenance features. An analysis would be conducted during the detailed studies to determine the effects of a deeper channel on the sedimentation in the river, but the starting point would be a continuation of the existing advance maintenance features, but at a lower elevation.

The Sediment Basin is a component of the Sediment Control Works of Savannah Harbor. The Basin is a quiescent area that collects sediments at a relatively high rate. The location of the Basin adjacent to large confined dredged sediment placement facilities allows for sediments to be removed from that location at a lower cost than elsewhere in the harbor. Although originally designed to be at a depth equal to the navigation channel, the Basin was not deepened as part of the 1993/1994 harbor deepening and it is now 4-feet shallower than the authorized navigation channel. That perched condition – being above the floor of the main river, along which many of the sediments are moved – is believed to have reduced the sediment trapping efficiency of that structure. After conducting a conceptual level assessment of the effects of further channel deepening, the team agreed to leave the Sediment Basin at its present depth and not deepen that facility as part of this project. The detailed studies will include a more in-depth analysis of the effects of a higher perched basin. Any expected increases in yearly channel maintenance costs will be included in the economic analysis of the proposed alternatives.

The Tier I design included one berth at the Garden City Terminal that would accommodate the larger vessels needing the deeper channel. For the Tier II design, the team agreed that two berths should be deepened to serve ships using the deeper channel. Those berths would be Container Berth 7 and Container Berth 8. Both are constructed (or being constructed) to accommodate a channel of greater than 48 feet of depth, so no modifications to those berths would be required for this project.

DESCRIPTION OF DETAILED PLANS

As a summary, the following alternative plans will be examined in detail.

PLAN A - NO ACTION.

In this plan, no improvements would be made to the existing Savannah Harbor Federal Navigation Project. The navigation channel would remain at its presently authorized 42-foot depth in the inner harbor and 44-foot depth in the entrance channel. This plan will serve as the basis for comparison of the expected project impacts. It will comprise the environmental and economic conditions that are expected to occur over the 50-year period of analysis. The analysis will include an identification of the type and volume of commodities that are expected to pass through Savannah Harbor if no harbor improvements are implemented. The size and number of vessels that will transport those commodities through the harbor will be identified. Expected changes in the environmental setting will also be identified.

PLAN B – CHANNEL DEEPENING

This plan will include several levels of harbor deepening so that an incremental analysis can be performed, as well as an overall determination of the justification of this proposed action. The plan will include several scales, ranging from a 44-foot to a 48-foot channel depth. The analyses will first be conducted on the following plans:

Plan B-44	A 2-foot channel deepening
Plan B-46	A 4-foot channel deepening
Plan B-48	A 6-foot channel deepening

A final interim depth will then be analyzed to allow identification of the NED plan, assuming the benefits peak before reaching the 48-foot depth. That plan will tentatively be identified as Plan B-4X.

The final channel deepening plans will have the following components:

- **Channel Length:** From the ocean to Station 103+500, plus an upstream transition.
-
- **Channel Width:** Maintain existing side slopes. The bottom width for a 48-foot channel would be 450-feet.

- **Channel Depth**: Channel depth will be looked at in 2-foot increments to 48-feet.
  Plan B-44
  Plan B-46
  Plan B-48

  Plan B-4X – One interim depth

- **Berth(s):** Container Berth 7 and Container Berth 8.

- **Turning Basins:** Deepen and enlarge Kings Island Turning Basin to 1,600-feet x 1,600-feet.

- **Bend Wideners:** Use the nine bend wideners identified in the Ship Simulation Study. Two locations have wideners on both sides of the river.

- **Advance Maintenance:** Continue the existing advance maintenance features.

ENVIRONMENTAL IMPACT STATEMENT
APPENDIX P: Fishery Habitat Maps

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

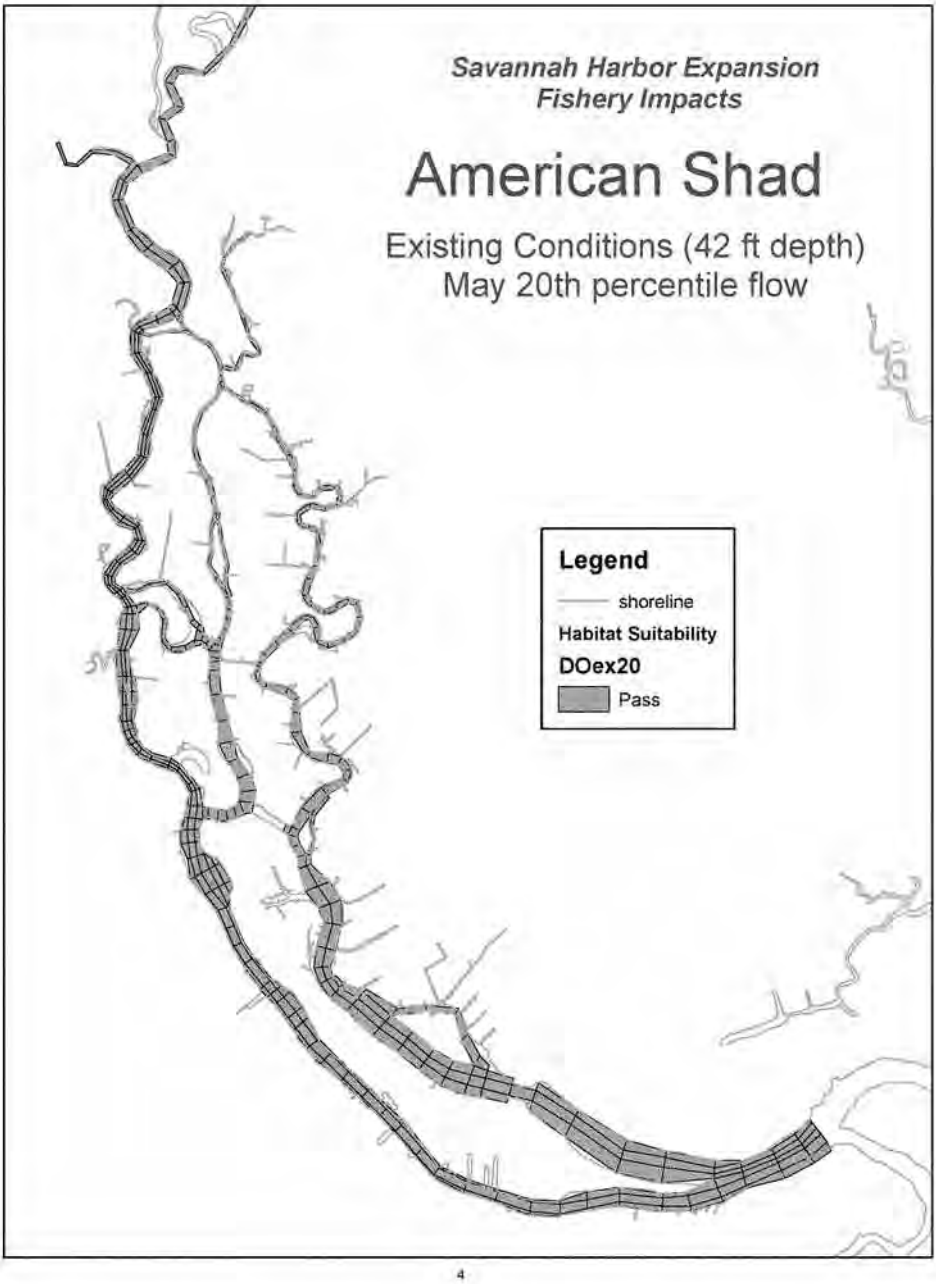
US Army Corps
of Engineers
Savannah District
South Atlantic Division

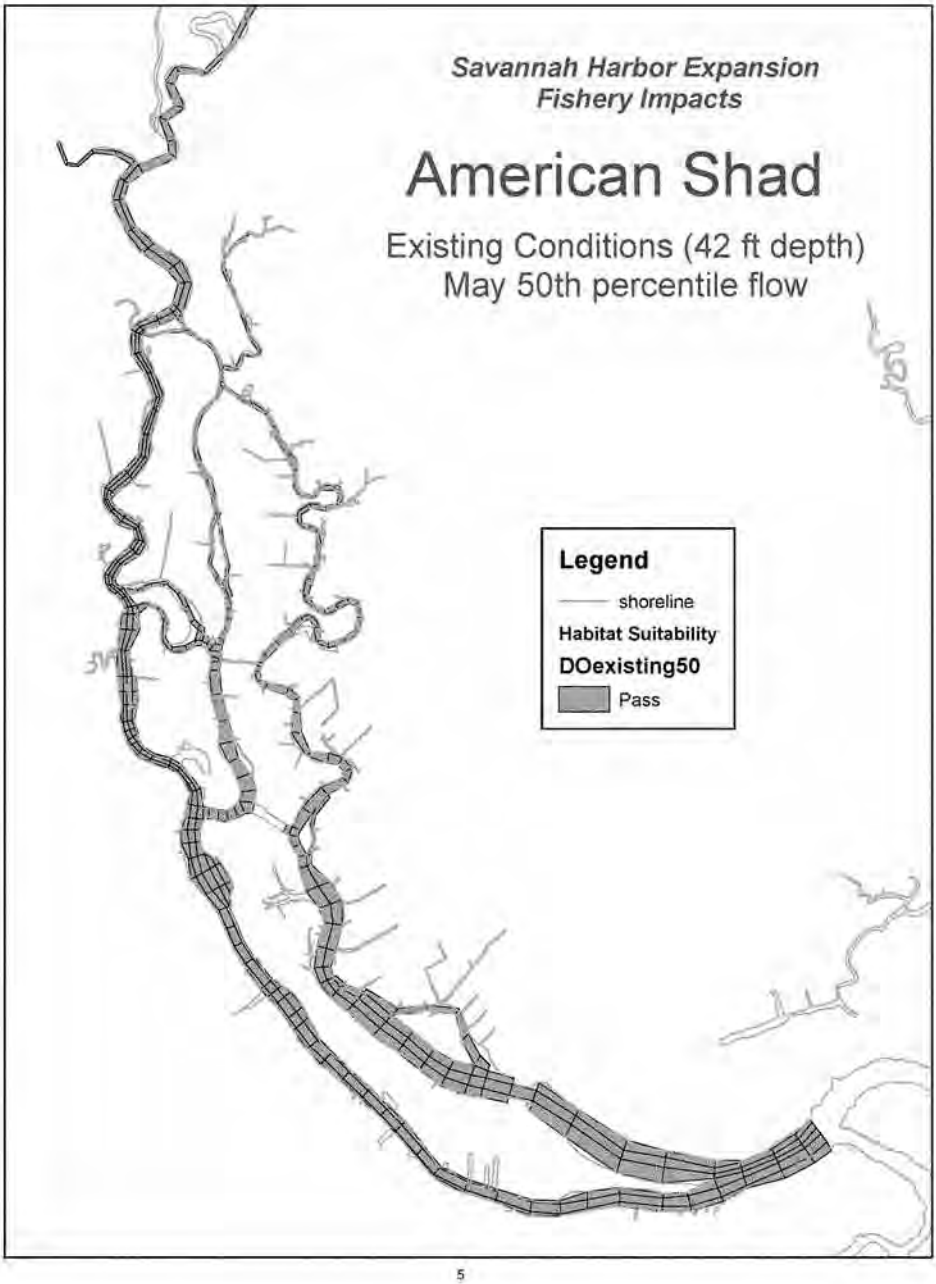
Model Input Conditions & Habitat Criteria

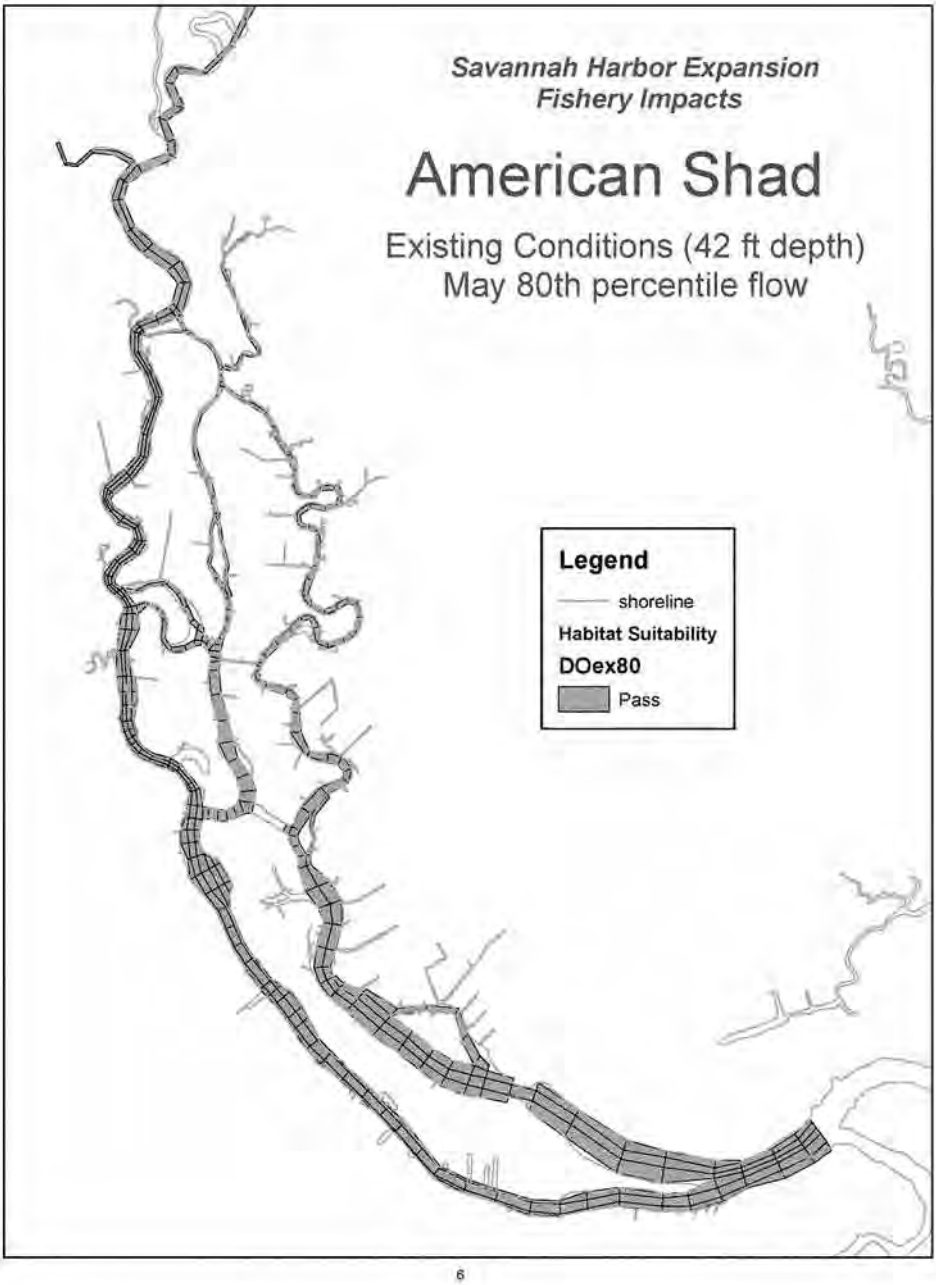
SPECIES & LIFE STAGE	FRESHWATER FLOW CONDITIONS	SIMULATION PERIOD	HABITAT CRITERIA
Striped Bass (spawning)	20%-tile of Long Term	April	Suitable habitat when (1) 90th percentile salinity <= 1 ppt, and (2) Mean velocity >= 30 cm/s
	50%-tile of Long Term	April	
	80%-tile of Long Term	April	
Striped Bass (eggs)	20%-tile of Long Term	April	Suitable habitat when (1) Mean 50th percentile salinity <= 9 ppt, (2) Mean velocity >= 30 cm/s, and (3) 10th percentile D.O. >= 4.5 mg/l
	50%-tile of Long Term	April	
	80%-tile of Long Term	April	
Striped Bass (larvae)	20%-tile of Long Term	May	Suitable habitat when (1) Mean 50th percentile salinity between 3 and 9 ppt, and (2) Mean 10th percentile D.O. >= 4.5 mg/l
	50%-tile of Long Term	May	
	80%-tile of Long Term	May	
Southern Flounder	50%-tile of Long Term	August*	Suitable habitat when DO >= 4.0 mg/l at 90% exceedance (10th %ile)
American Shad	50%-tile of Long Term	January	Suitable habitat when D.O. >= 4.0 mg/l at 90% exceedance (10th percentile)
	50%-tile of Long Term	May	
	50%-tile of Long Term	August*	
Shortnose Sturgeon (adult)	50%-tile of Long Term	January	Suitable habitat when DO >= 3.5 mg/l at 90% exceedance (10th %ile), >=3.0 at 95% (5th percentile), and >=2.0 at 99% (1 percentile) Suitable habitat when Max Salinity <= 25 ppt
Shortnose Sturgeon (adult)	50%-tile of Long Term	August*	Suitable habitat when DO >= 4.0 mg/l at 90% exceedance (10th %ile), >=3.0 at 95% (5th percentile), and >=2.0 at 99% (1 percentile) Suitable habitat when Max Salinity <= 10 ppt
Shortnose Sturgeon (juvenile)	50%-tile of Long Term	January	Suitable habitat when DO >= 3.5 mg/l at 90% exceedance (10th %ile), >=3.0 at 95% (5th percentile), and >=2.0 at 99% (1 percentile) Suitable habitat when Max Salinity <= 4 ppt

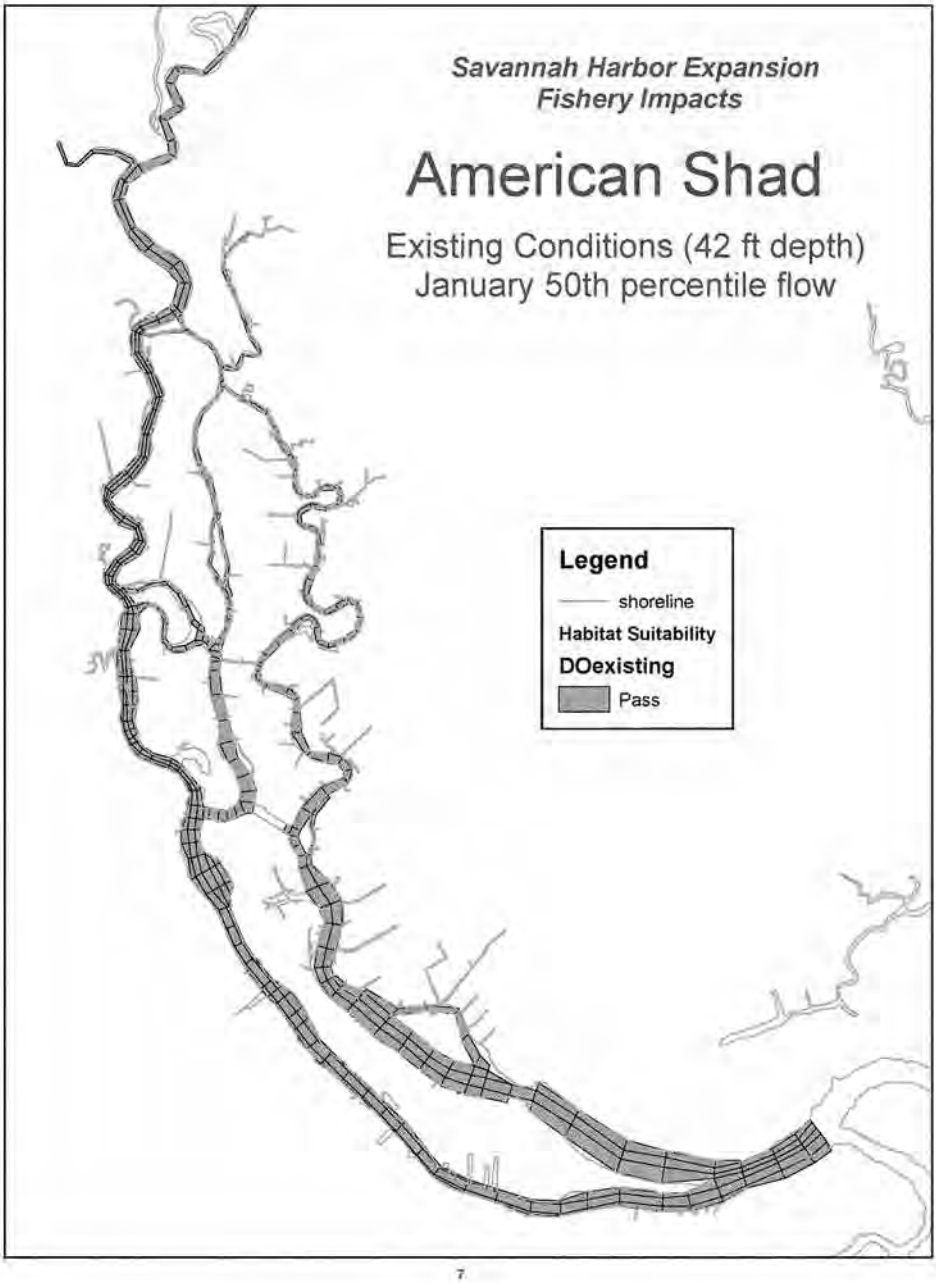
Existing Conditions

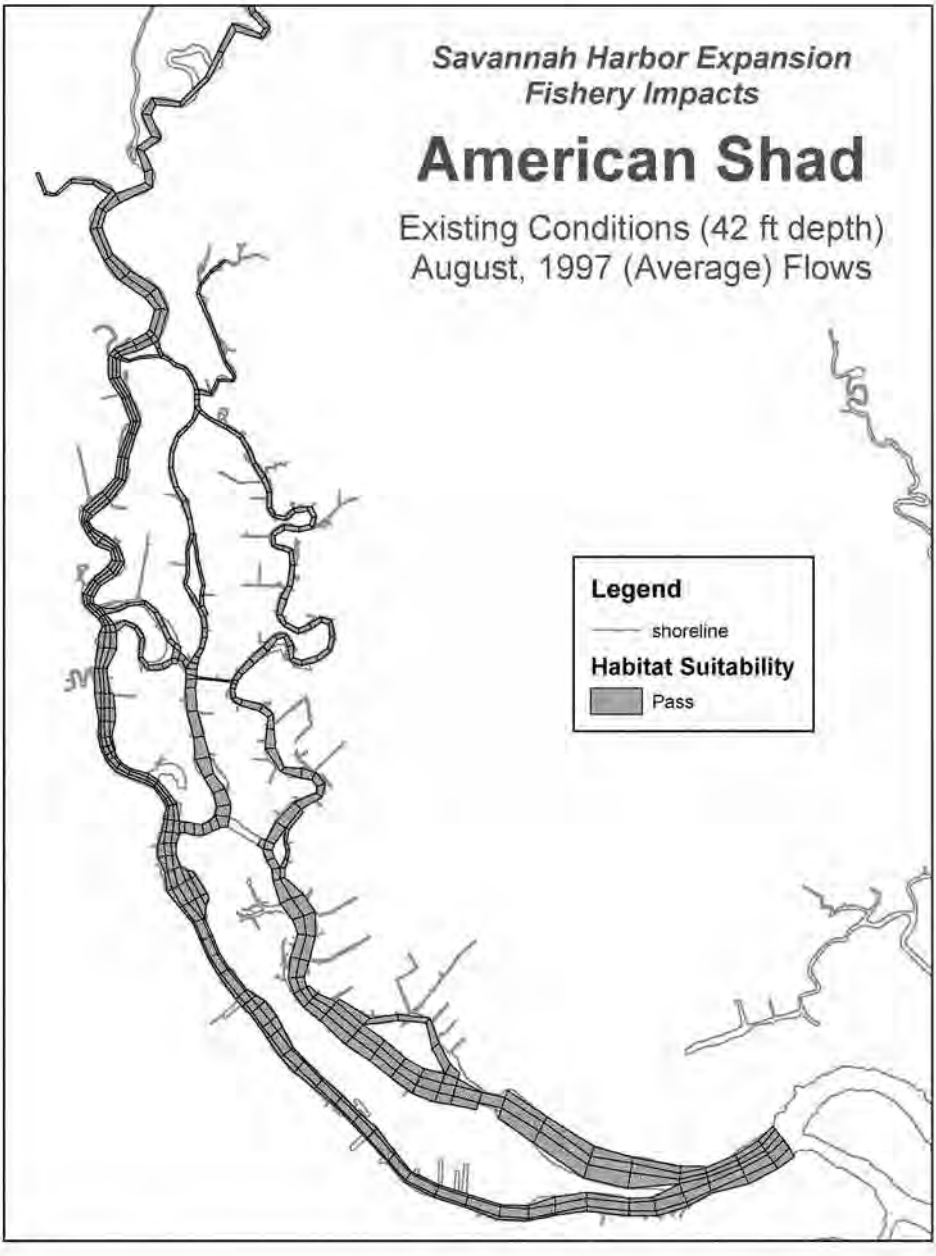
No Deepening No Mitigation

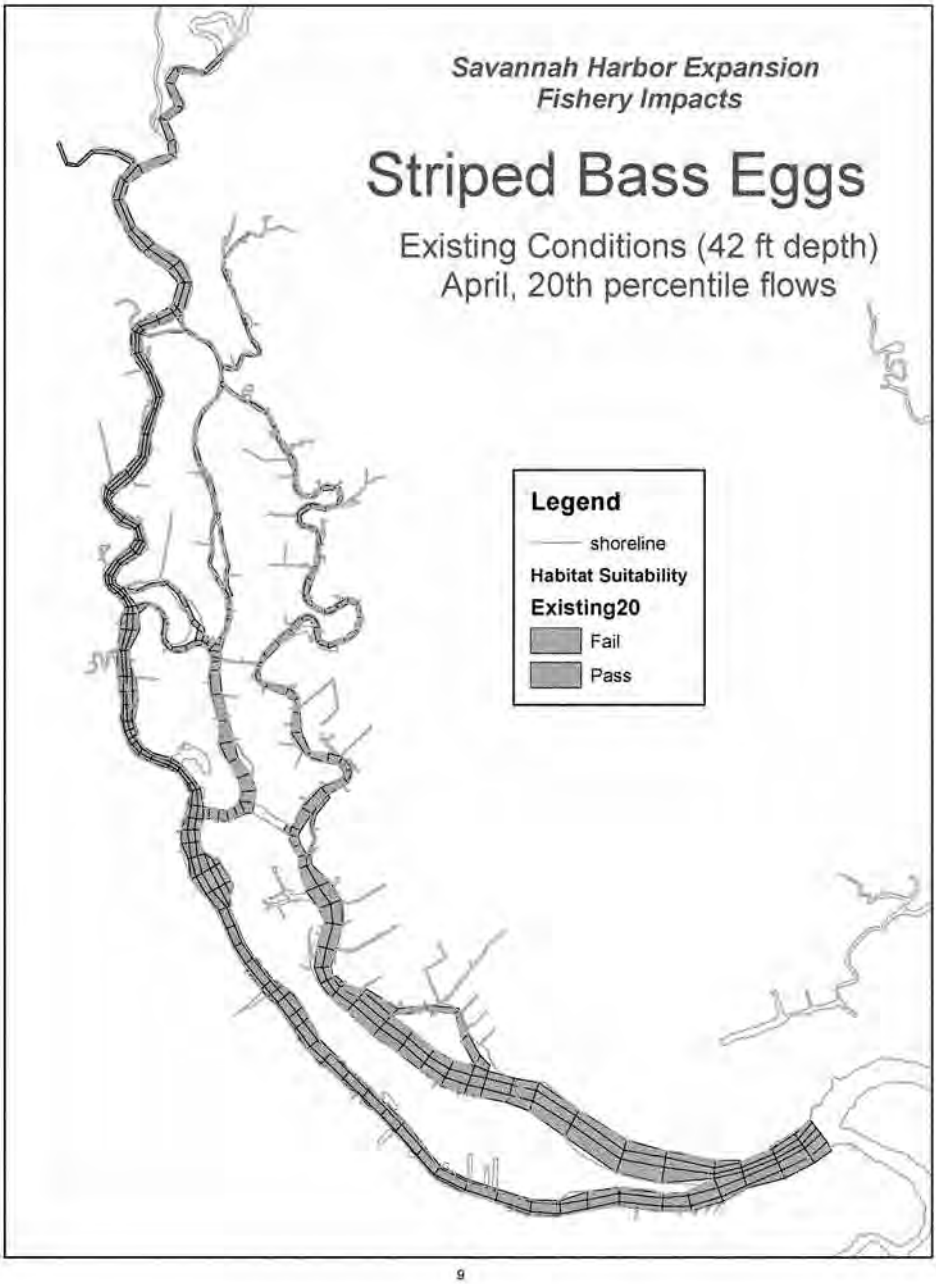

Savannah Harbor Expansion
Fishery Impacts
American Shad
Existing Conditions (42 ft depth)
May 20th percentile flow
Legend
shoreline
Habitat Suitability
DOex20
Pass

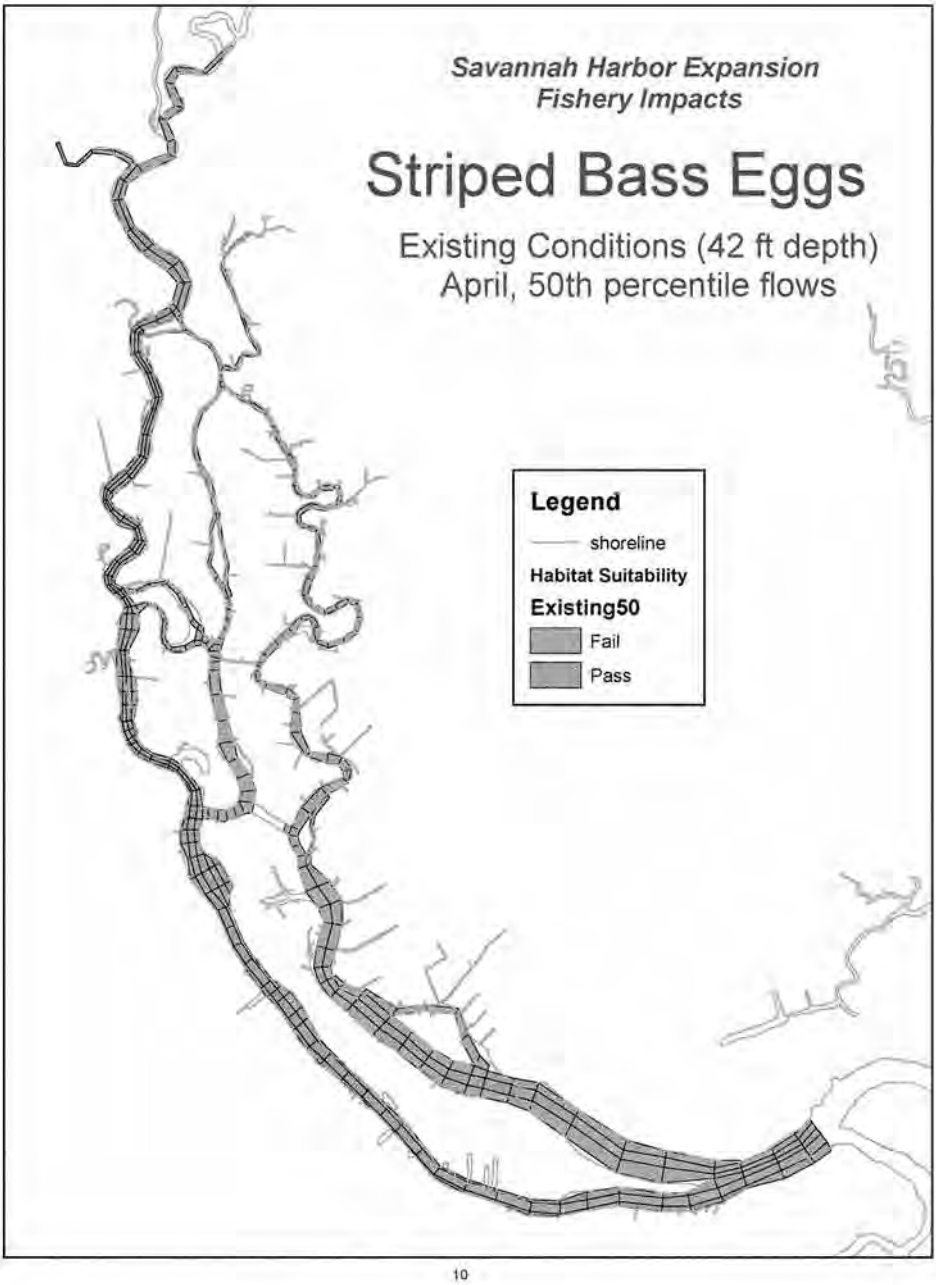

Savannah Harbor Expansion
Fishery Impacts
American Shad
Existing Conditions (42 ft depth)
May 50th percentile flow
Legend
shoreline
Habitat Suitability
DOexisting50
Pass

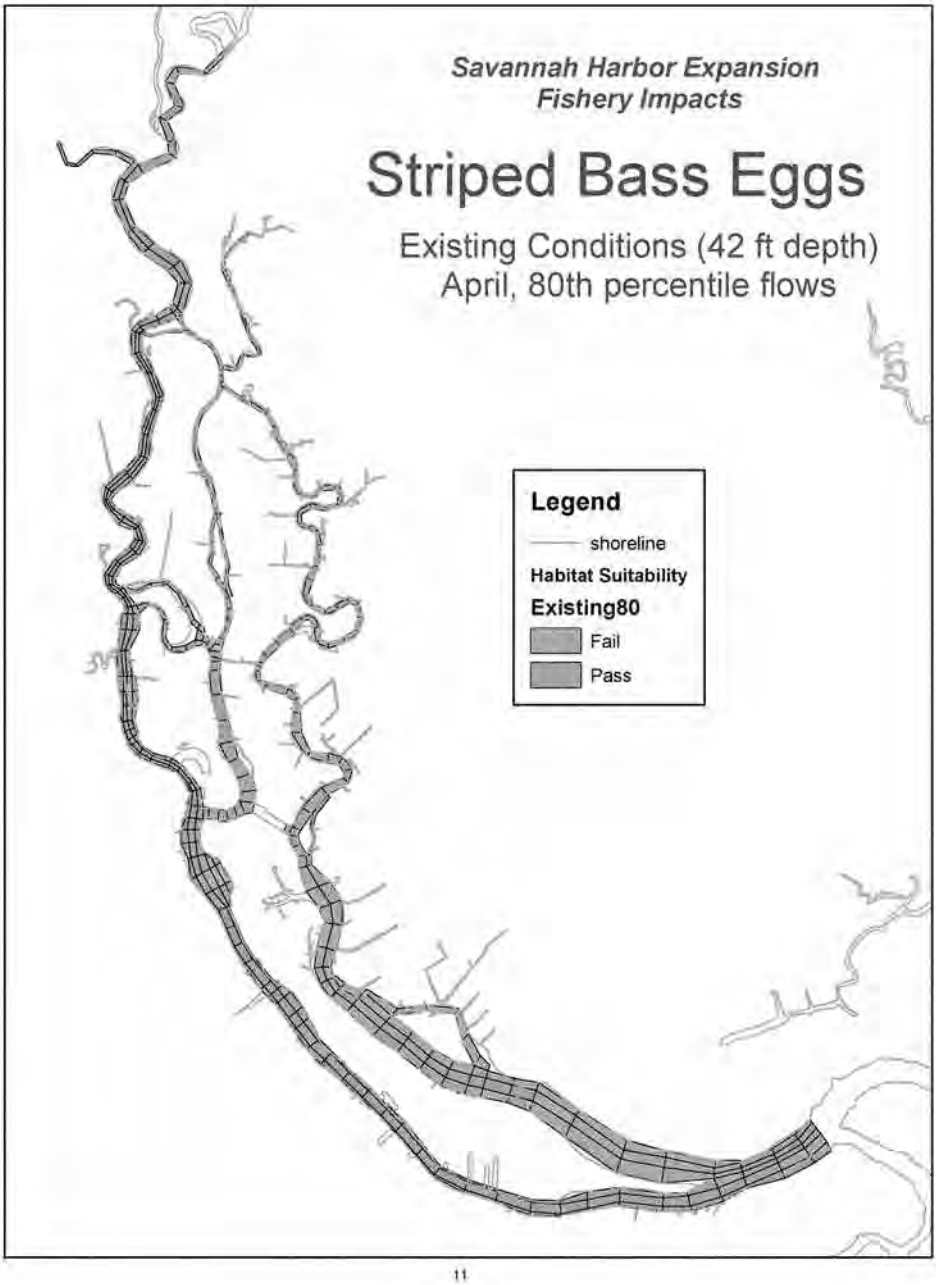

Savannah Harbor Expansion
Fishery Impacts
American Shad
Existing Conditions (42 ft depth)
May 80th percentile flow
Legend
shoreline
Habitat Suitability
DOex80
Pass

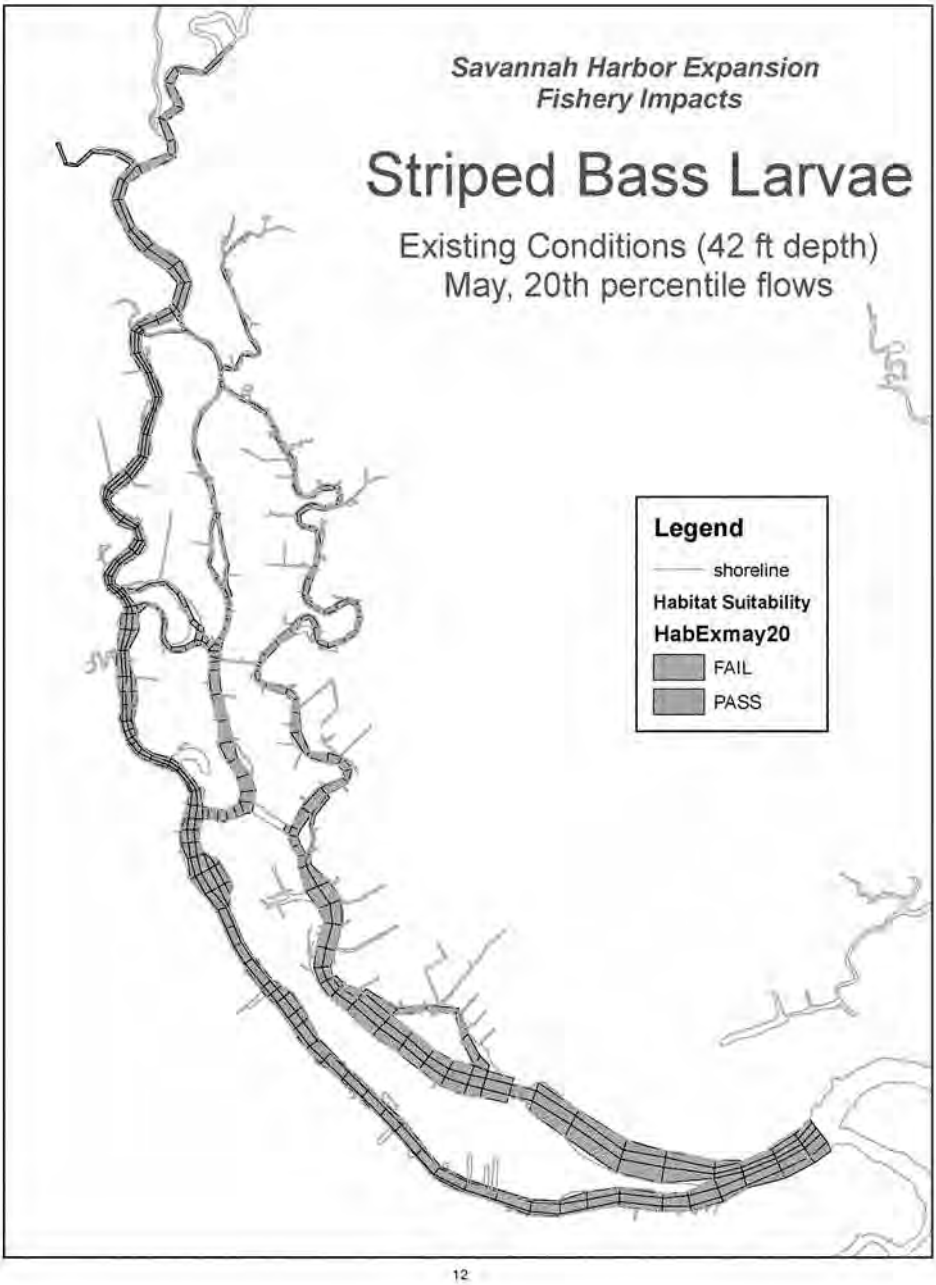

Savannah Harbor Expansion
Fishery Impacts
American Shad
Existing Conditions (42 ft depth)
January 50th percentile flow
Legend
shoreline
Habitat Suitability
DOexisting
Pass

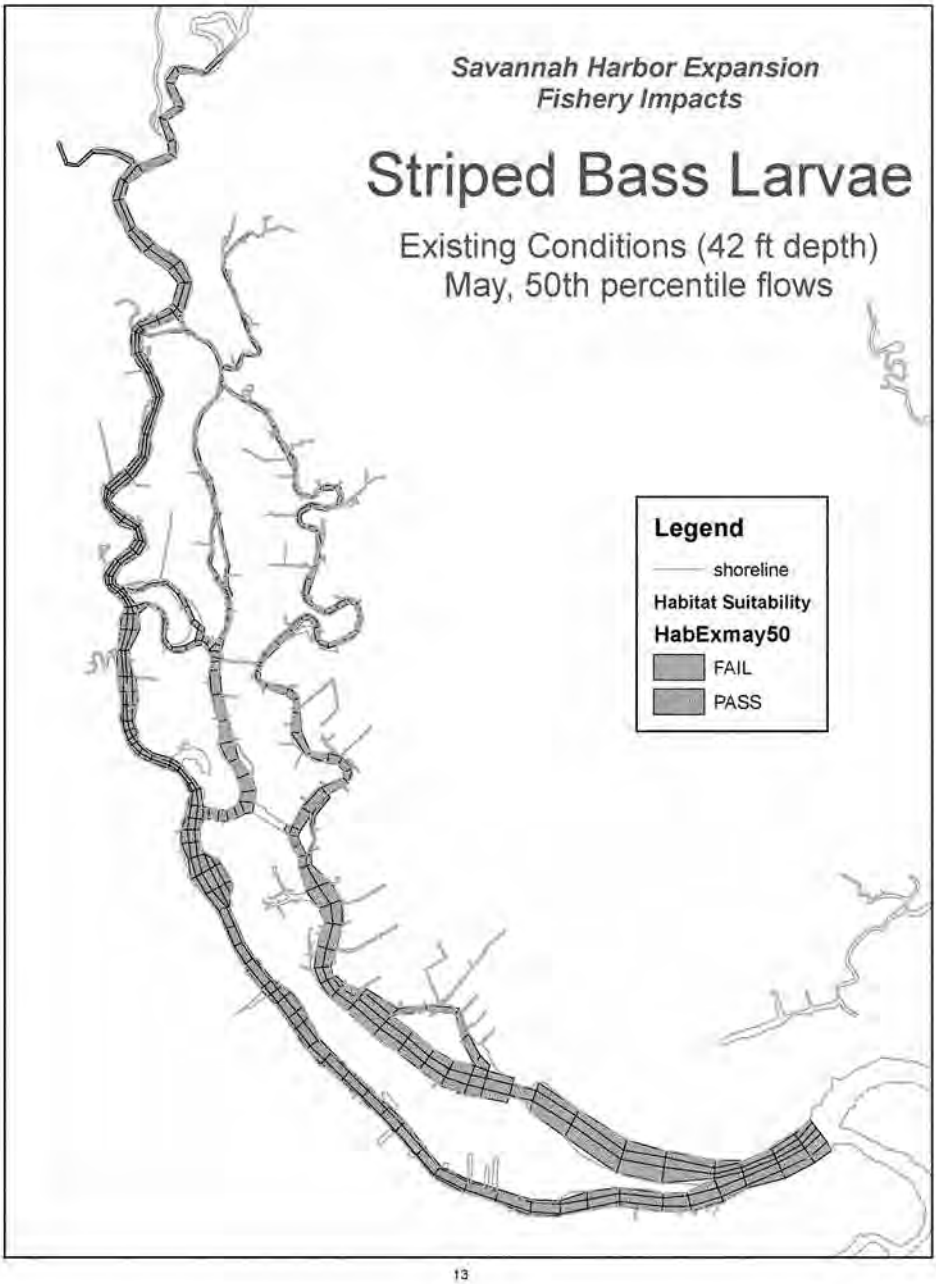

Savannah Harbor Expansion
Fishery Impacts
American Shad
Existing Conditions (42 ft depth)
August, 1997 (Average) Flows
Legend
shoreline
Habitat Suitability
Pass

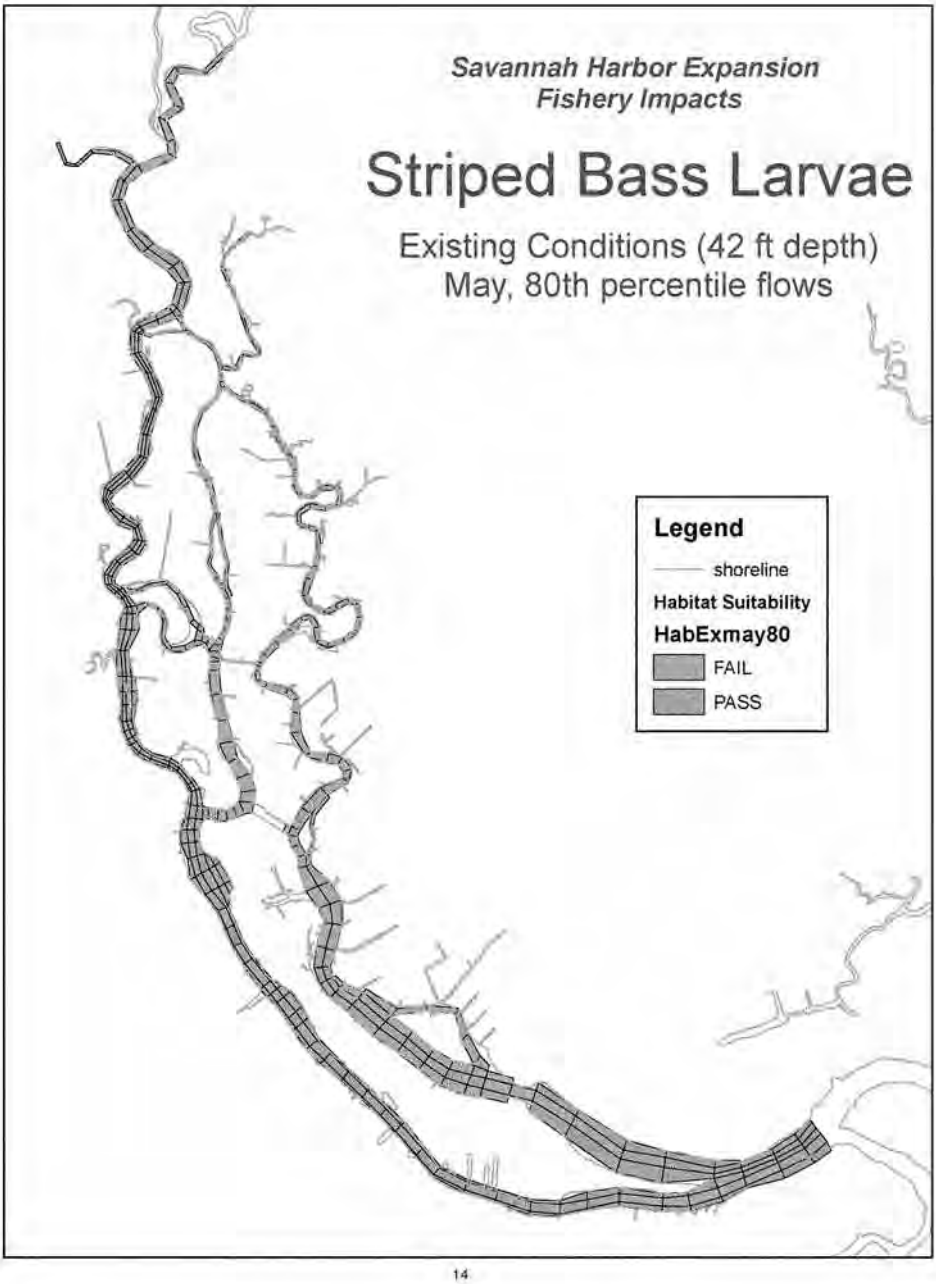

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
Existing Conditions (42 ft depth)
April, 20th percentile flows
Legend
shoreline
Habitat Suitability
Existing20
Fail
Pass

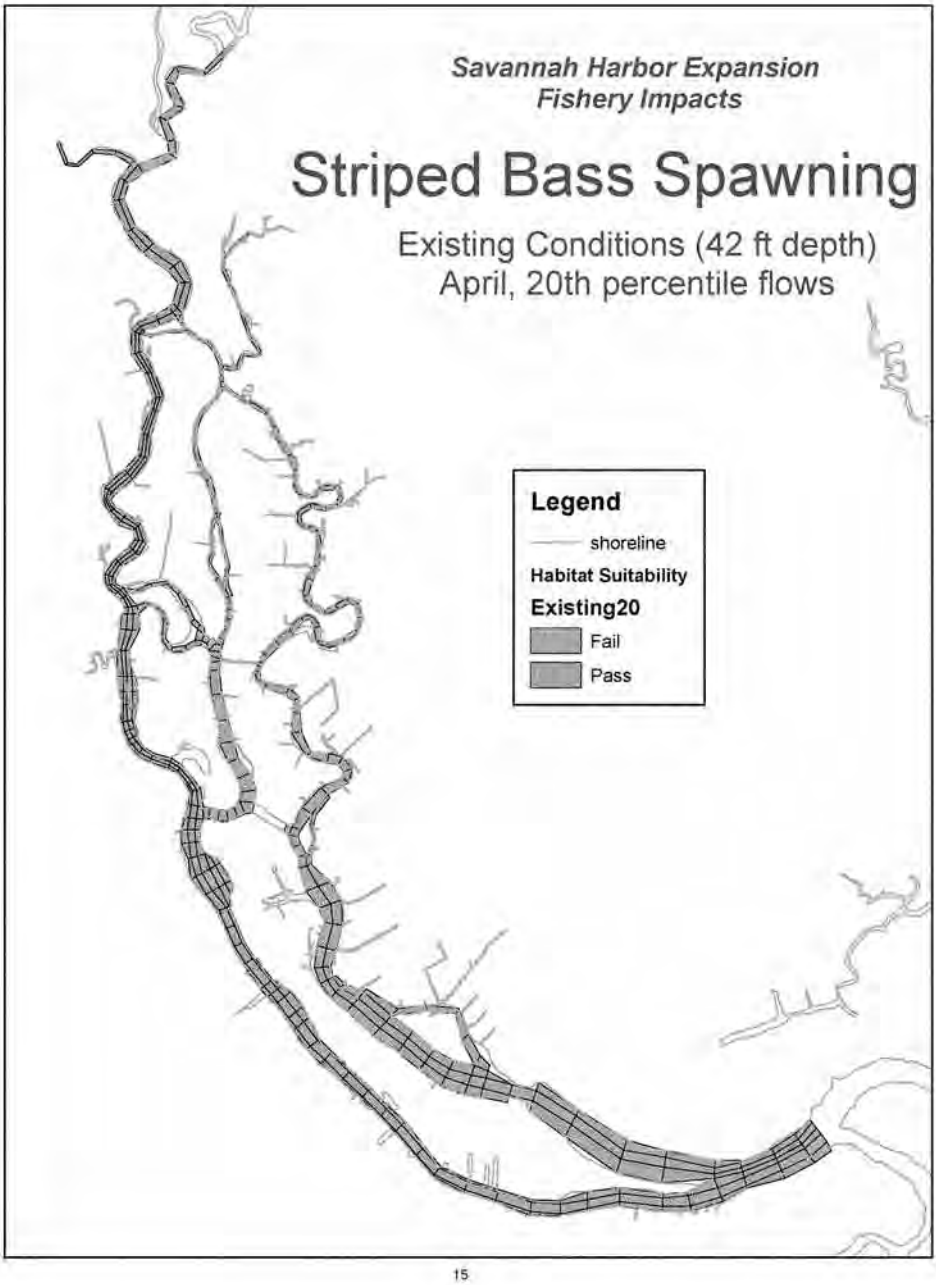

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
Existing Conditions (42 ft depth)
April, 50th percentile flows
Legend
shoreline
Habitat Suitability
Existing50
Fail
Pass

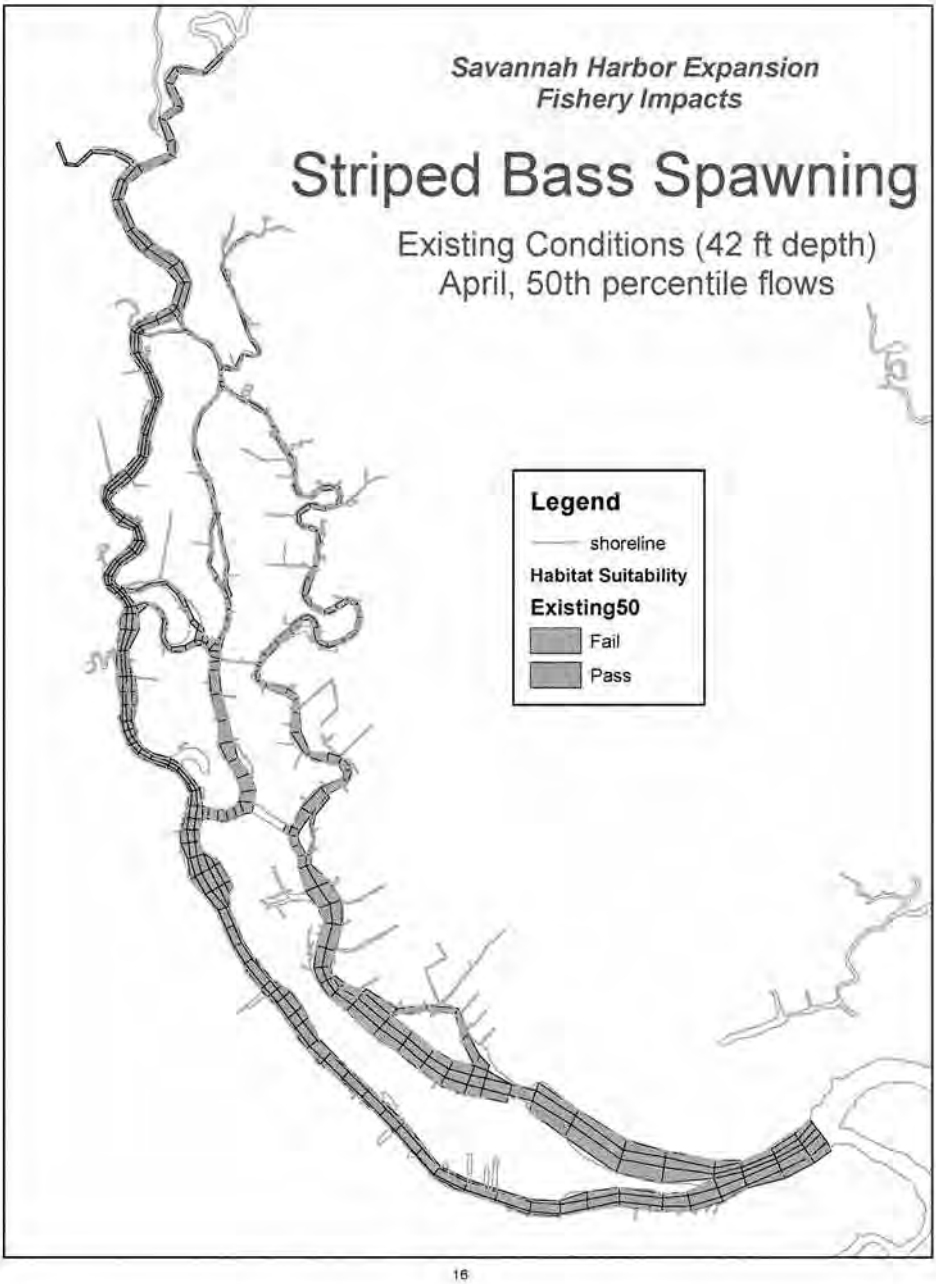

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
Existing Conditions (42 ft depth)
April, 80th percentile flows
Legend
shoreline
Habitat Suitability
Existing80
Fail
Pass


Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
Existing Conditions (42 ft depth)
May, 20th percentile flows
Legend
shoreline
Habitat Suitability
HabExmay20
FAIL
PASS

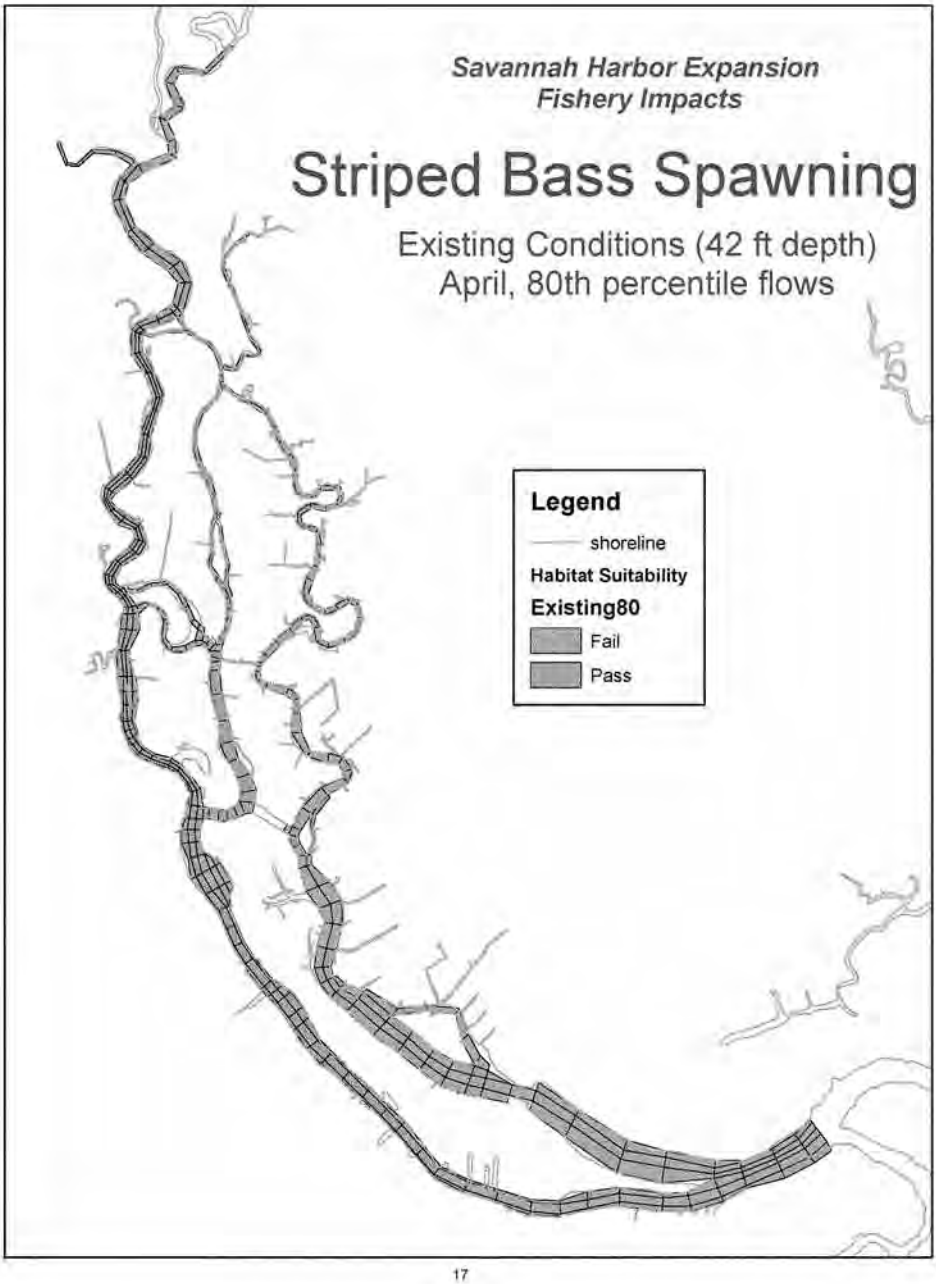

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
Existing Conditions (42 ft depth)
May, 50th percentile flows
Legend
shoreline
Habitat Suitability
HabExmay50
FAIL
PASS

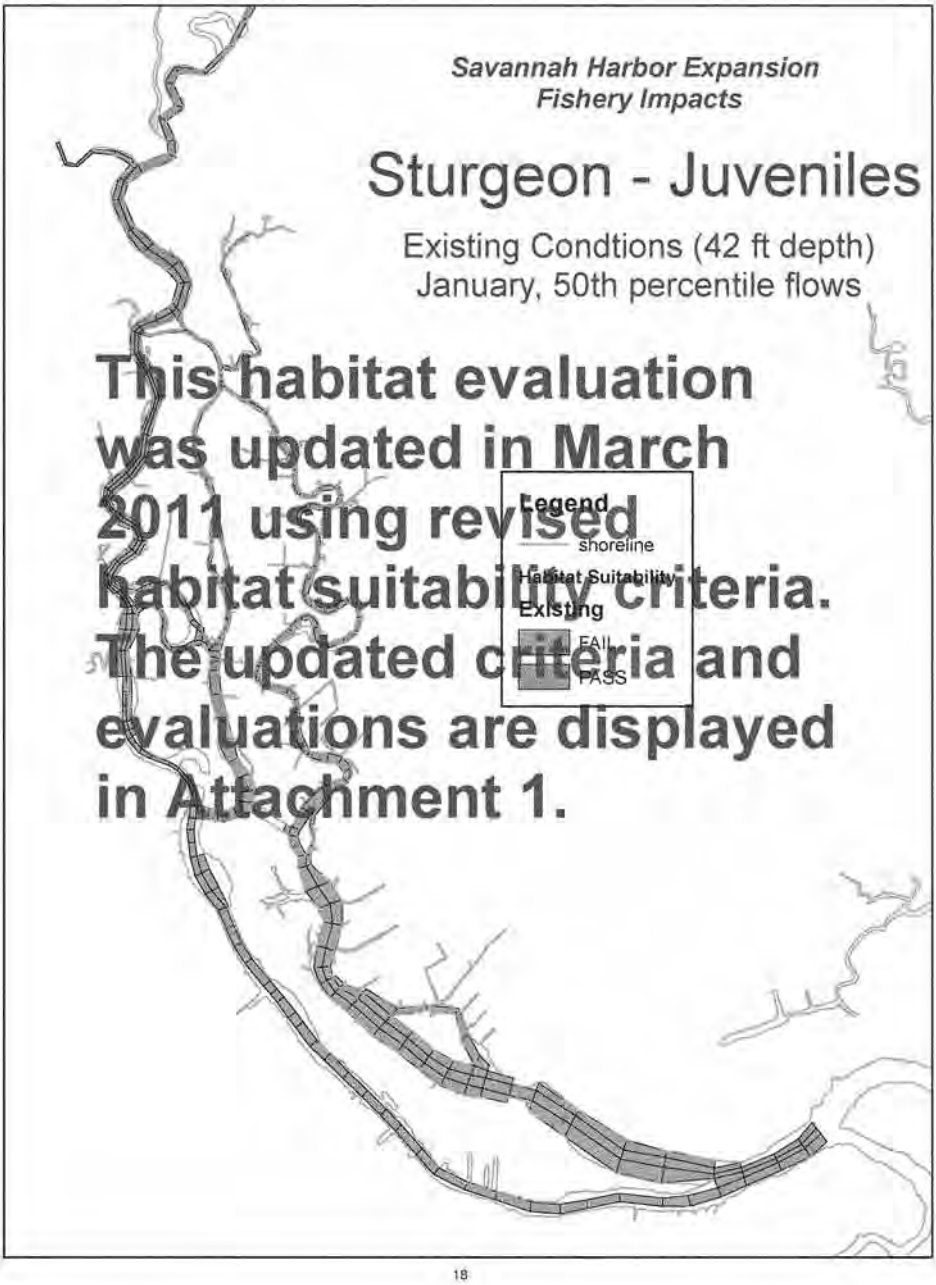

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
Existing Conditions (42 ft depth)
May, 80th percentile flows
Legend
shoreline
Habitat Suitability
HabExmay80
FAIL
PASS

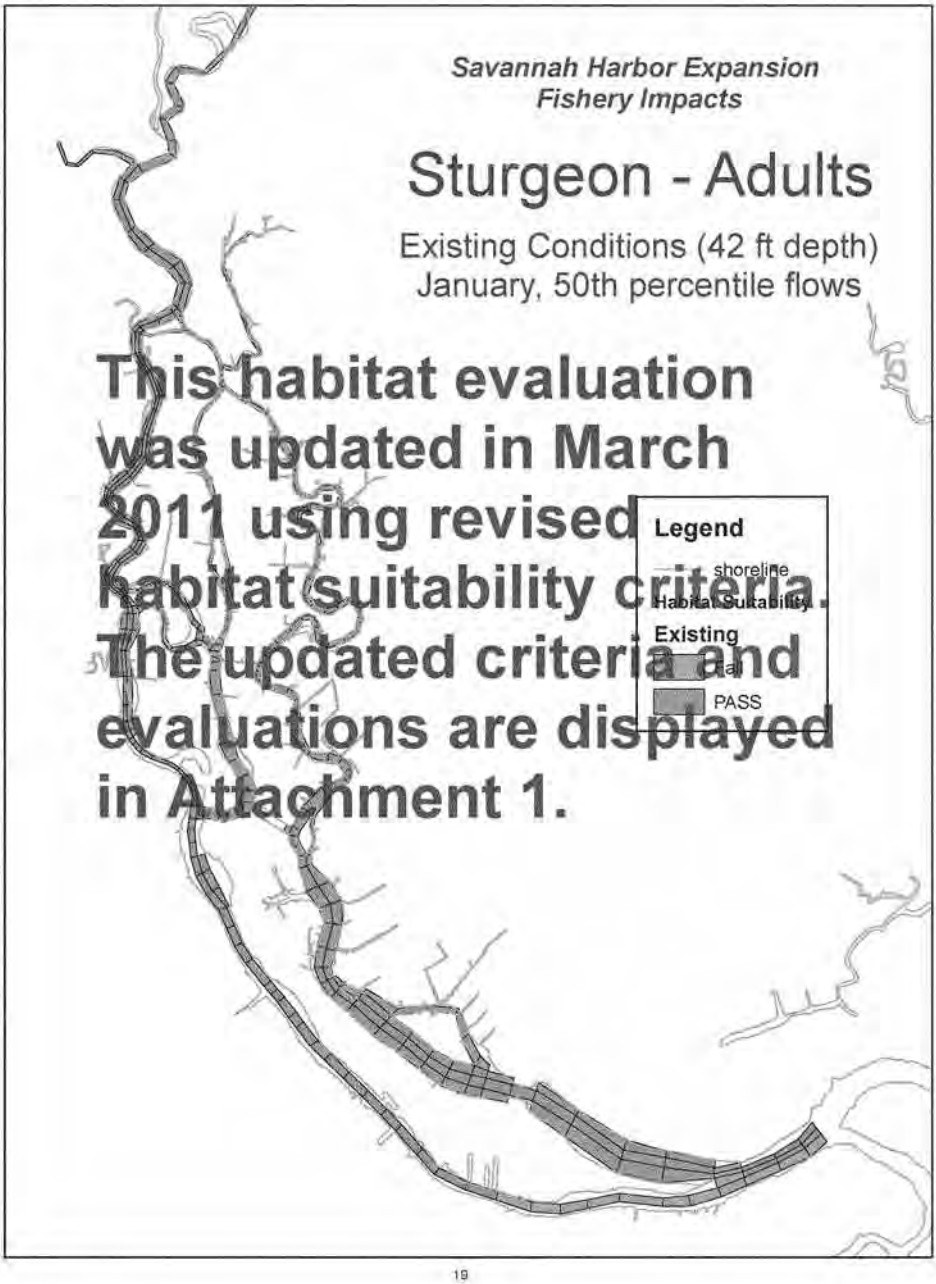

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
Existing Conditions (42 ft depth)
April, 20th percentile flows
Legend
shoreline
Habitat Suitability
Existing20
Fail
Pass

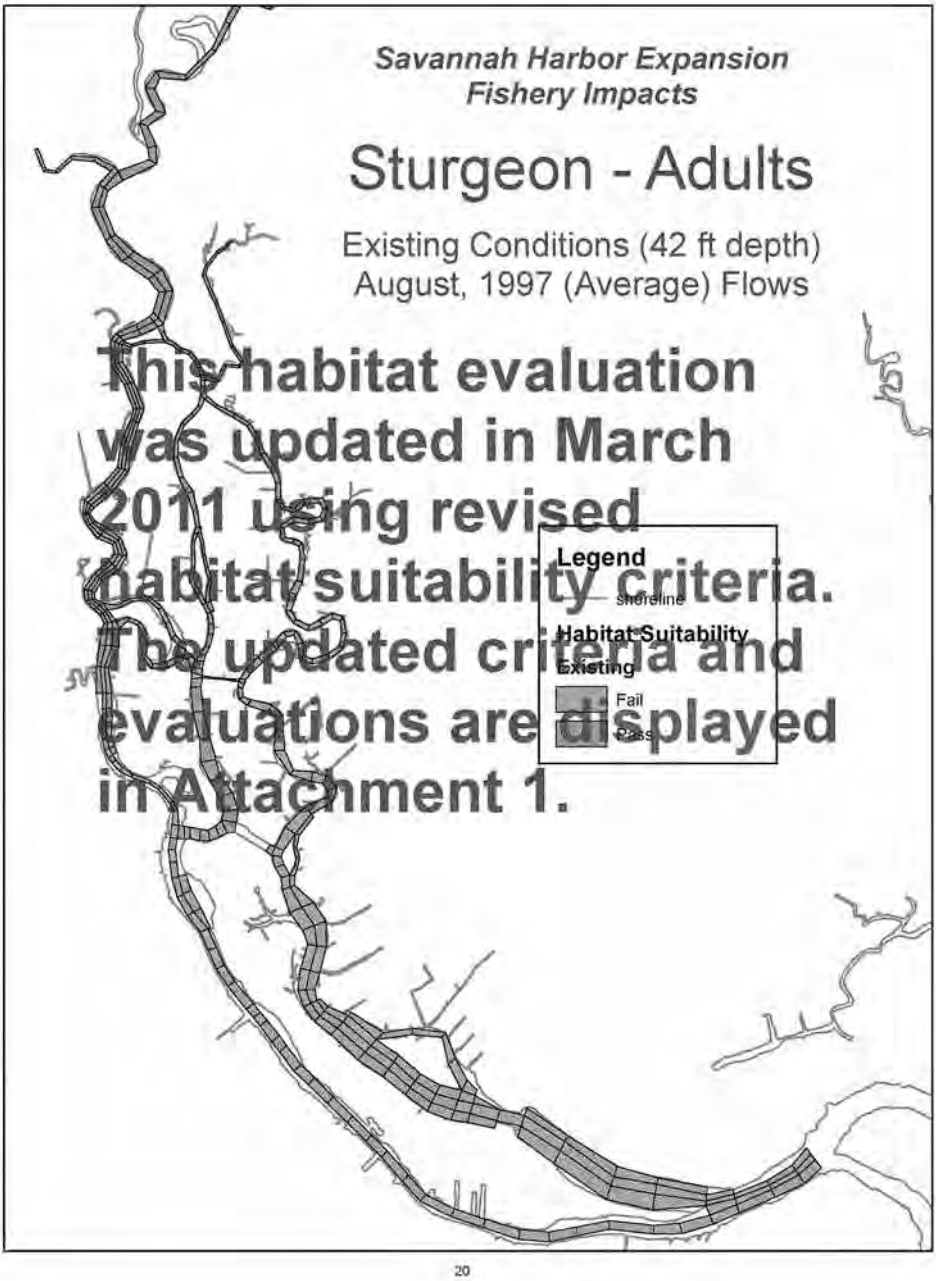

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
Existing Conditions (42 ft depth)
April, 50th percentile flows
Legend
shoreline
Habitat Suitability
Existing50
Fail
Pass

16

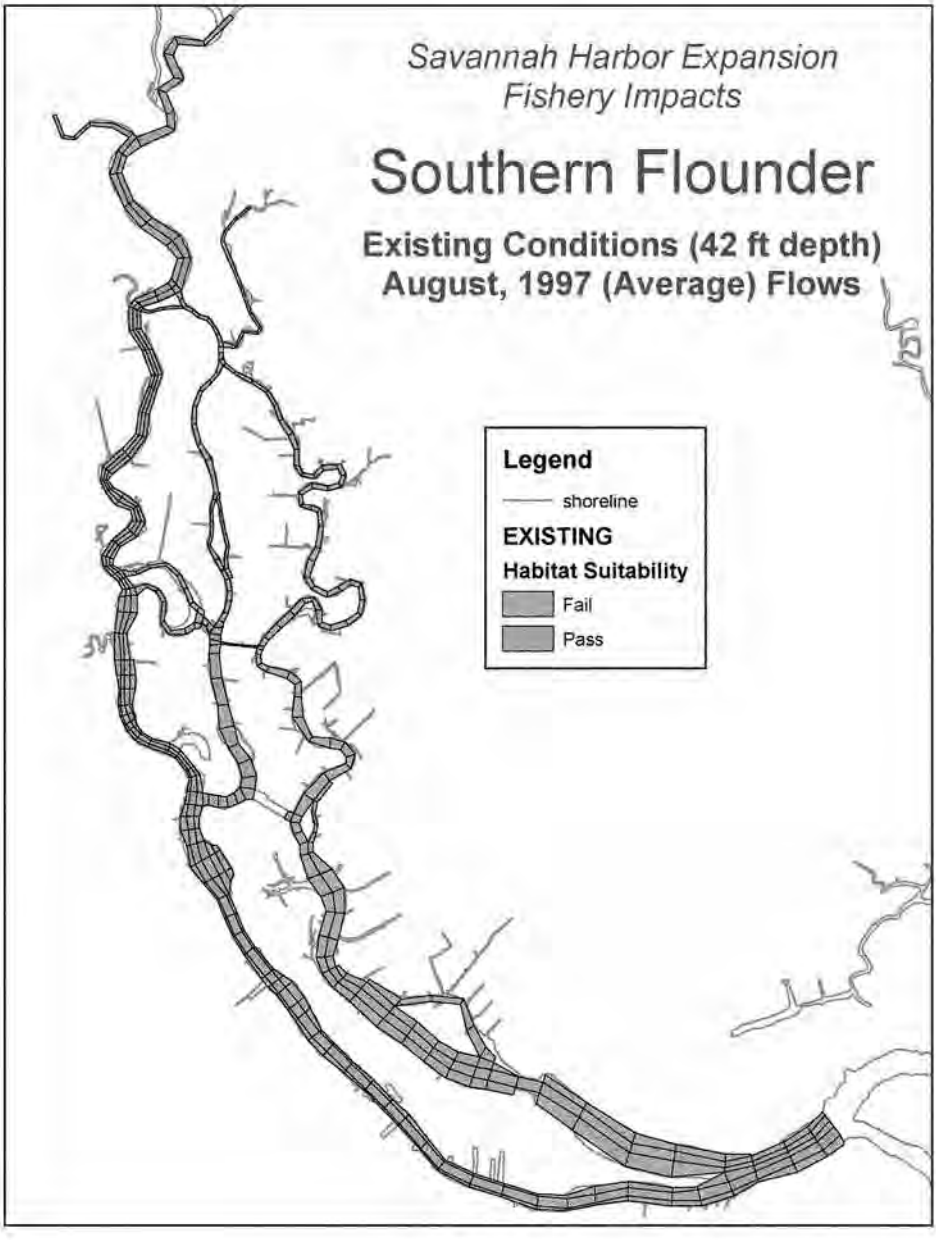

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
Existing Conditions (42 ft depth)
April, 80th percentile flows
Legend
shoreline
Habitat Suitability
Existing80
Fail
Pass


Savannah Harbor Expansion
Fishery Impacts
Sturgeon - Juveniles
Existing Condtions (42 ft depth)
January, 50th percentile flows
Legend
shoreline
Habitat Suitability
Existing
FAIL
PASS
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.
18


Savannah Harbor Expansion
Fishery Impacts
Sturgeon - Adults
Existing Conditions (42 ft depth)
January, 50th percentile flows
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.
Legend
shoreline
Habitat Suitability
Existing
PASS

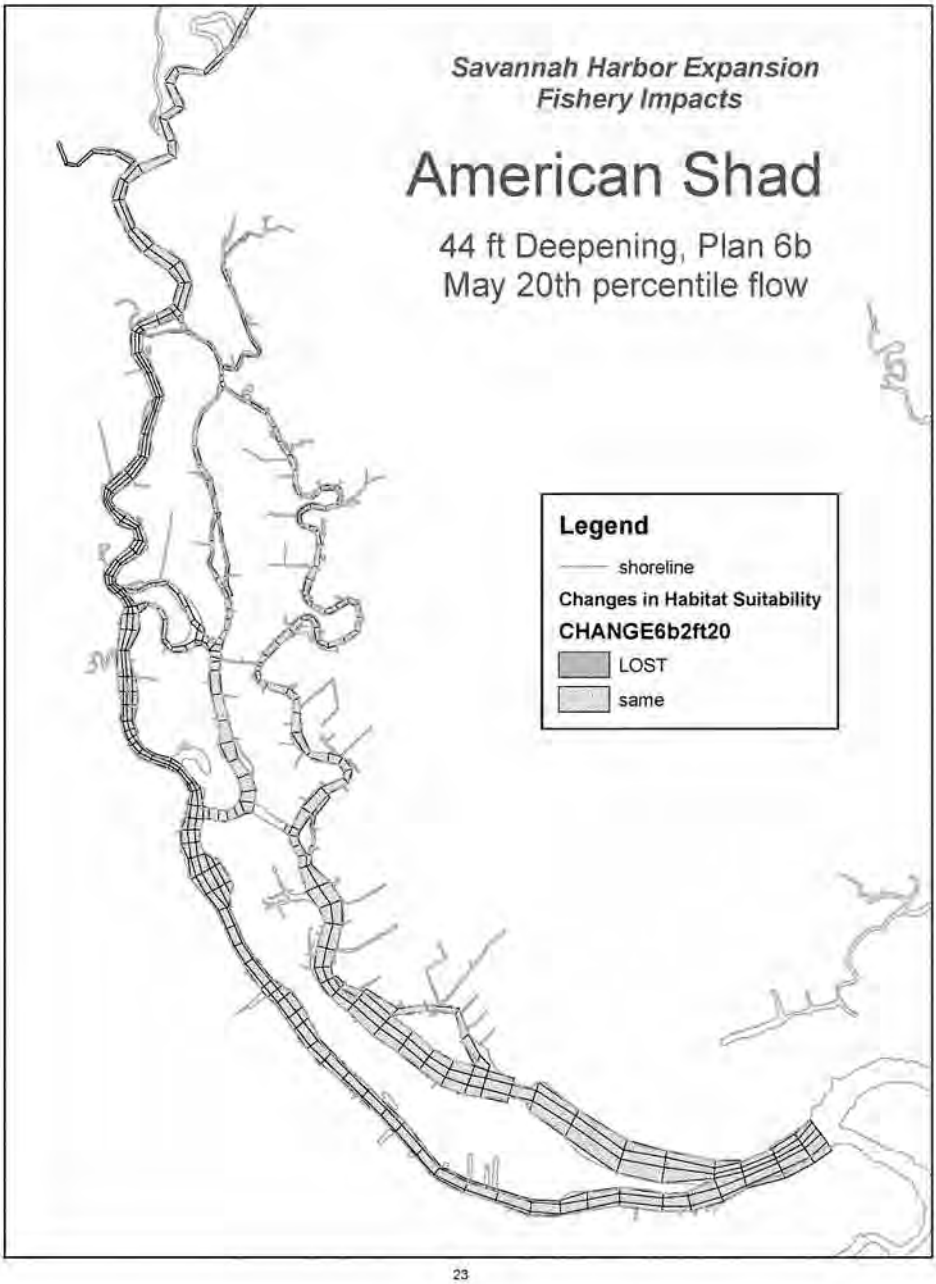


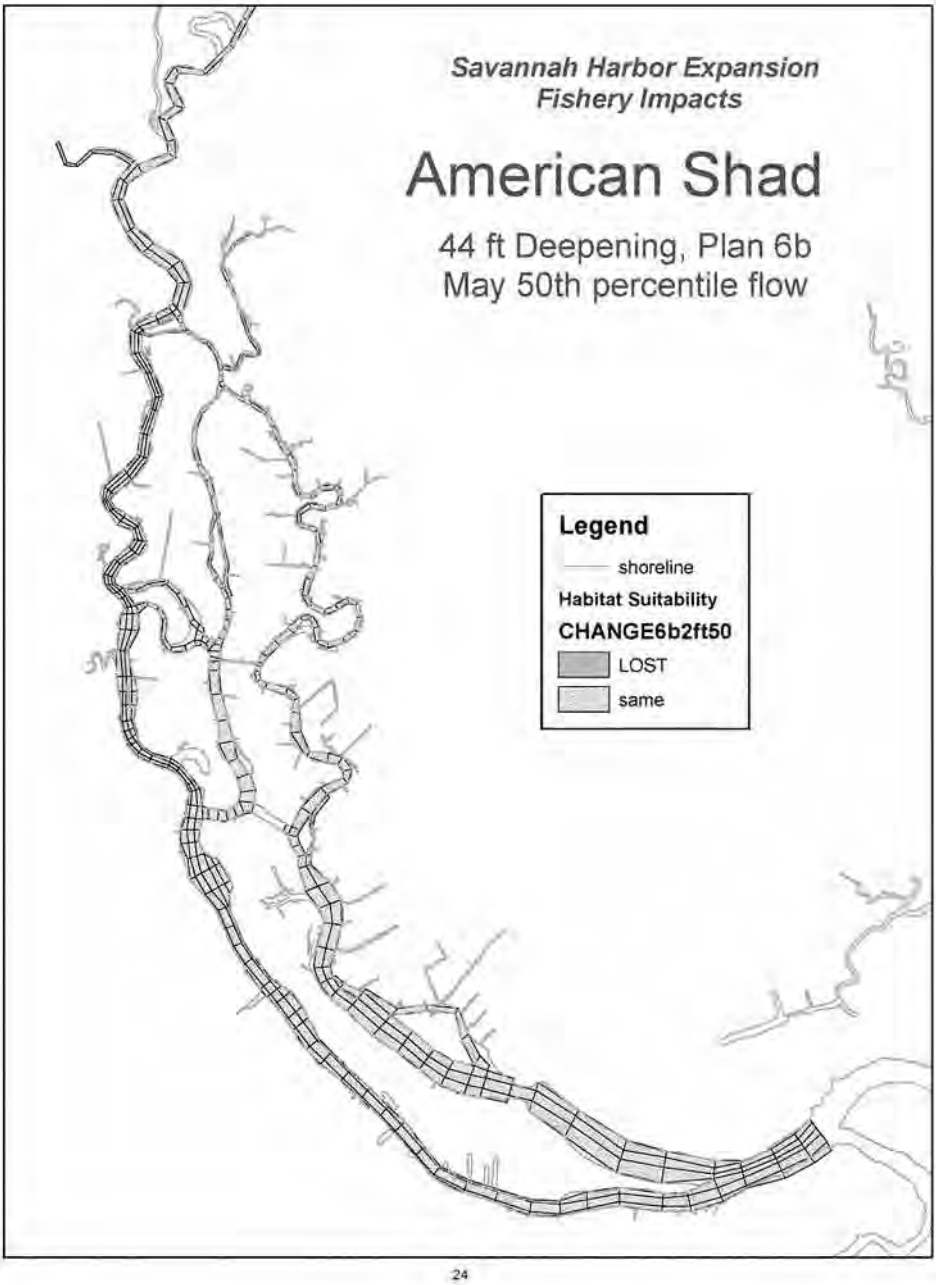
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.

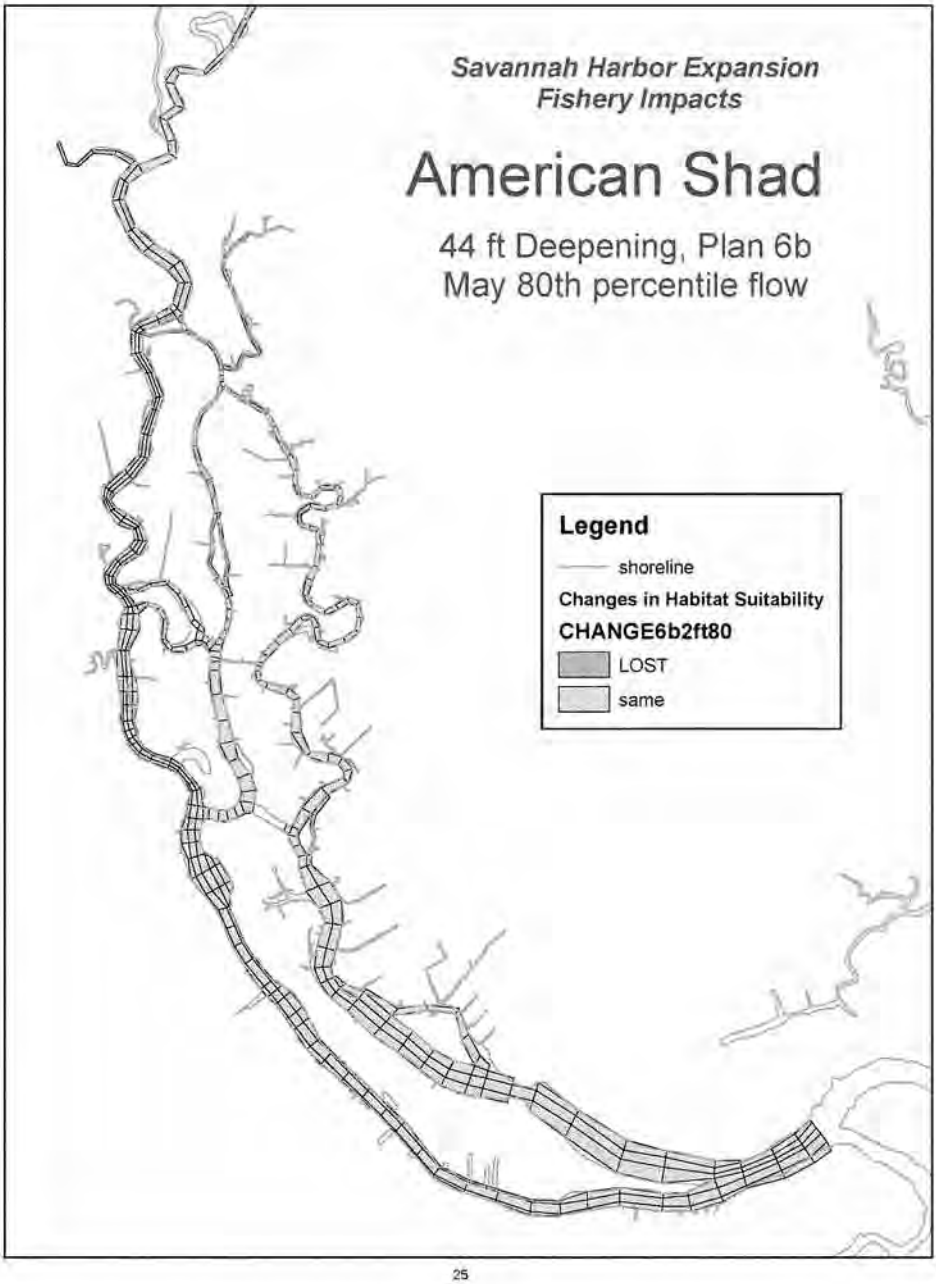

Savannah Harbor Expansion
Fishery Impacts
Southern Flounder
Existing Conditions (42 ft depth)
August, 1997 (Average) Flows
Legend
shoreline
EXISTING
Habitat Suitability
Fail
Pass

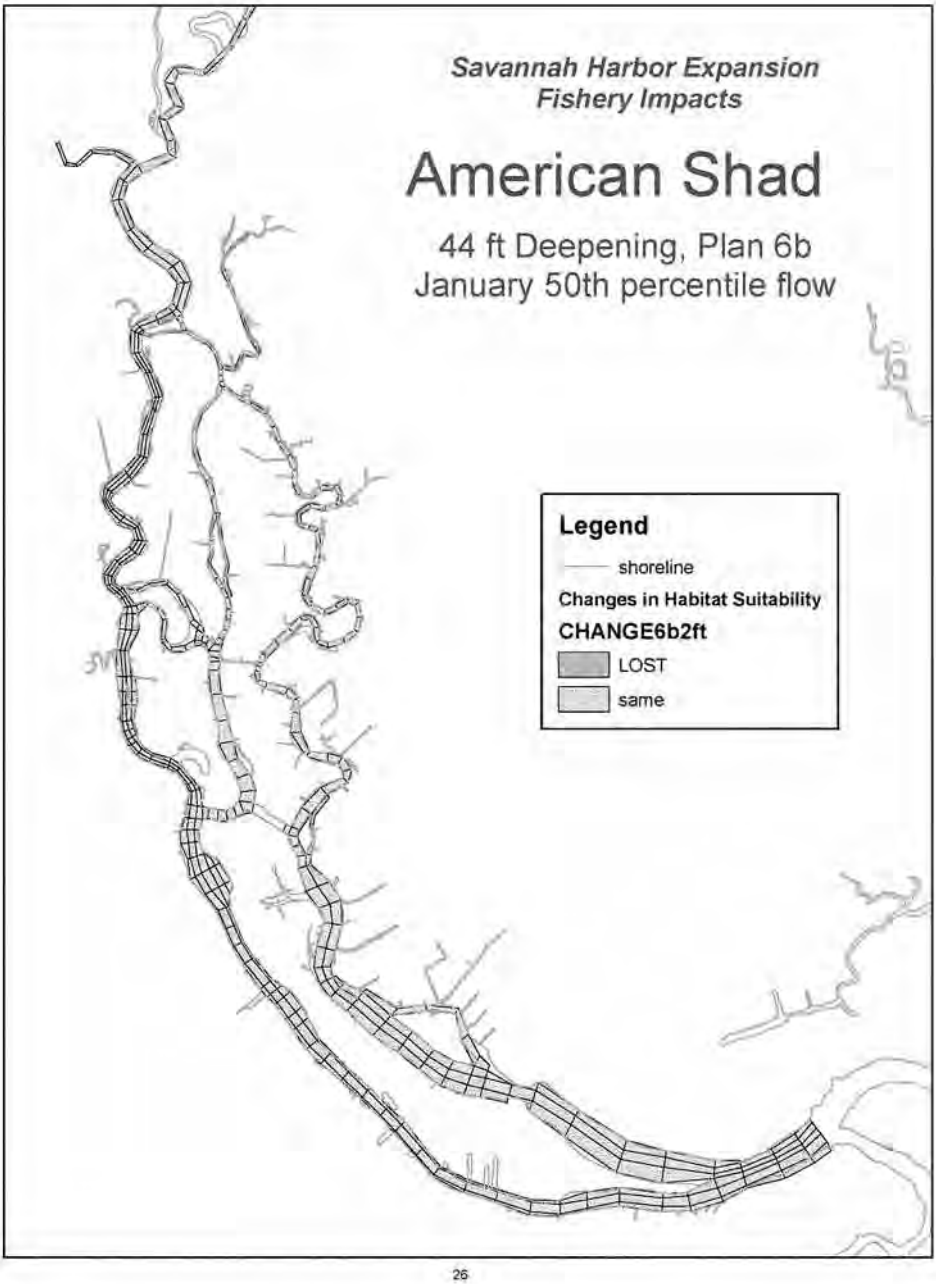
44 ft Channel Depth

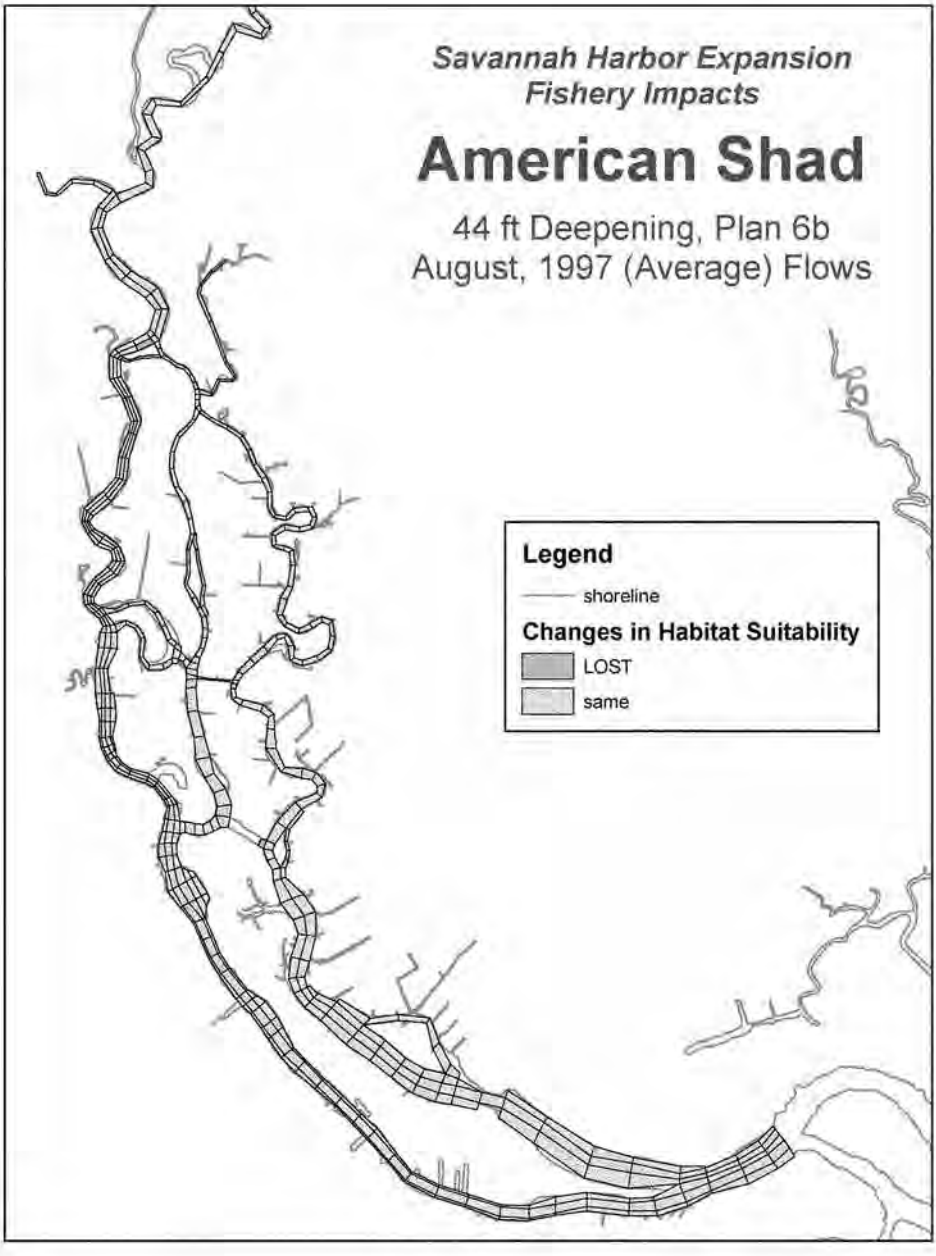
Mitigation Plan 6b

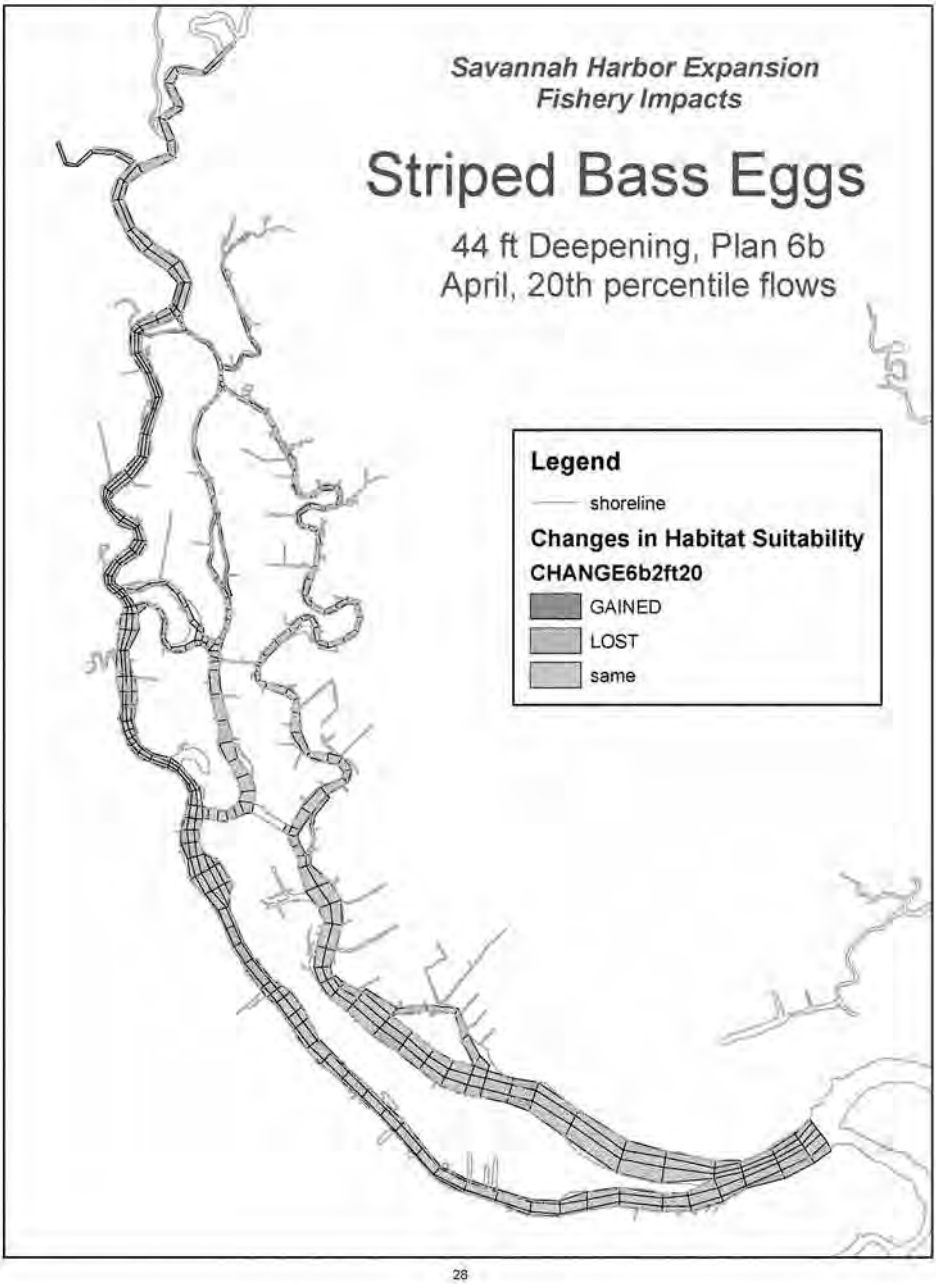

Savannah Harbor Expansion
Fishery Impacts
American Shad
44 ft Deepening, Plan 6b
May 20th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft20
LOST
same

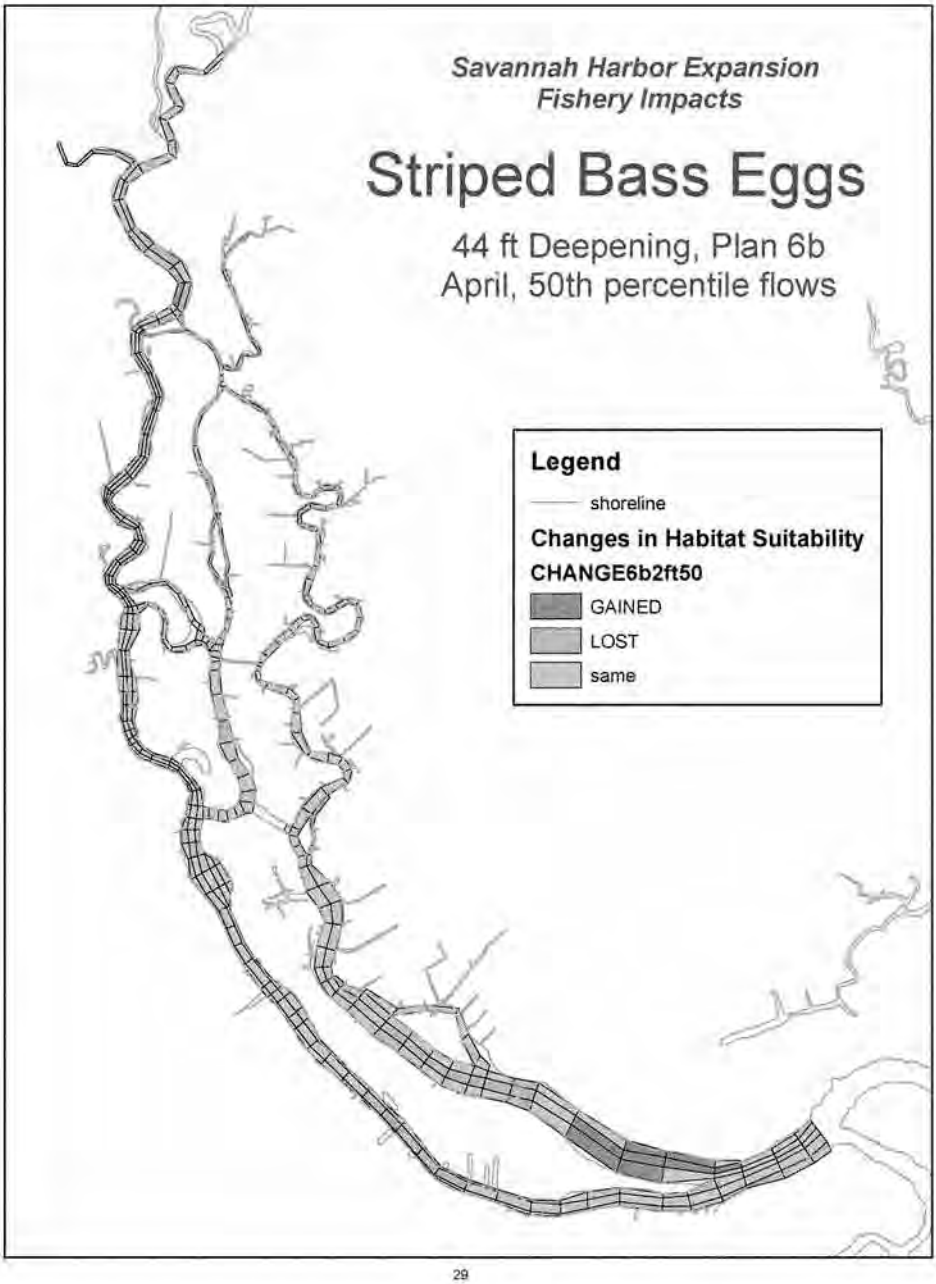

Savannah Harbor Expansion
Fishery Impacts
American Shad
44 ft Deepening, Plan 6b
May 50th percentile flow
Legend
shoreline
Habitat Suitability
CHANGE6b2ft50
LOST
same

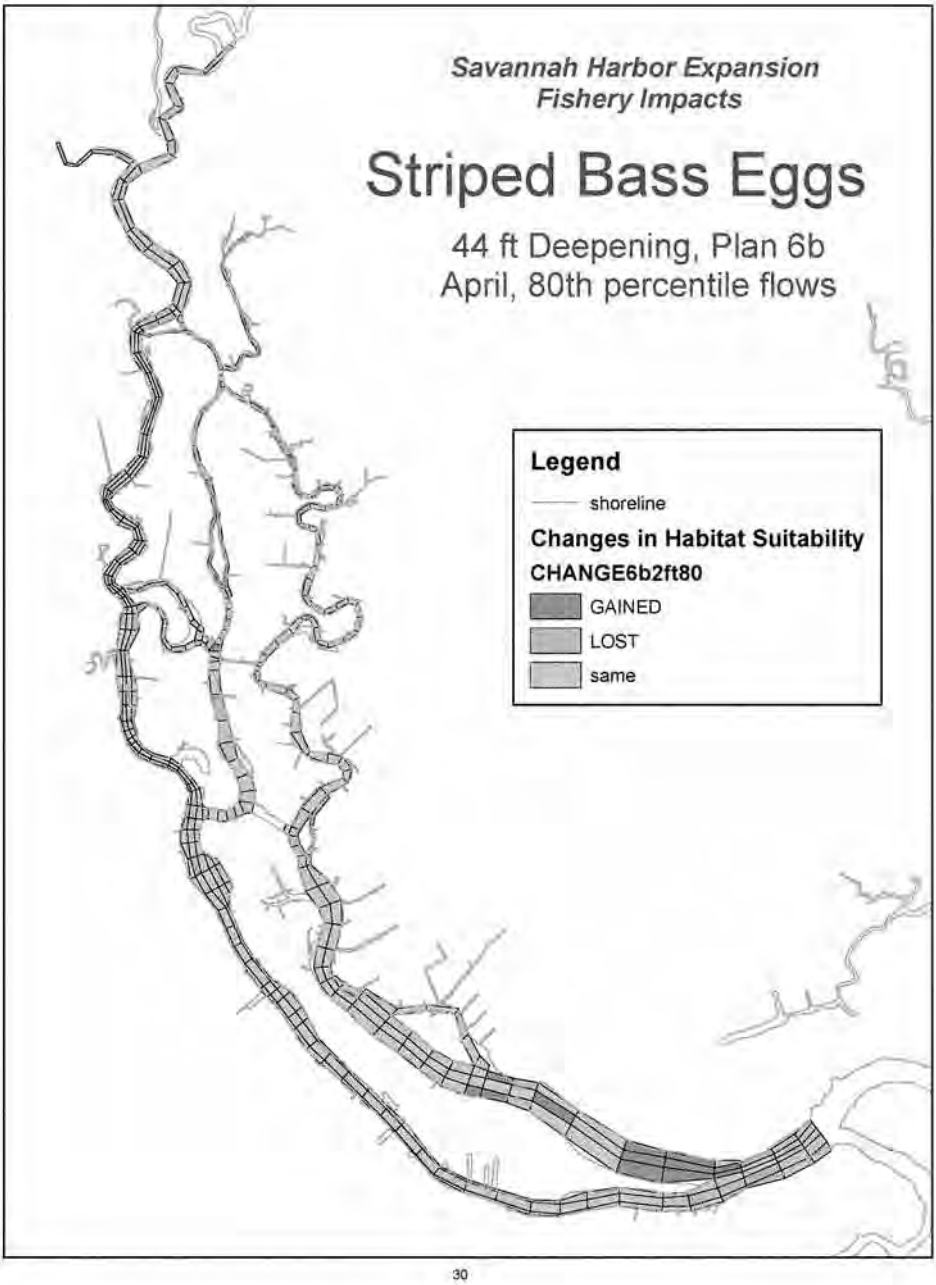

Savannah Harbor Expansion
Fishery Impacts
American Shad
44 ft Deepening, Plan 6b
May 80th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft80
LOST
same

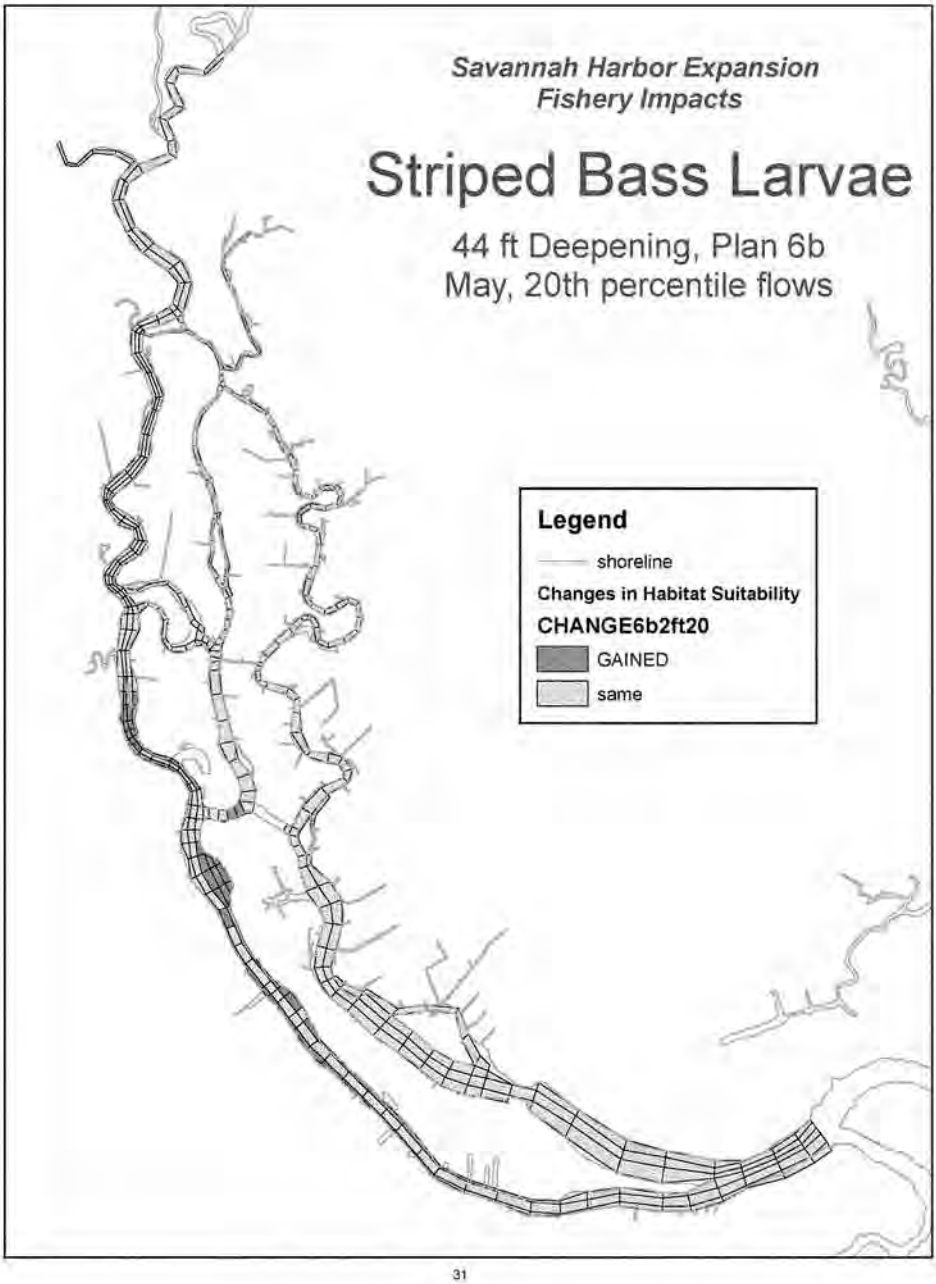

Savannah Harbor Expansion
Fishery Impacts
American Shad
44 ft Deepening, Plan 6b
January 50th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft
LOST
same

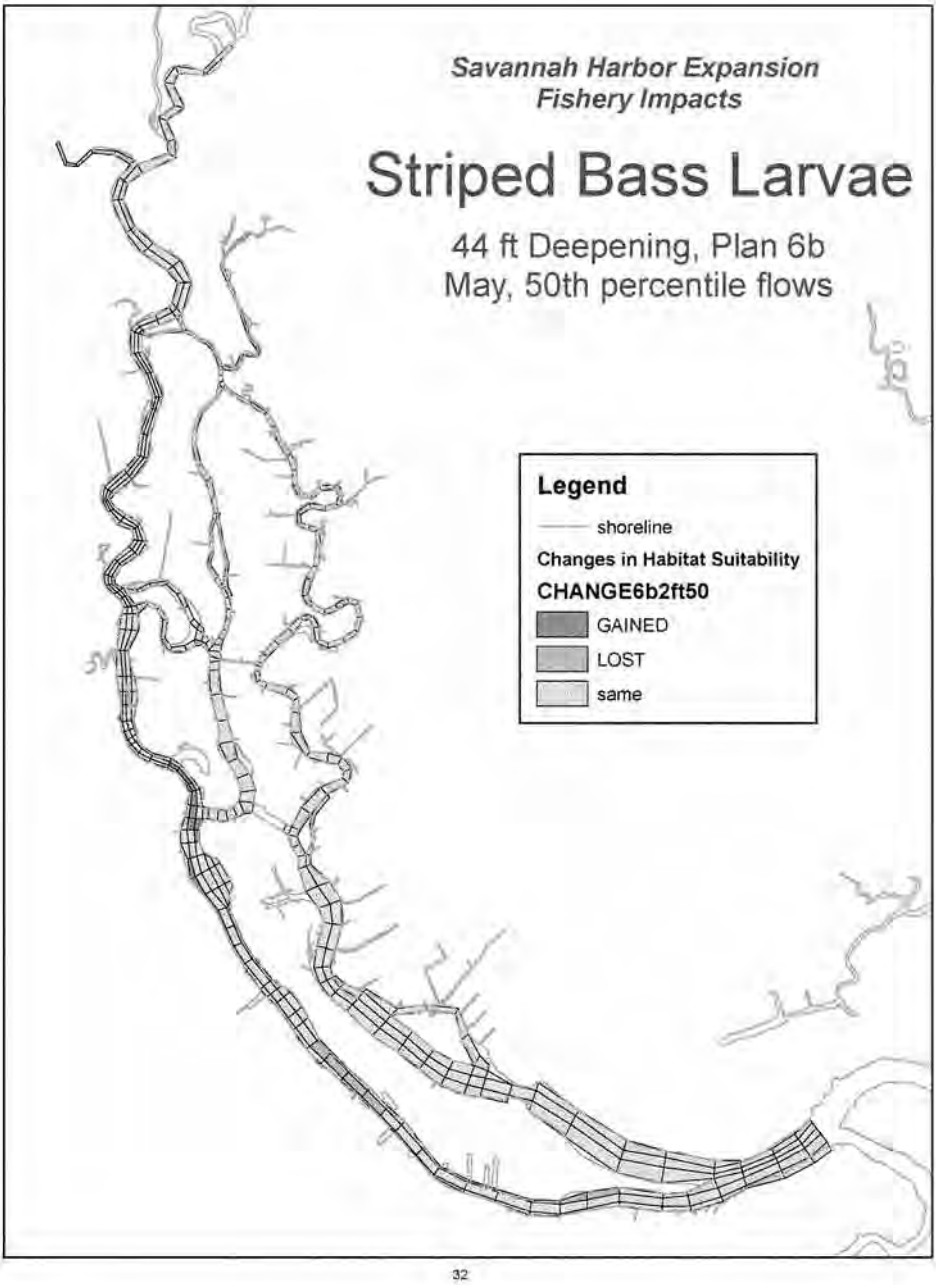

Savannah Harbor Expansion
Fishery Impacts
American Shad
44 ft Deepening, Plan 6b
August, 1997 (Average) Flows
Legend
shoreline
Changes in Habitat Suitability
LOST
same

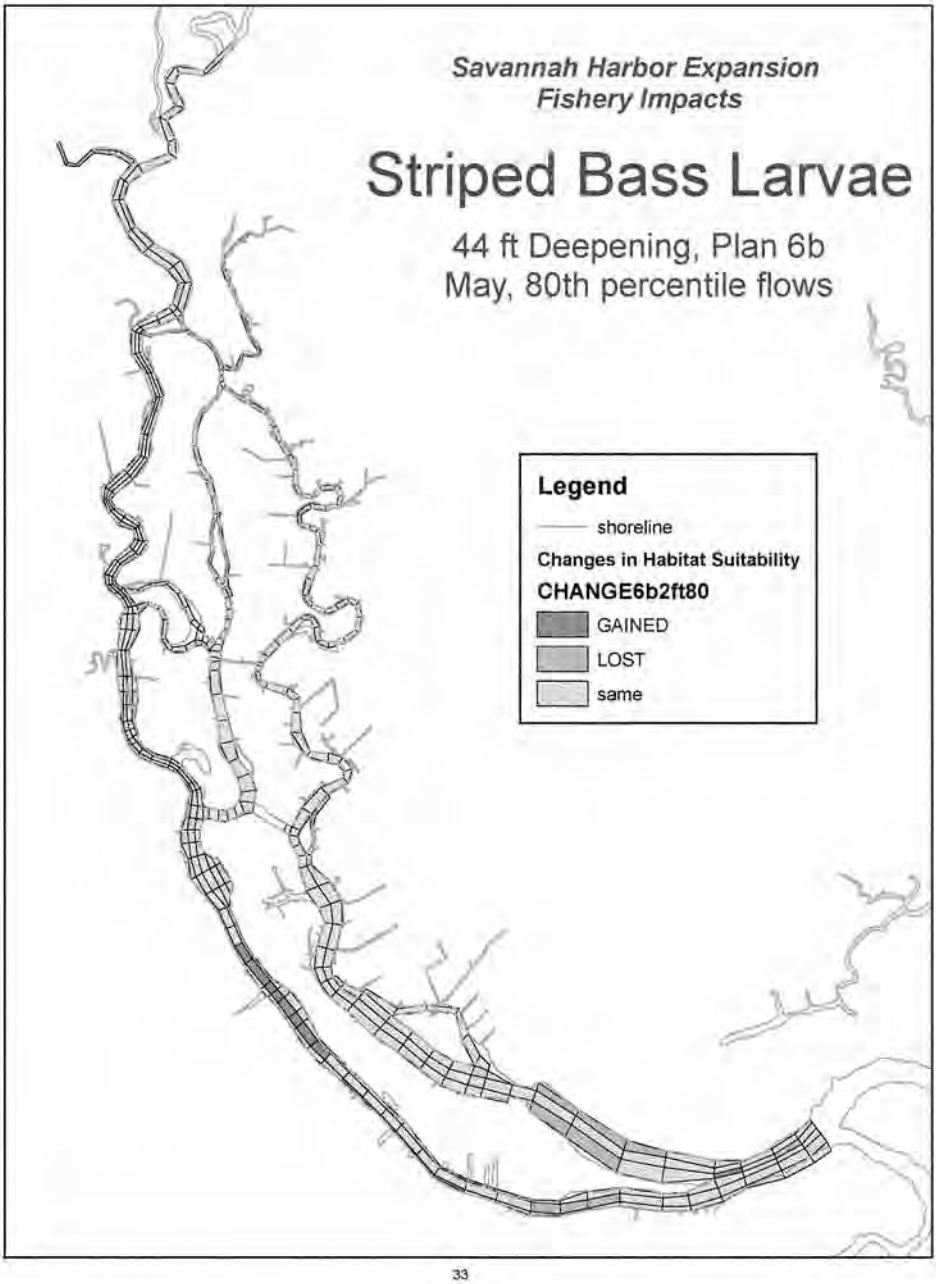

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
44 ft Deepening, Plan 6b
April, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft20
GAINED
LOST
same

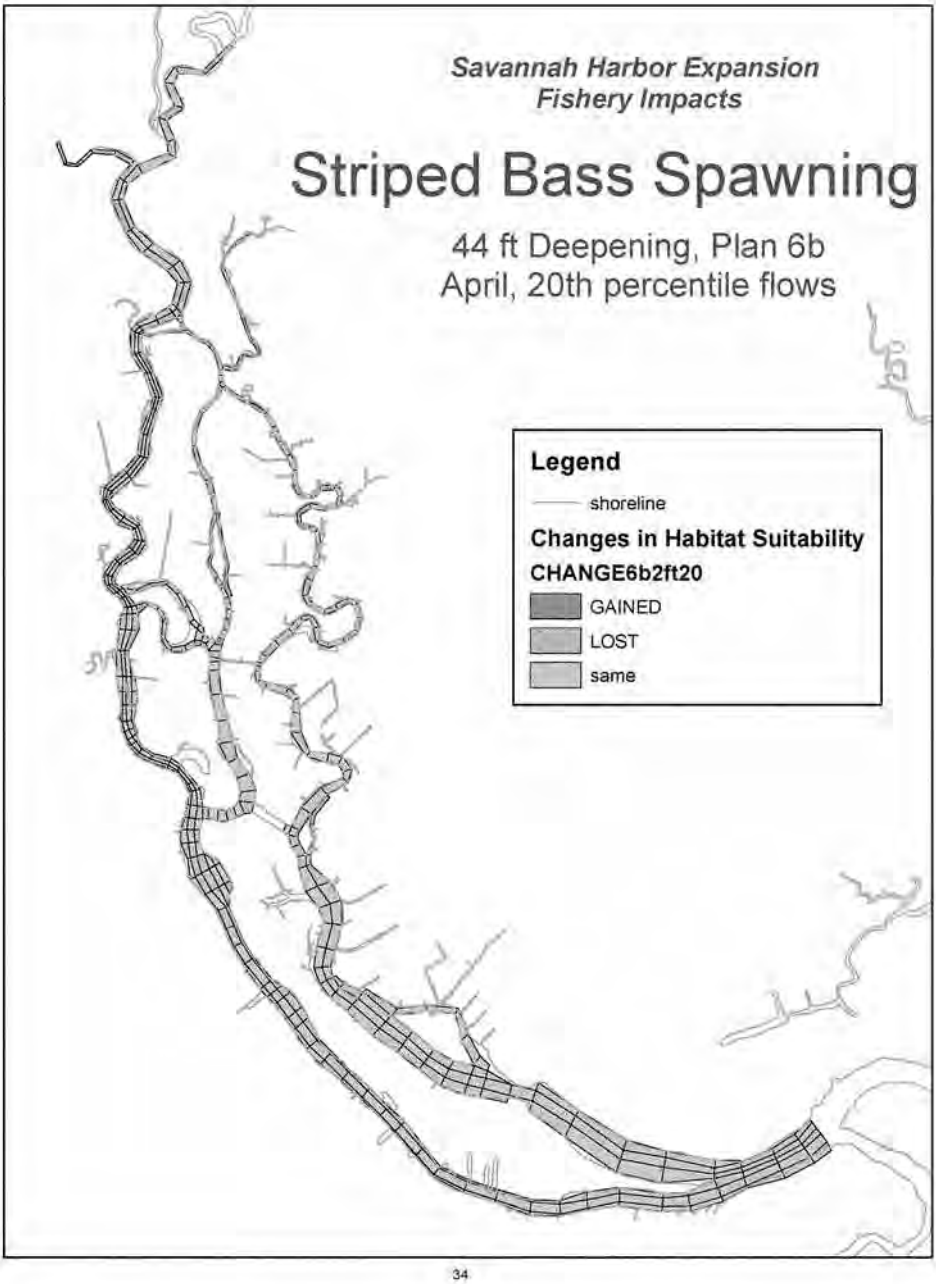

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
44 ft Deepening, Plan 6b
April, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft50
GAINED
LOST
same

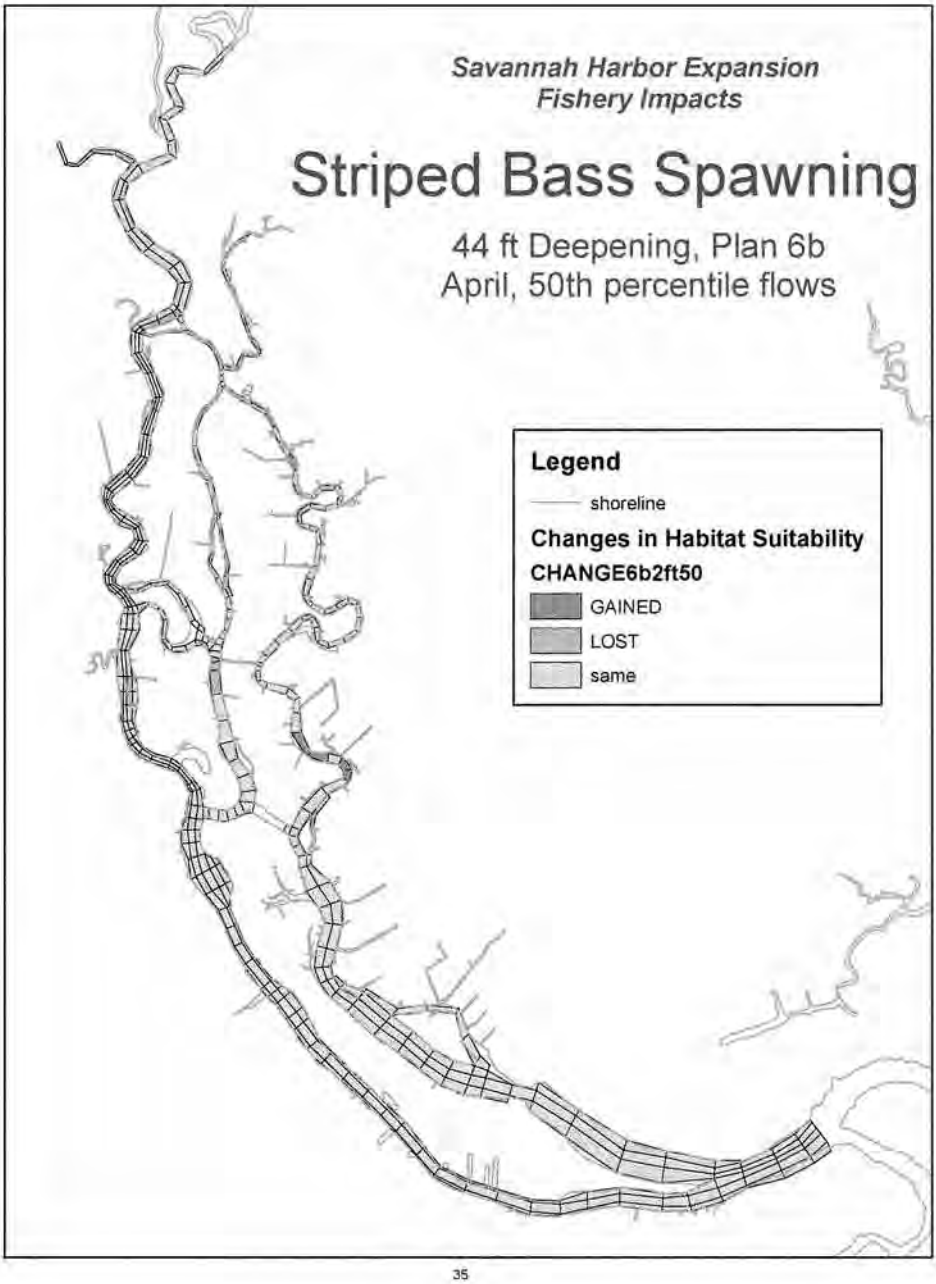

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
44 ft Deepening, Plan 6b
April, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft80
GAINED
LOST
same

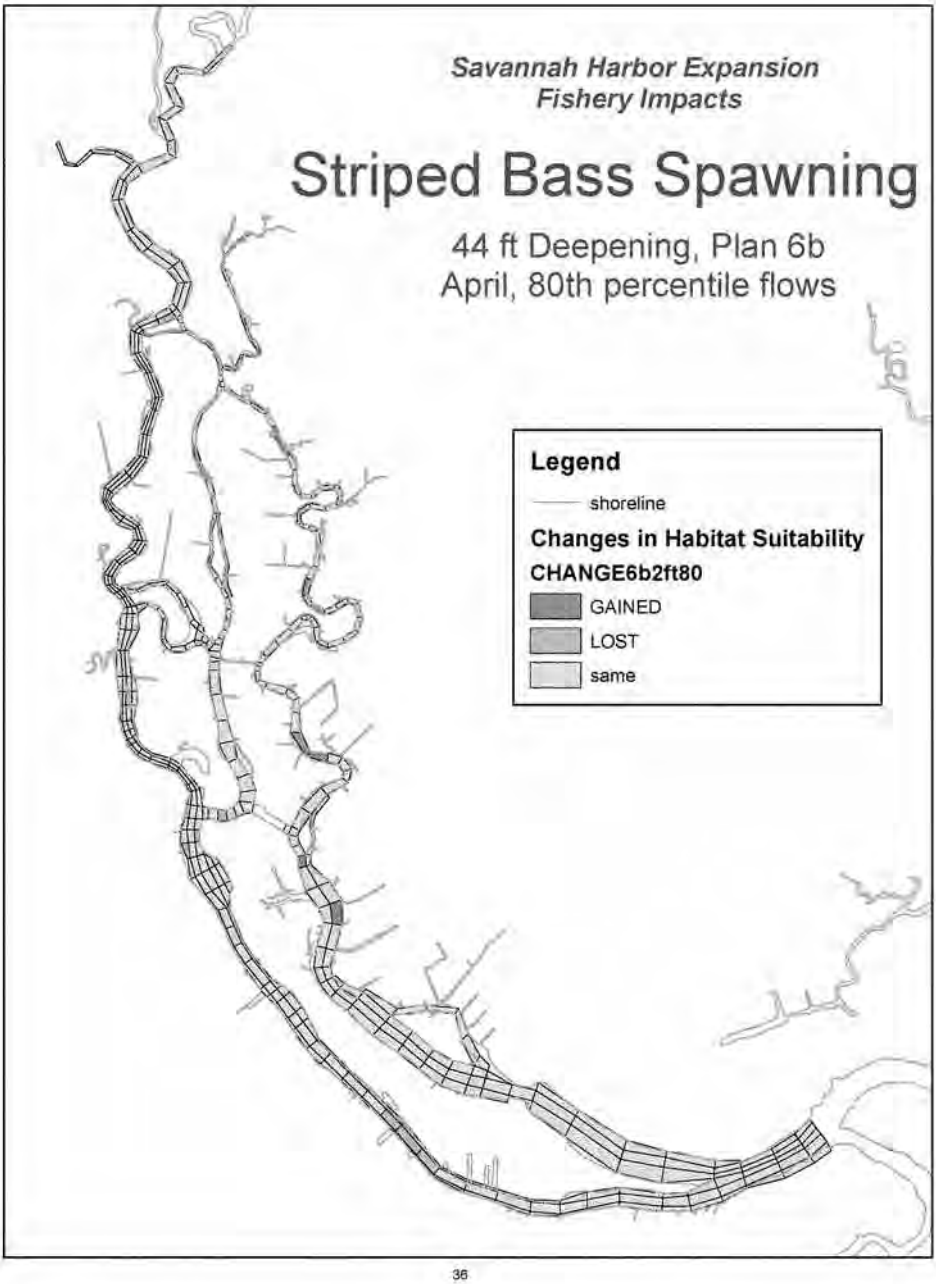

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
44 ft Deepening, Plan 6b
May, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft20
GAINED
same

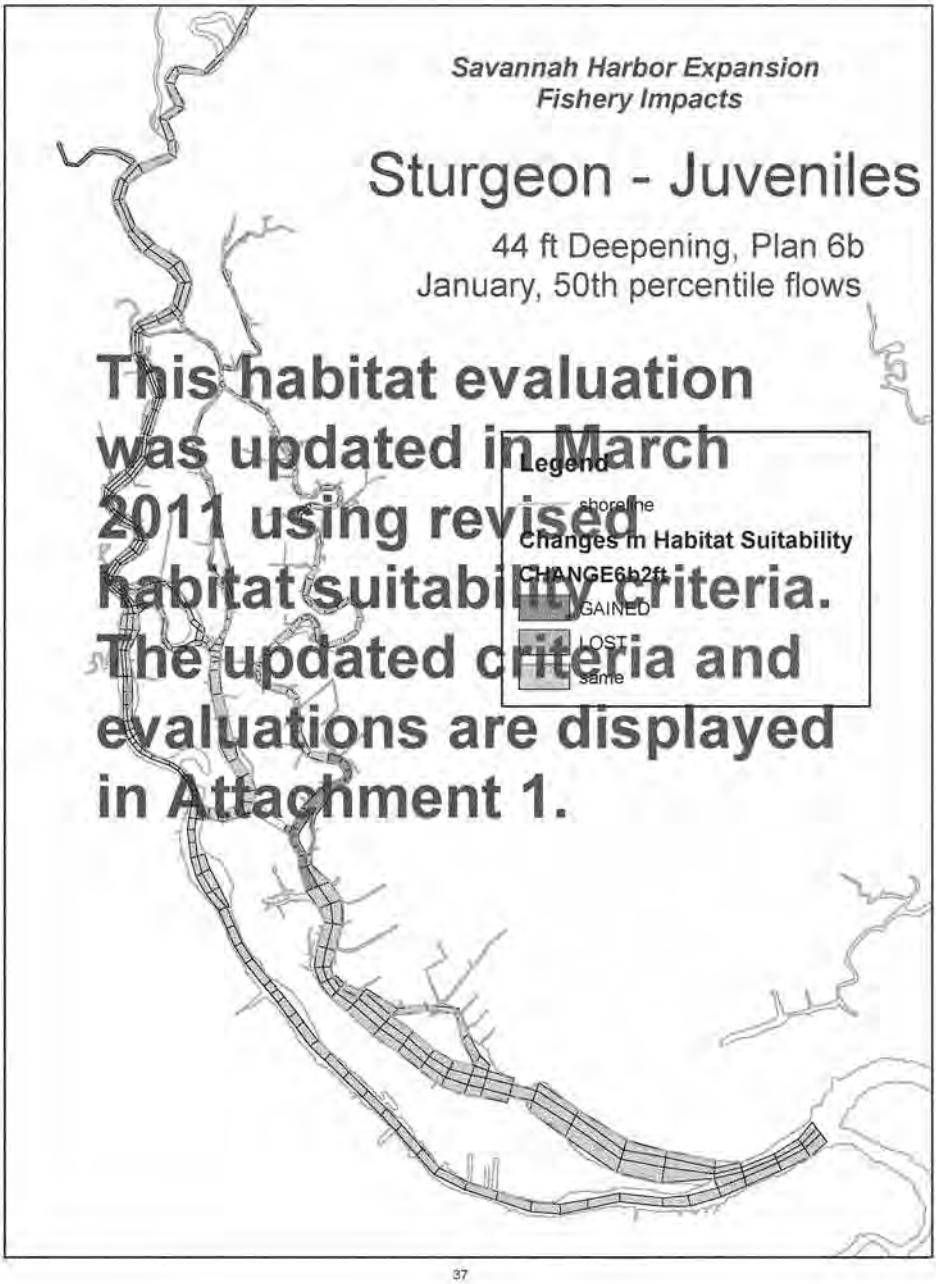

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
44 ft Deepening, Plan 6b
May, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft50
GAINED
LOST
same


Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
44 ft Deepening, Plan 6b
May, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft80
GAINED
LOST
same

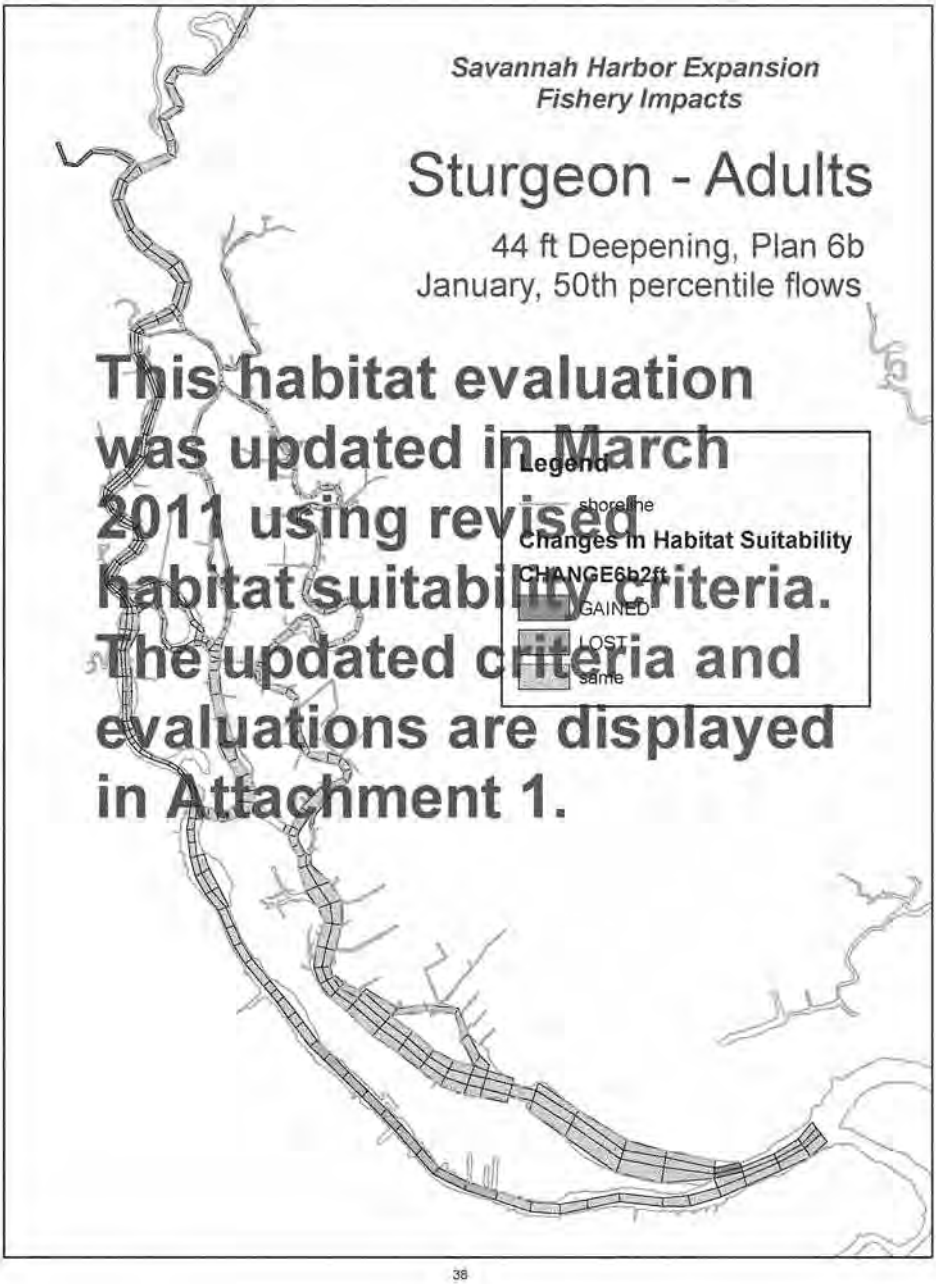

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
44 ft Deepening, Plan 6b
April, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft20
GAINED
LOST
same

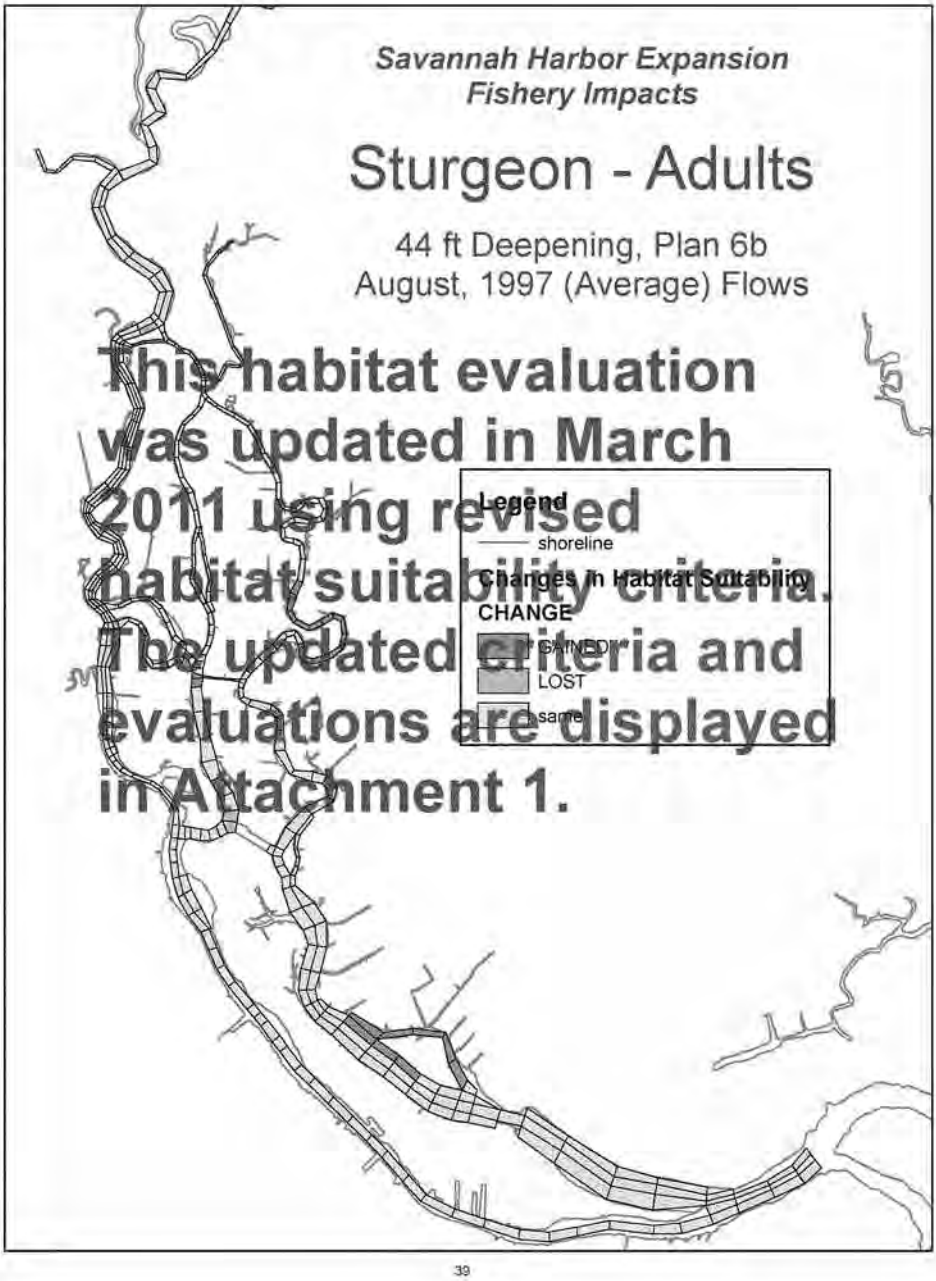

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
44 ft Deepening, Plan 6b
April, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft50
GAINED
LOST
same


Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
44 ft Deepening, Plan 6b
April, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft80
GAINED
LOST
same

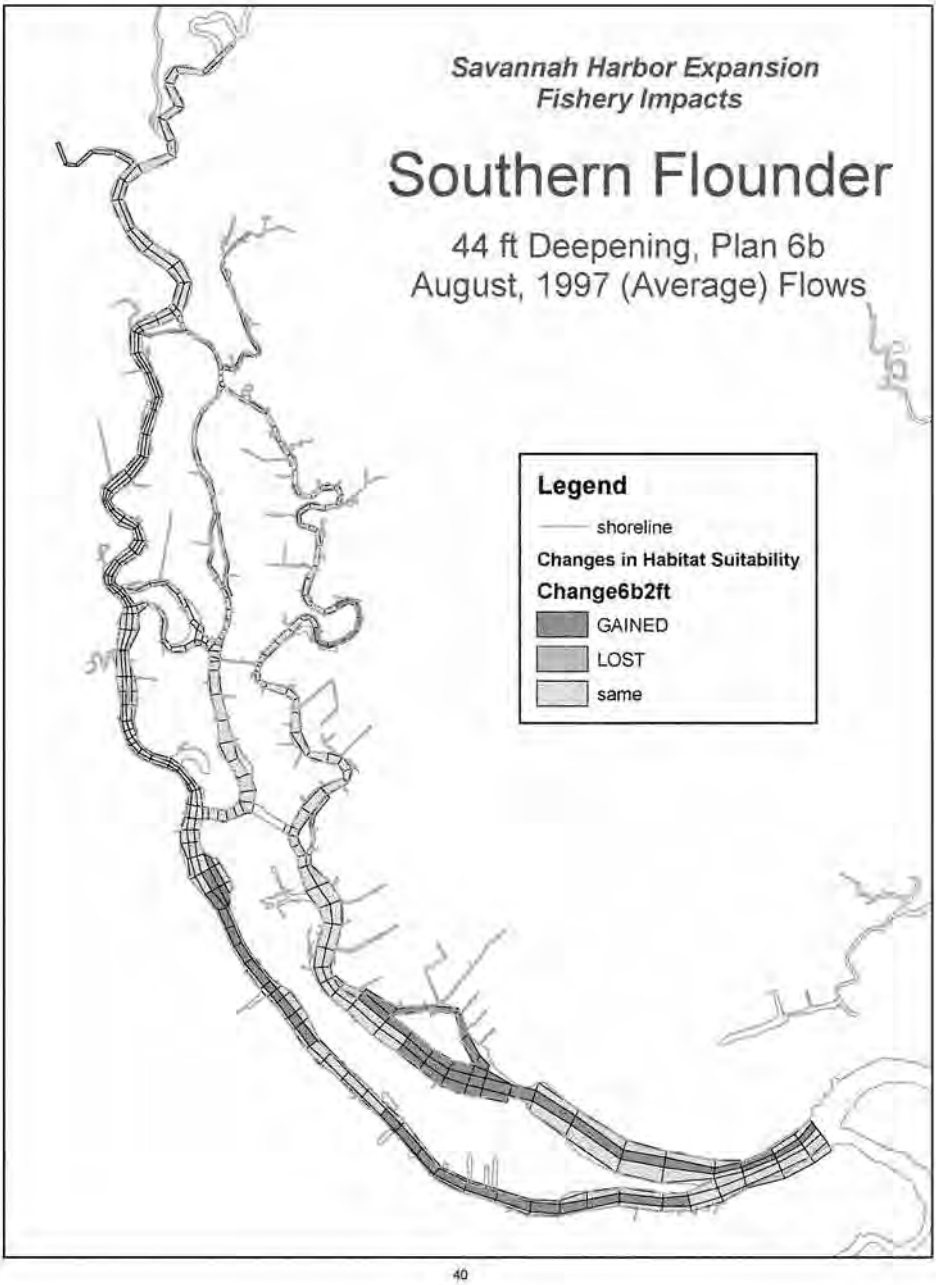


This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.


Savannah Harbor Expansion
Fishery Impacts
Sturgeon - Adults
44 ft Deepening, Plan 6b
January, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6b2ft
GAINED
LOST
same
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.

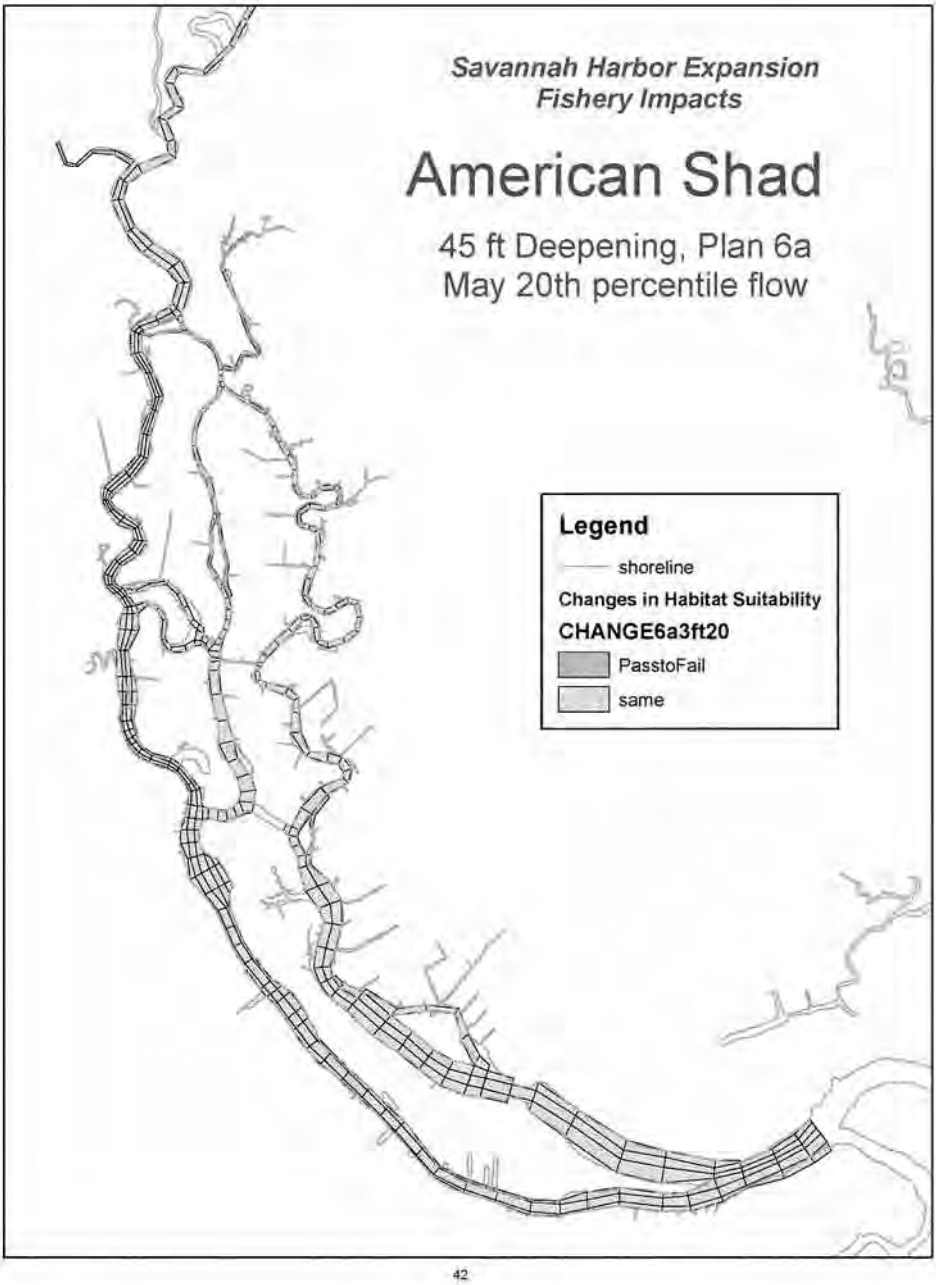


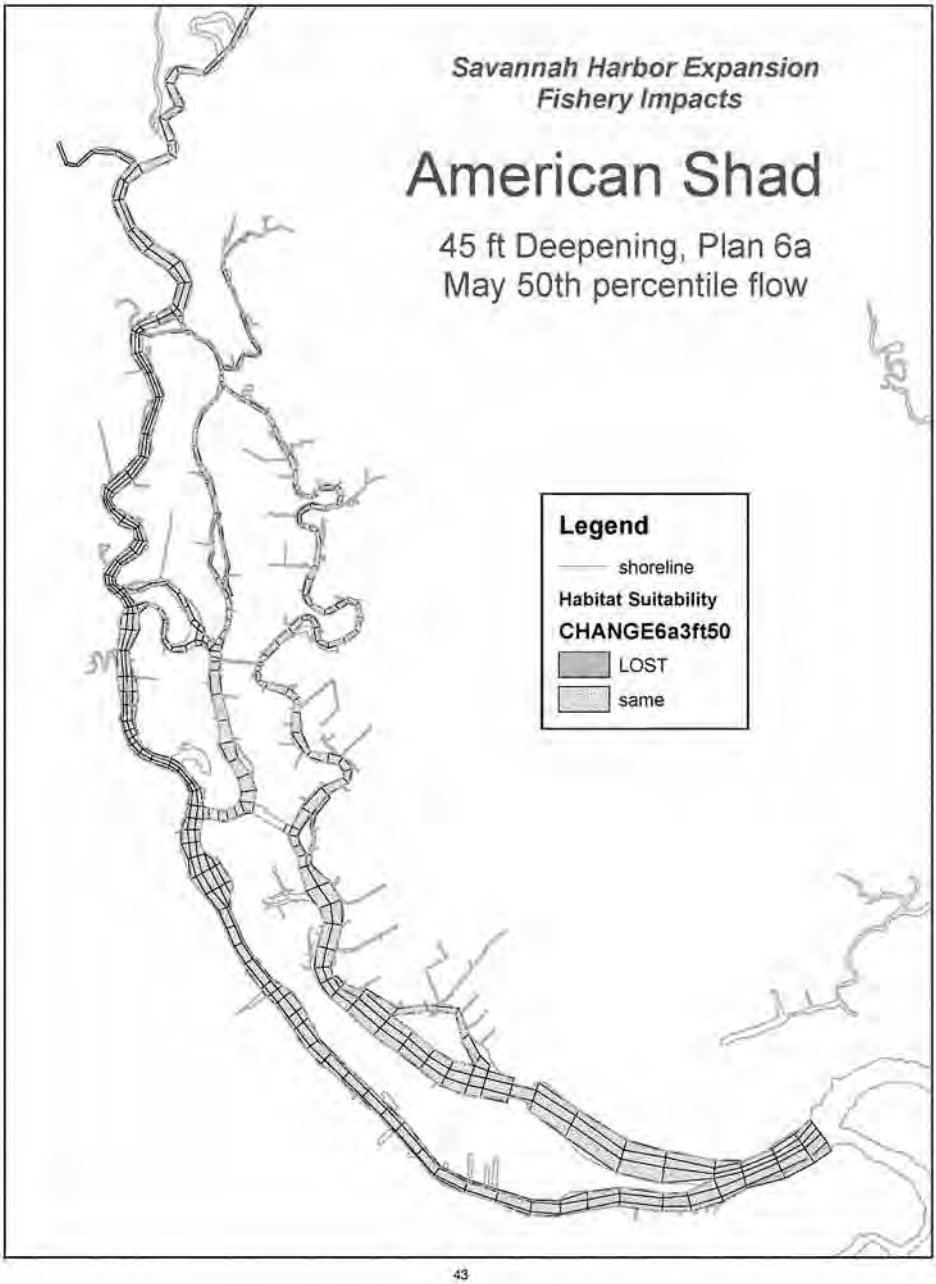
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.

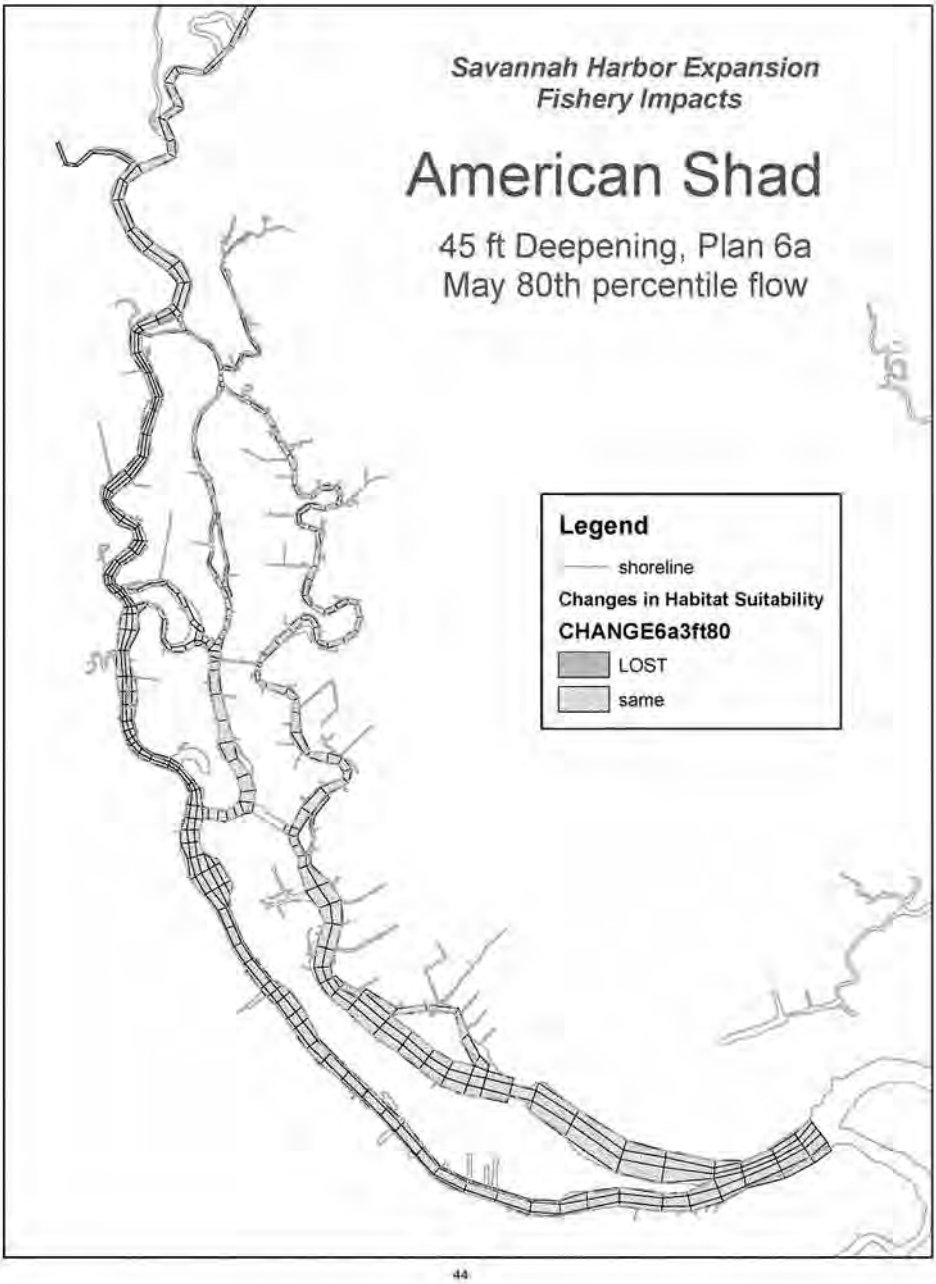

Savannah Harbor Expansion
Fishery Impacts
Southern Flounder
44 ft Deepening, Plan 6b
August, 1997 (Average) Flows
Legend
shoreline
Changes in Habitat Suitability
Change6b2ft
GAINED
LOST
same

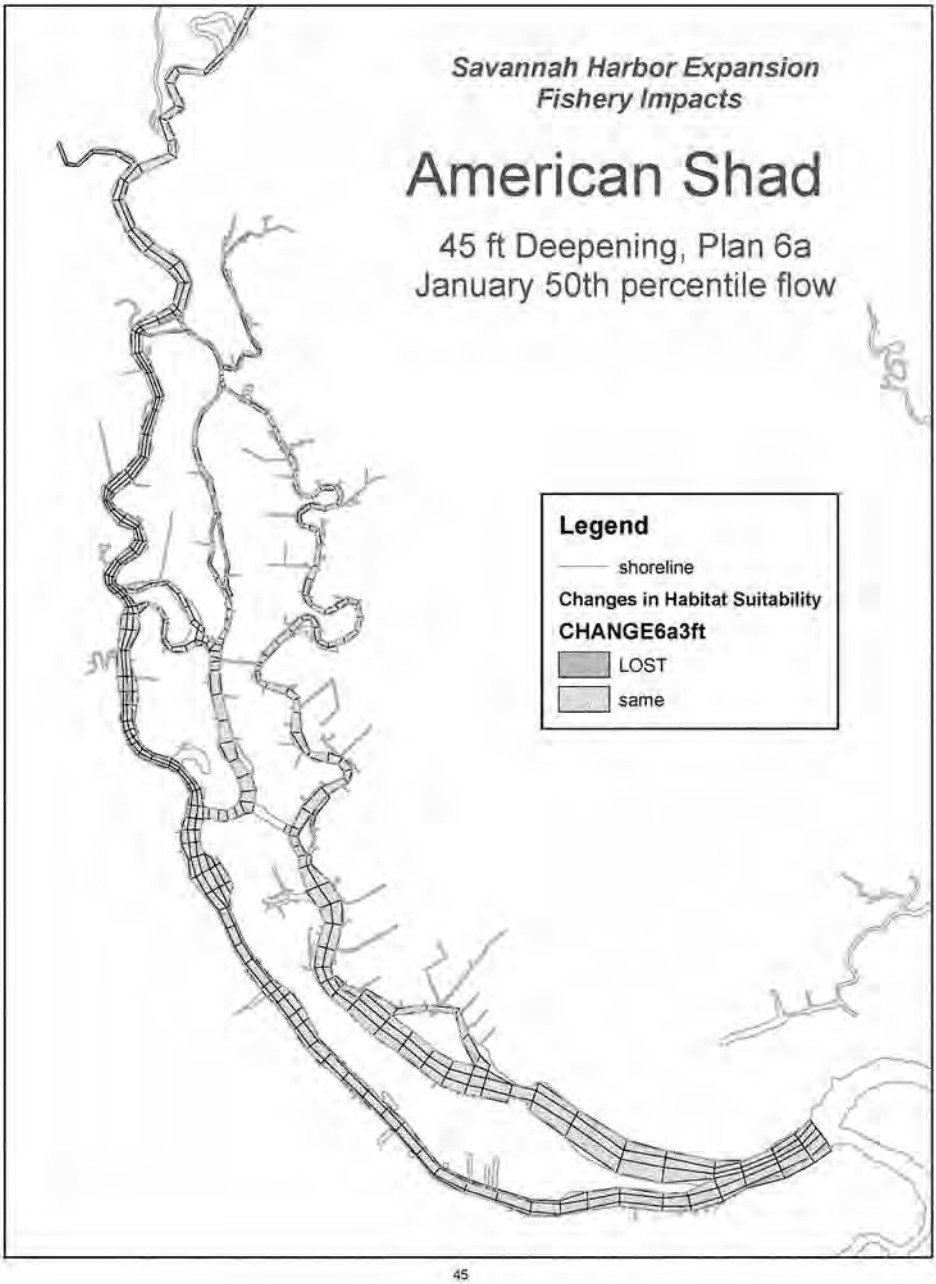
45 ft Channel Depth

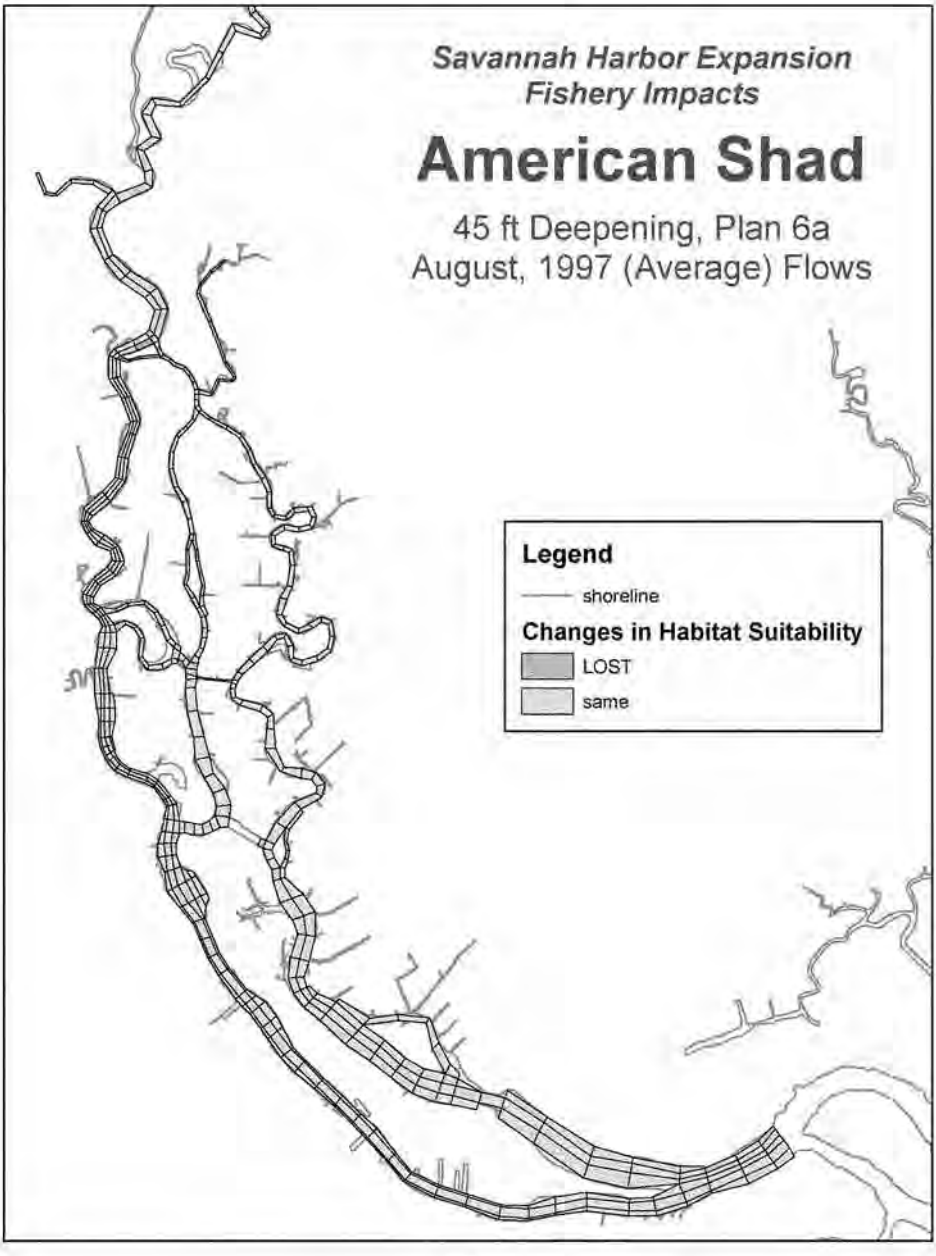
Mitigation Plan 6a

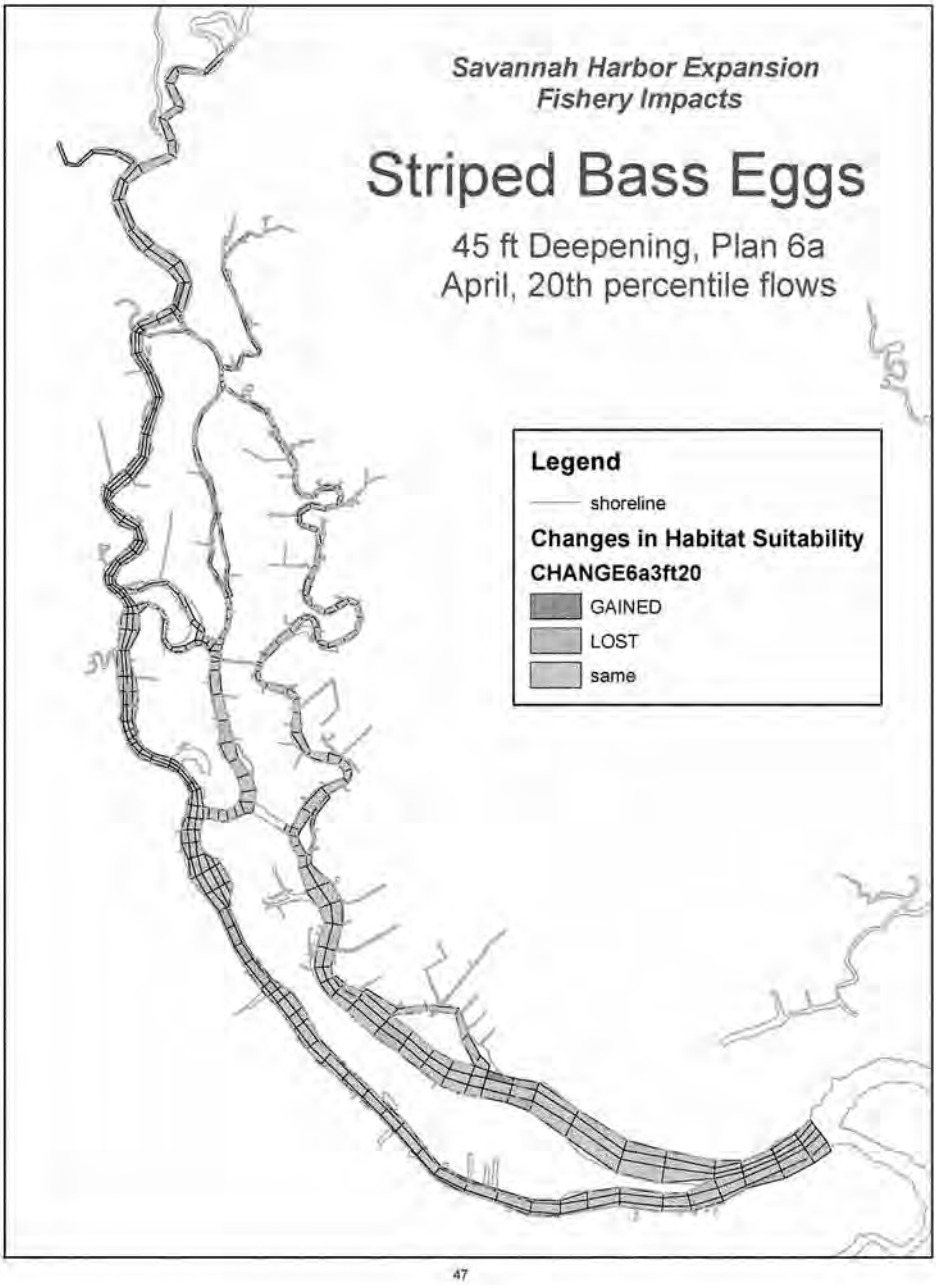

Savannah Harbor Expansion
Fishery Impacts
American Shad
45 ft Deepening, Plan 6a
May 20th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft20
PasstoFail
same

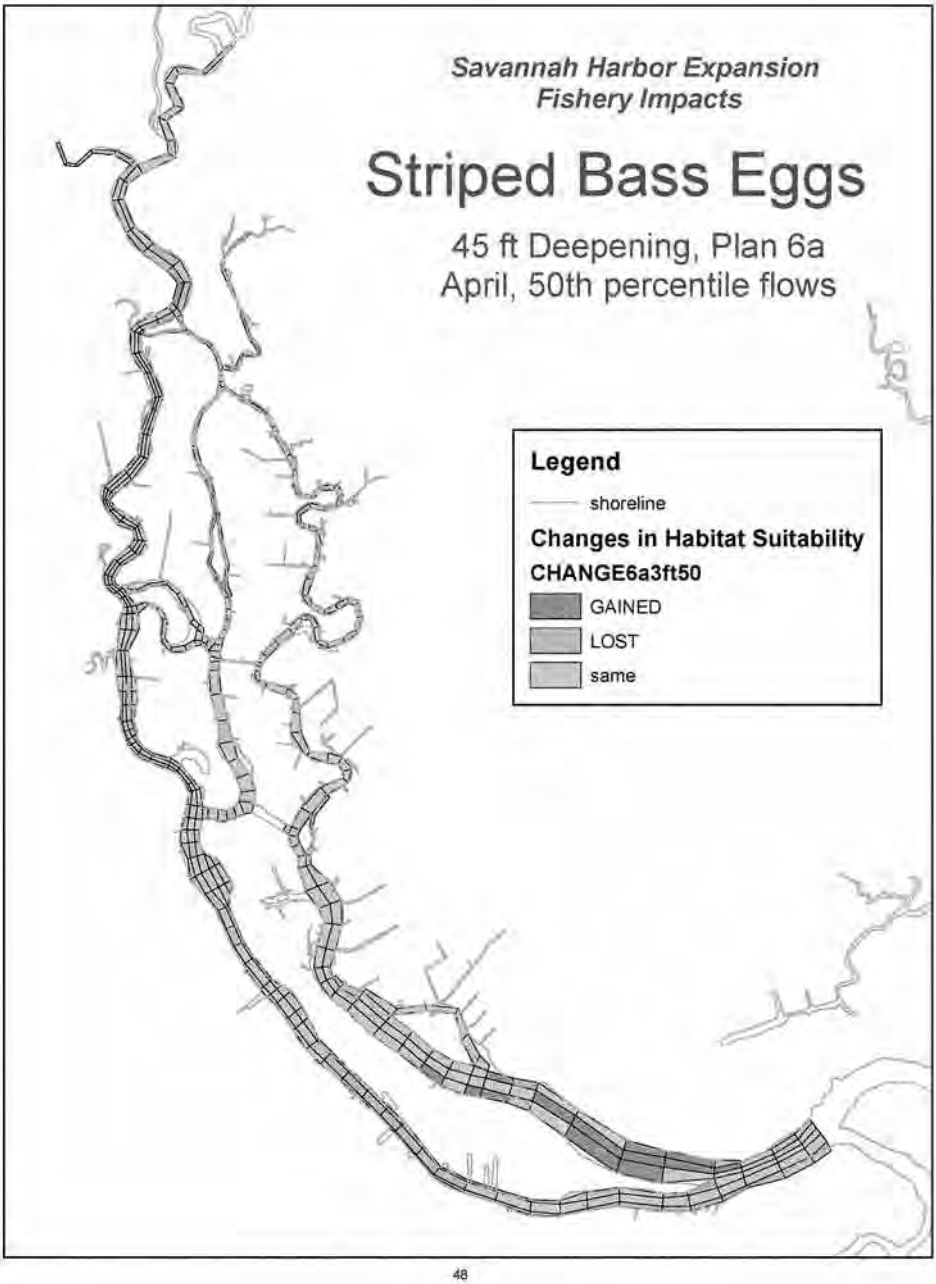

Savannah Harbor Expansion
Fishery Impacts
American Shad
45 ft Deepening, Plan 6a
May 50th percentile flow
Legend
shoreline
Habitat Suitability
CHANGE6a3ft50
LOST
same

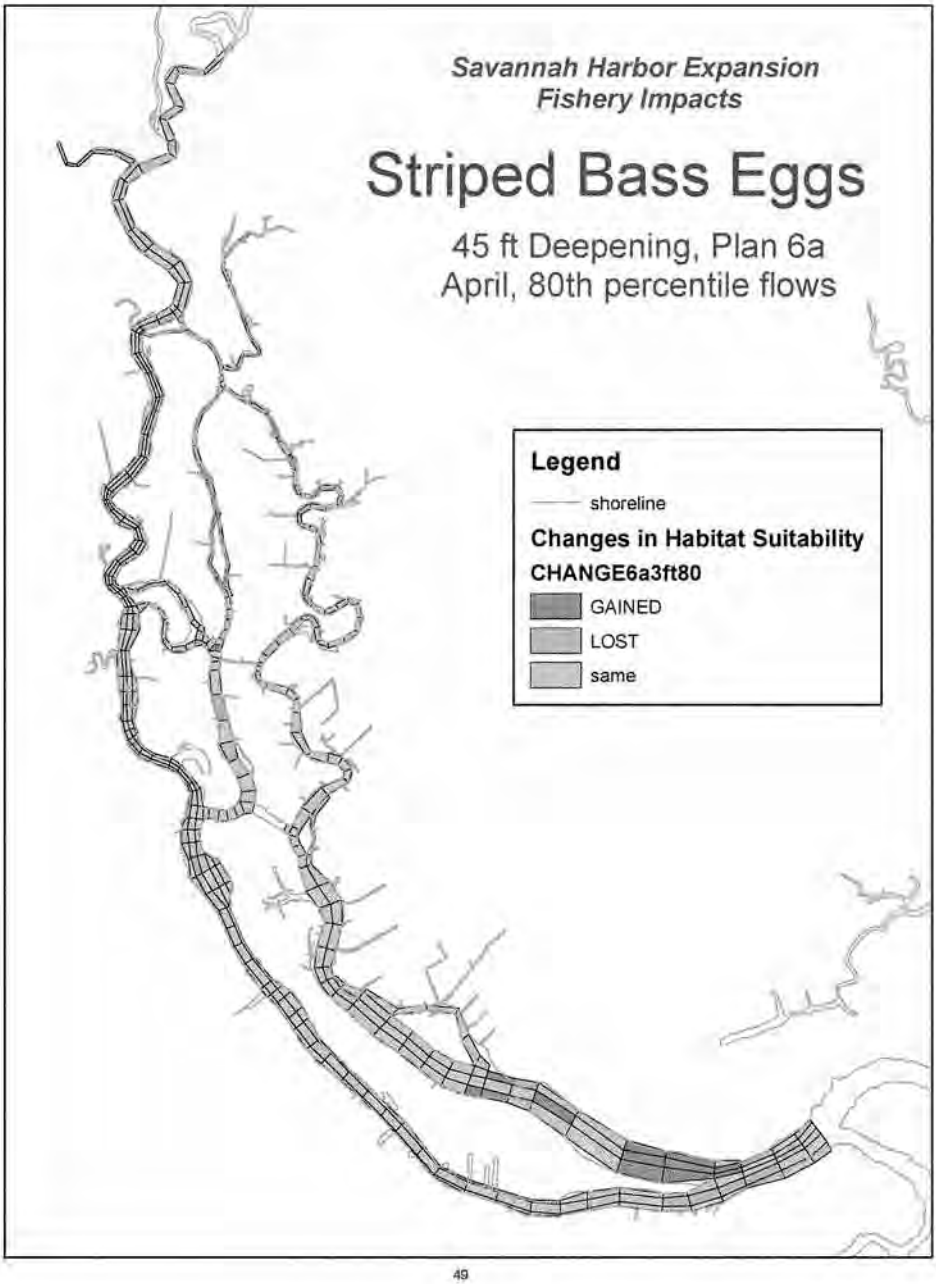

Savannah Harbor Expansion
Fishery Impacts
American Shad
45 ft Deepening, Plan 6a
May 80th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft80
LOST
same

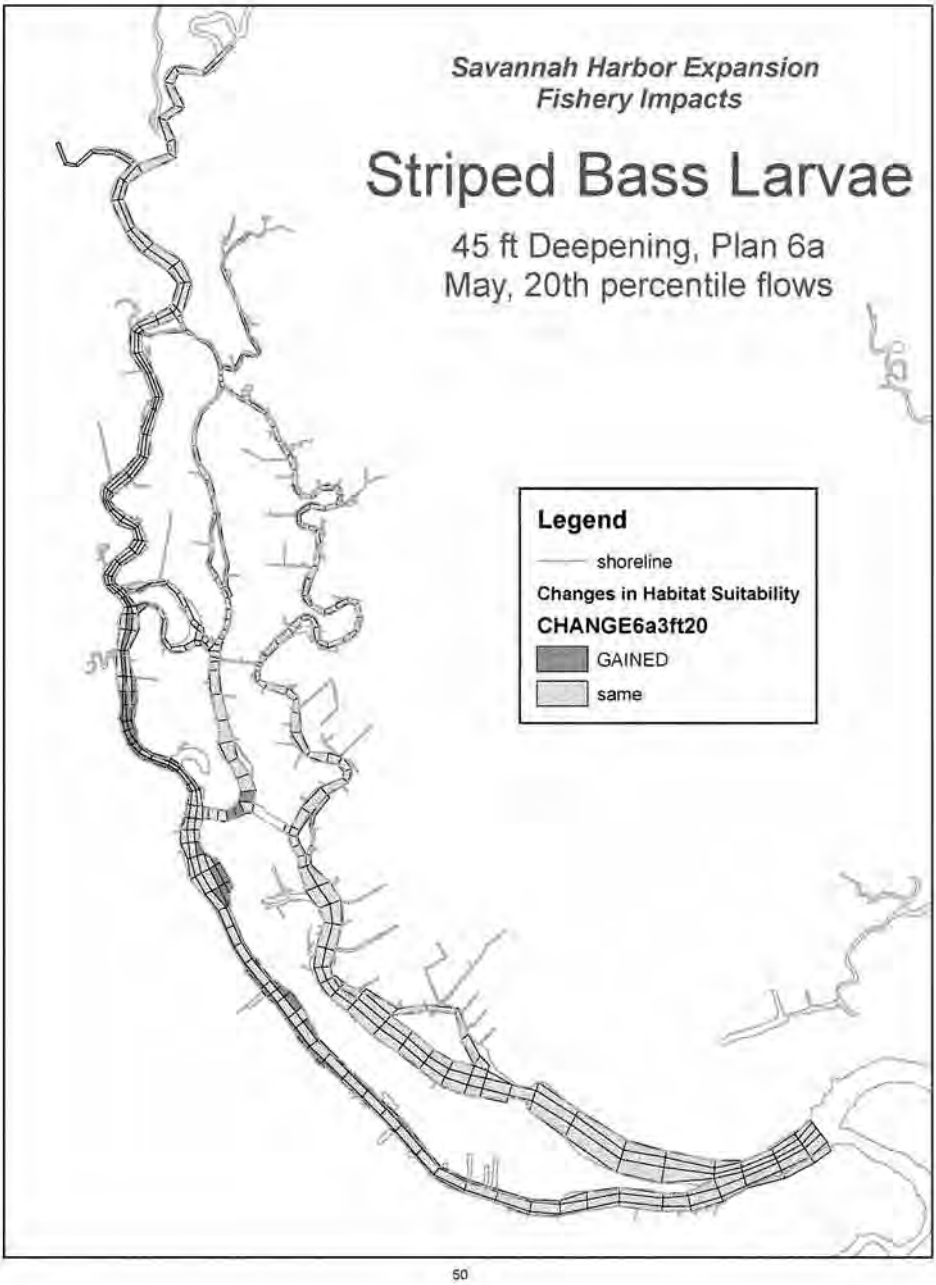

Savannah Harbor Expansion
Fishery Impacts
American Shad
45 ft Deepening, Plan 6a
January 50th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft
LOST
same

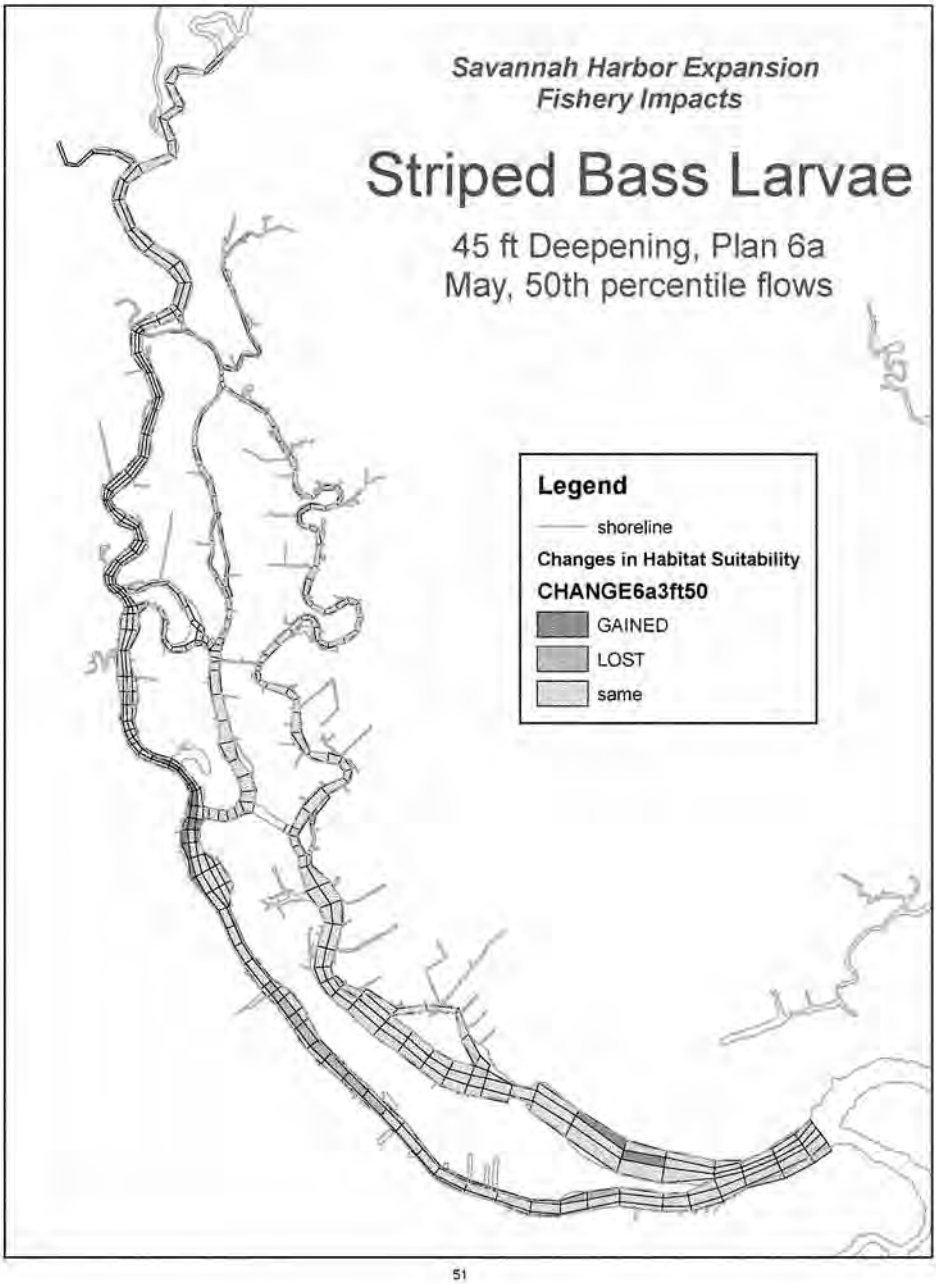

Savannah Harbor Expansion
Fishery Impacts
American Shad
45 ft Deepening, Plan 6a
August, 1997 (Average) Flows
Legend
shoreline
Changes in Habitat Suitability
LOST
same

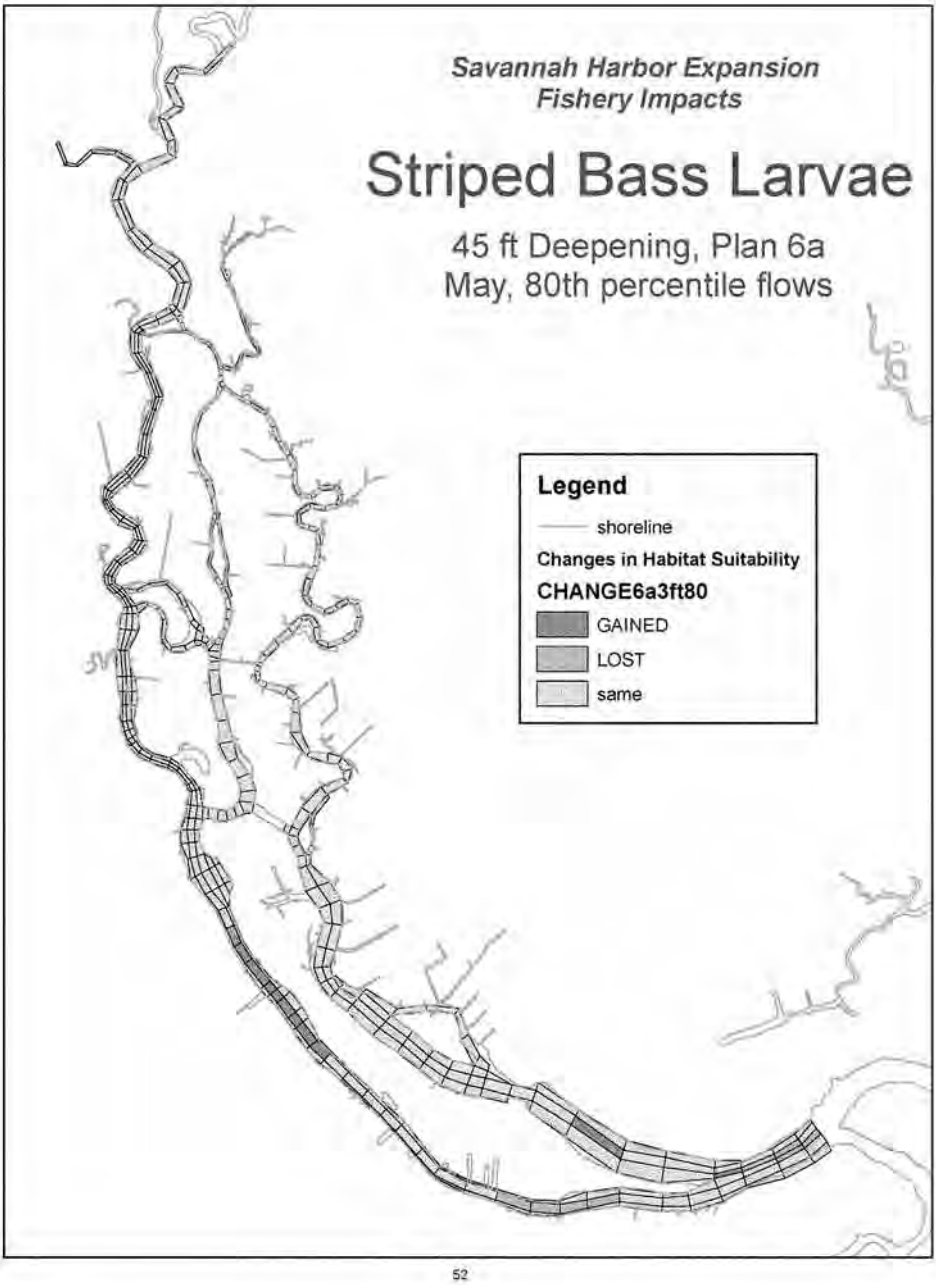

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
45 ft Deepening, Plan 6a
April, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft20
GAINED
LOST
same

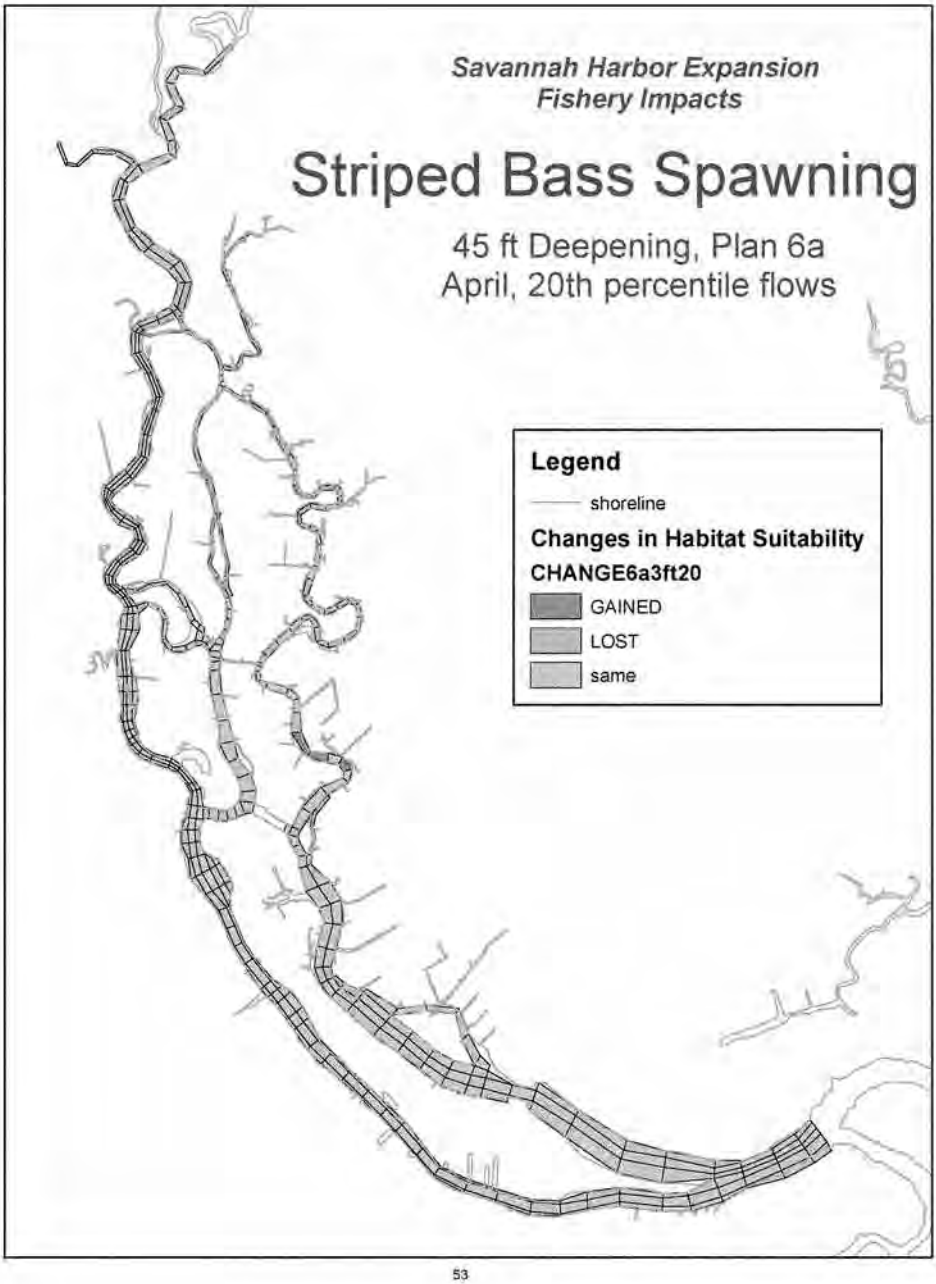

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
45 ft Deepening, Plan 6a
April, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft50
GAINED
LOST
same

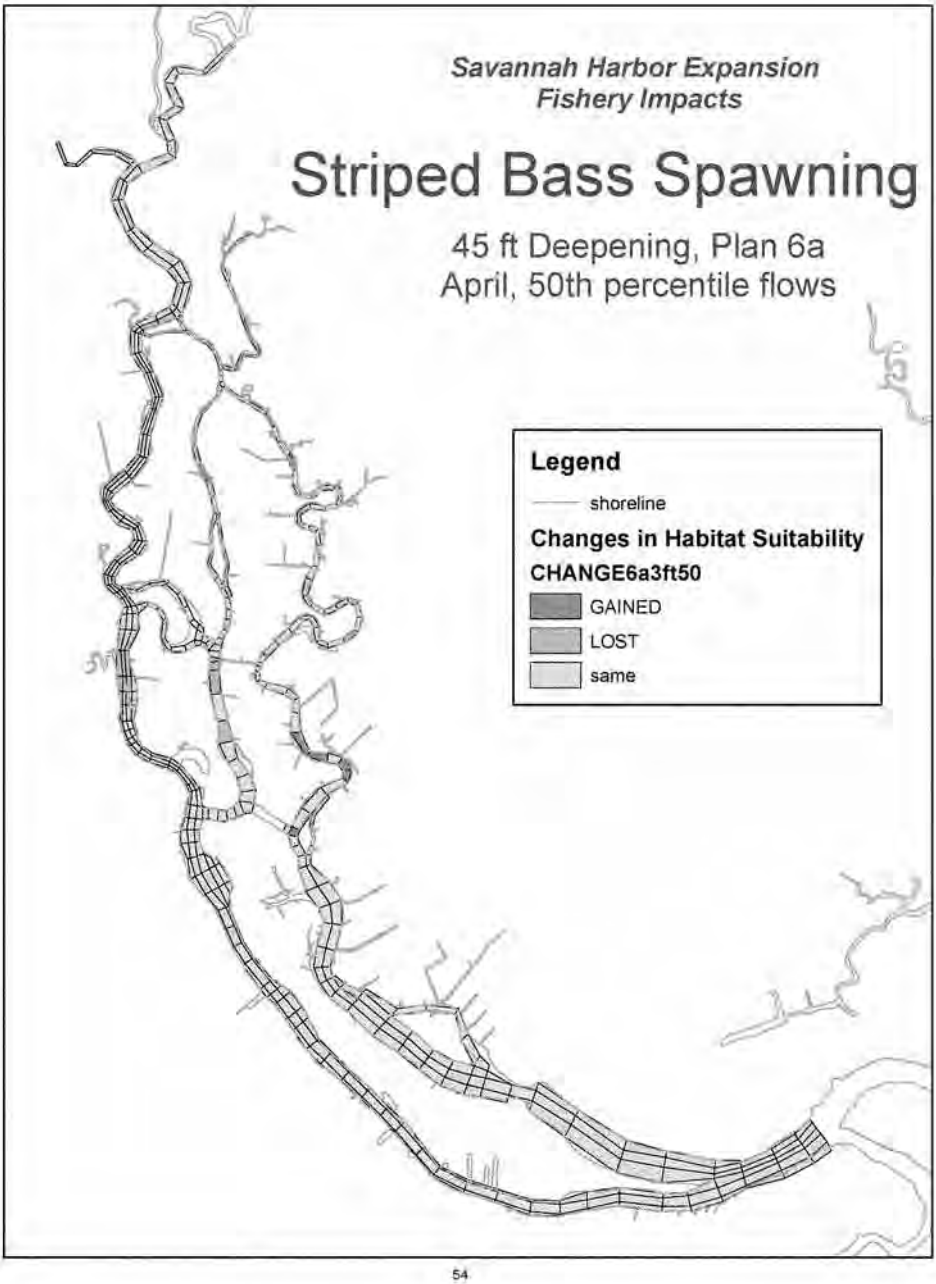

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
45 ft Deepening, Plan 6a
April, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft80
GAINED
LOST
same

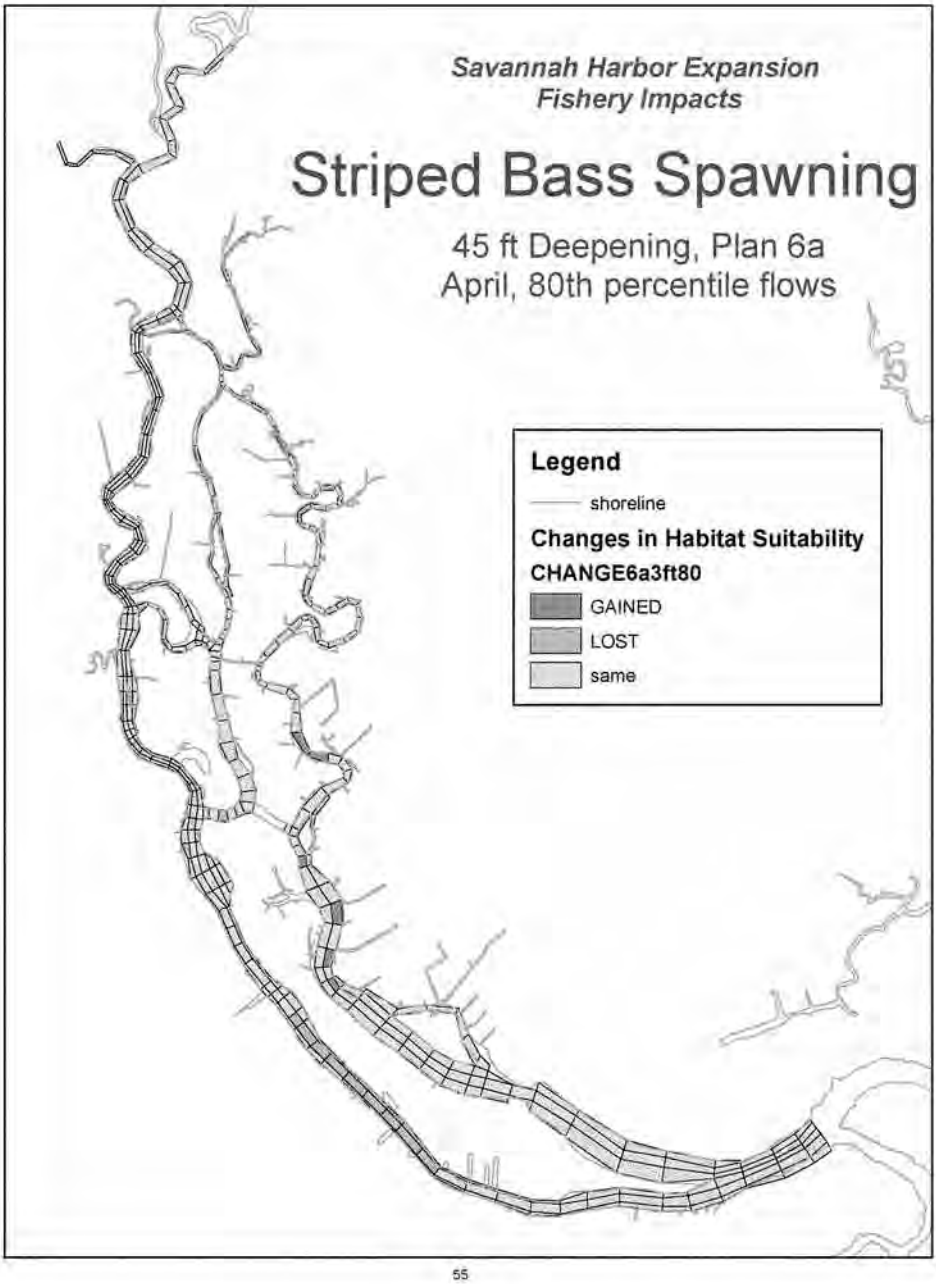

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
45 ft Deepening, Plan 6a
May, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft20
GAINED
same

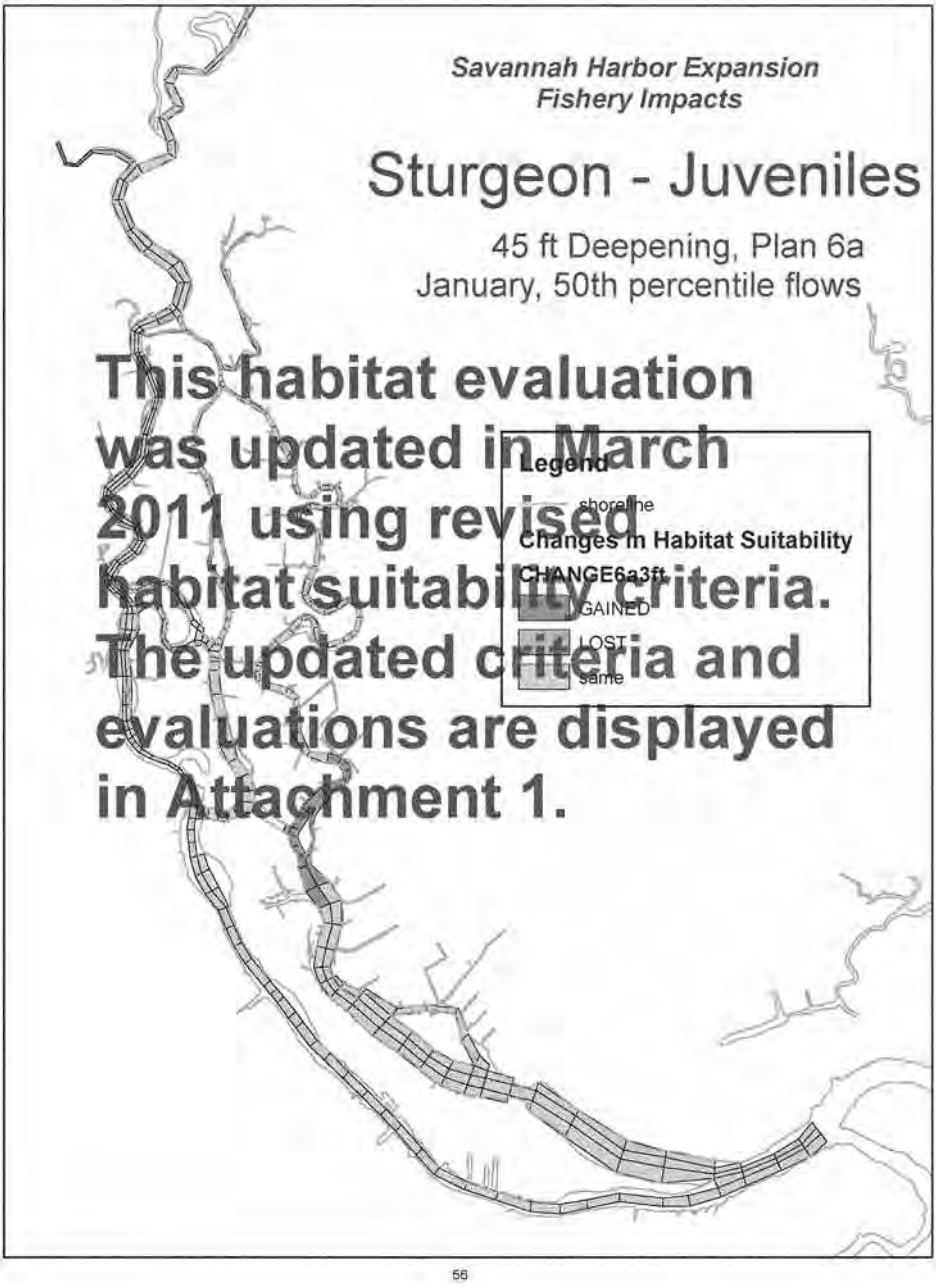

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
45 ft Deepening, Plan 6a
May, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft50
GAINED
LOST
same


Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
45 ft Deepening, Plan 6a
May, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft80
GAINED
LOST
same

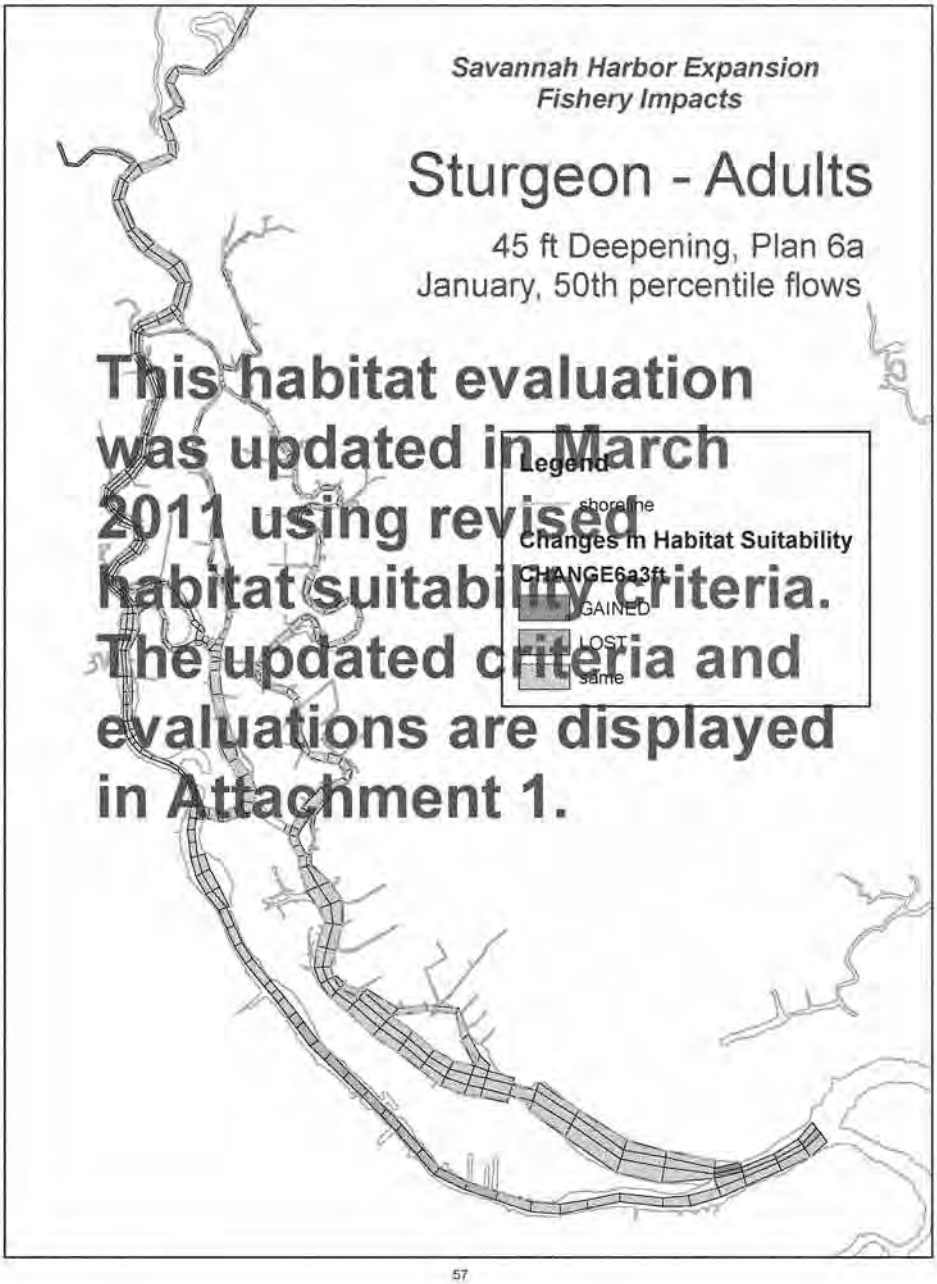

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
45 ft Deepening, Plan 6a
April, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft20
GAINED
LOST
same


Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
45 ft Deepening, Plan 6a
April, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft50
GAINED
LOST
same

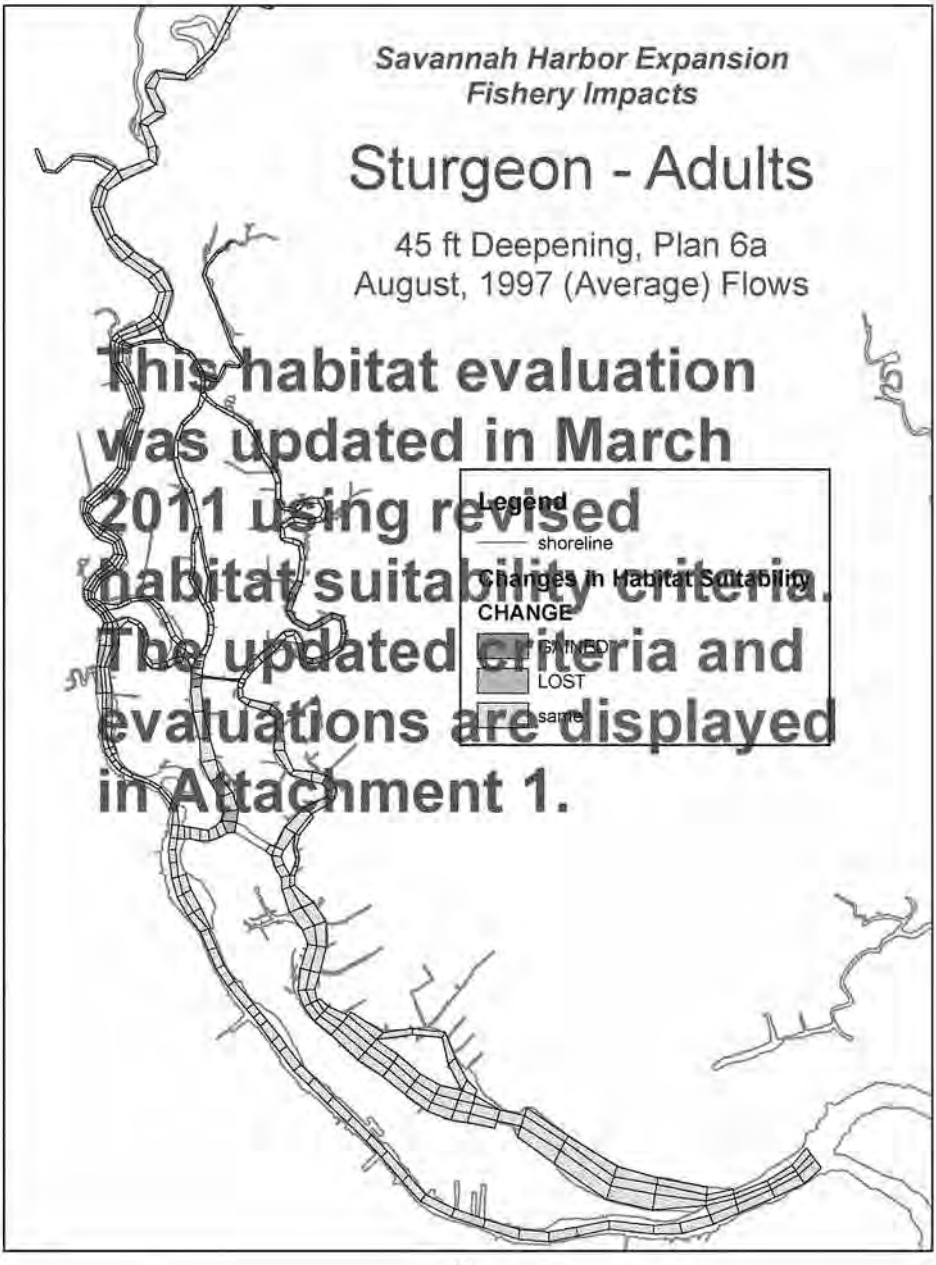

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
45 ft Deepening, Plan 6a
April, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a3ft80
GAINED
LOST
same



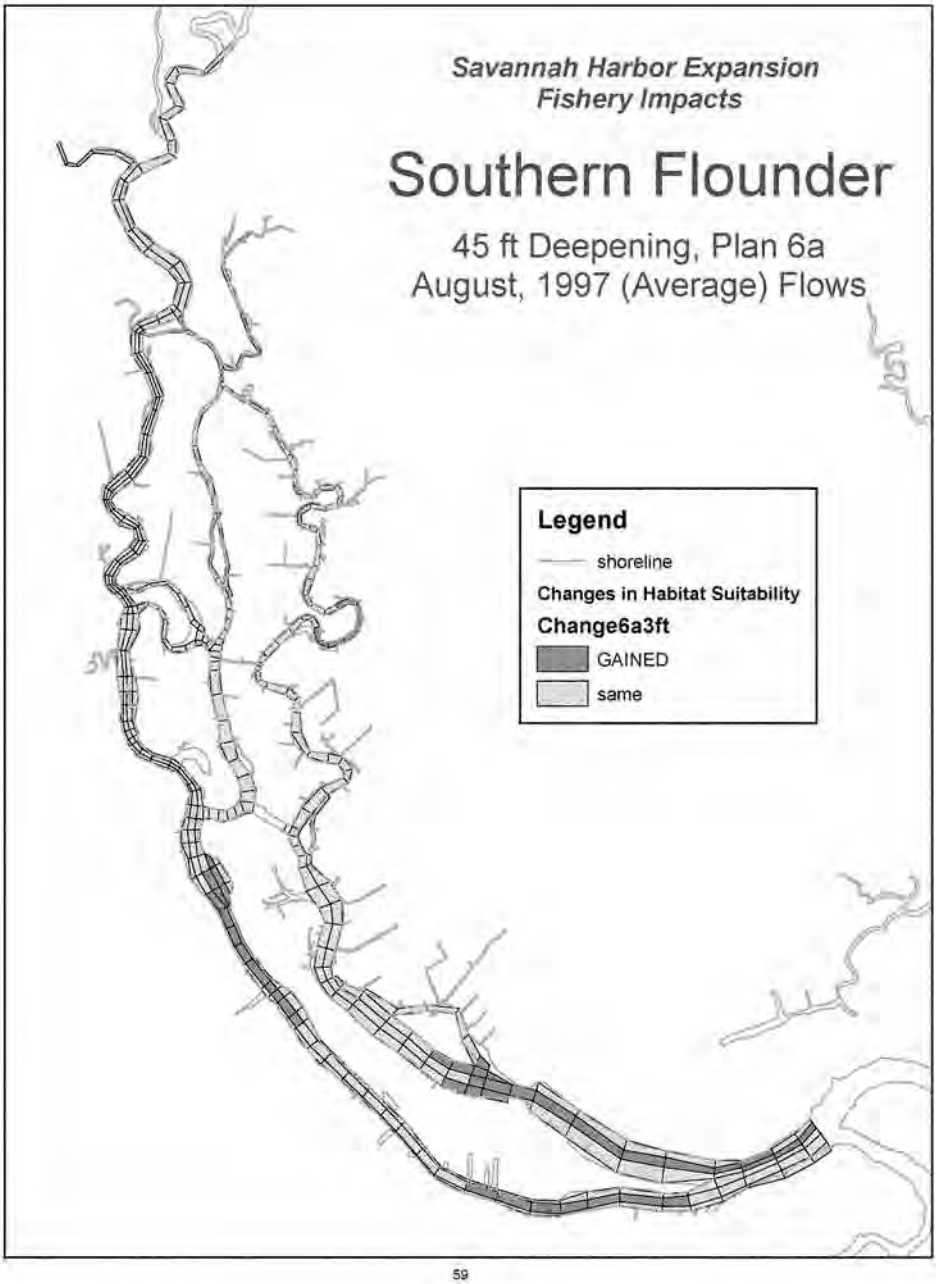
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.



This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.

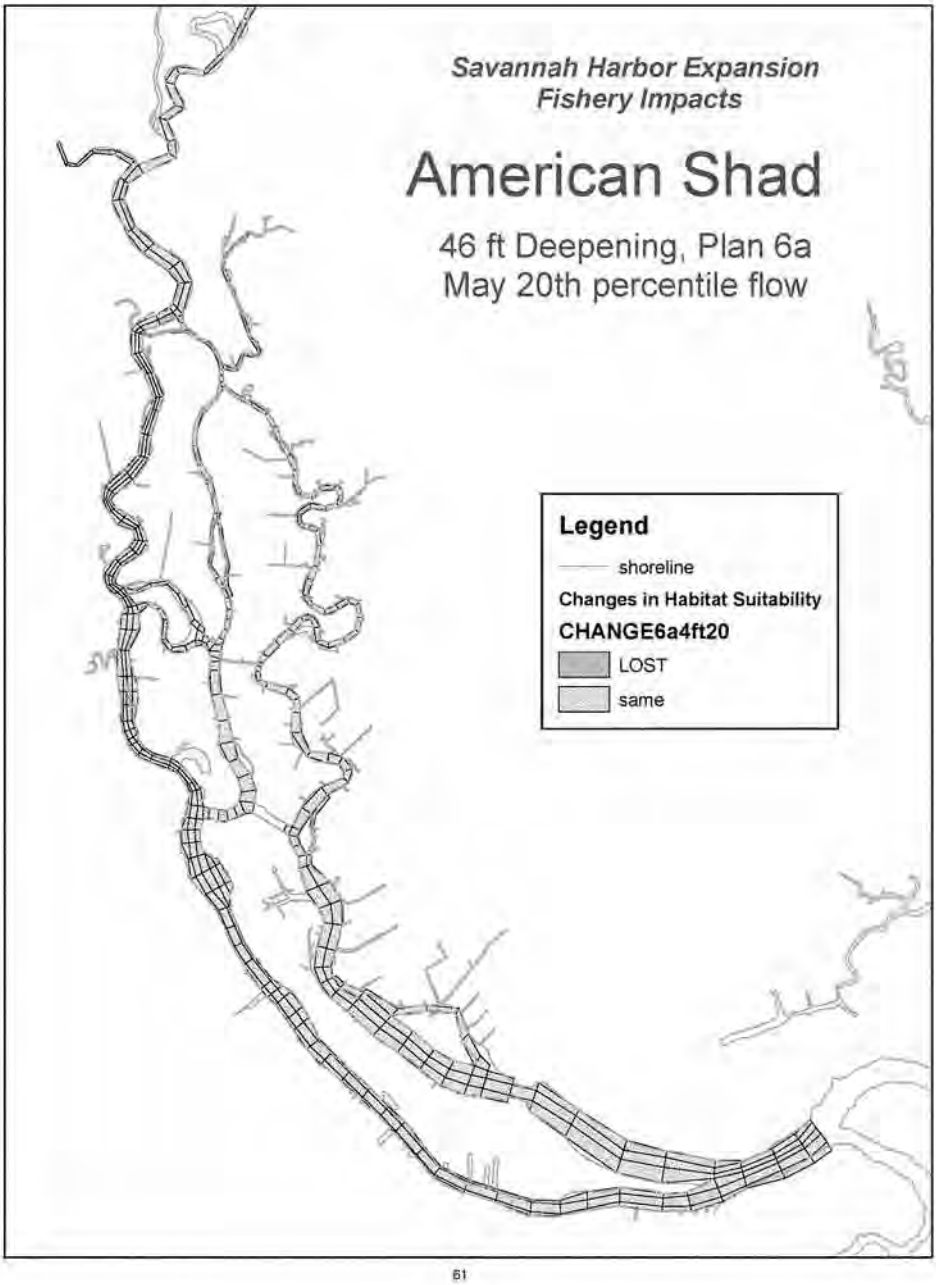


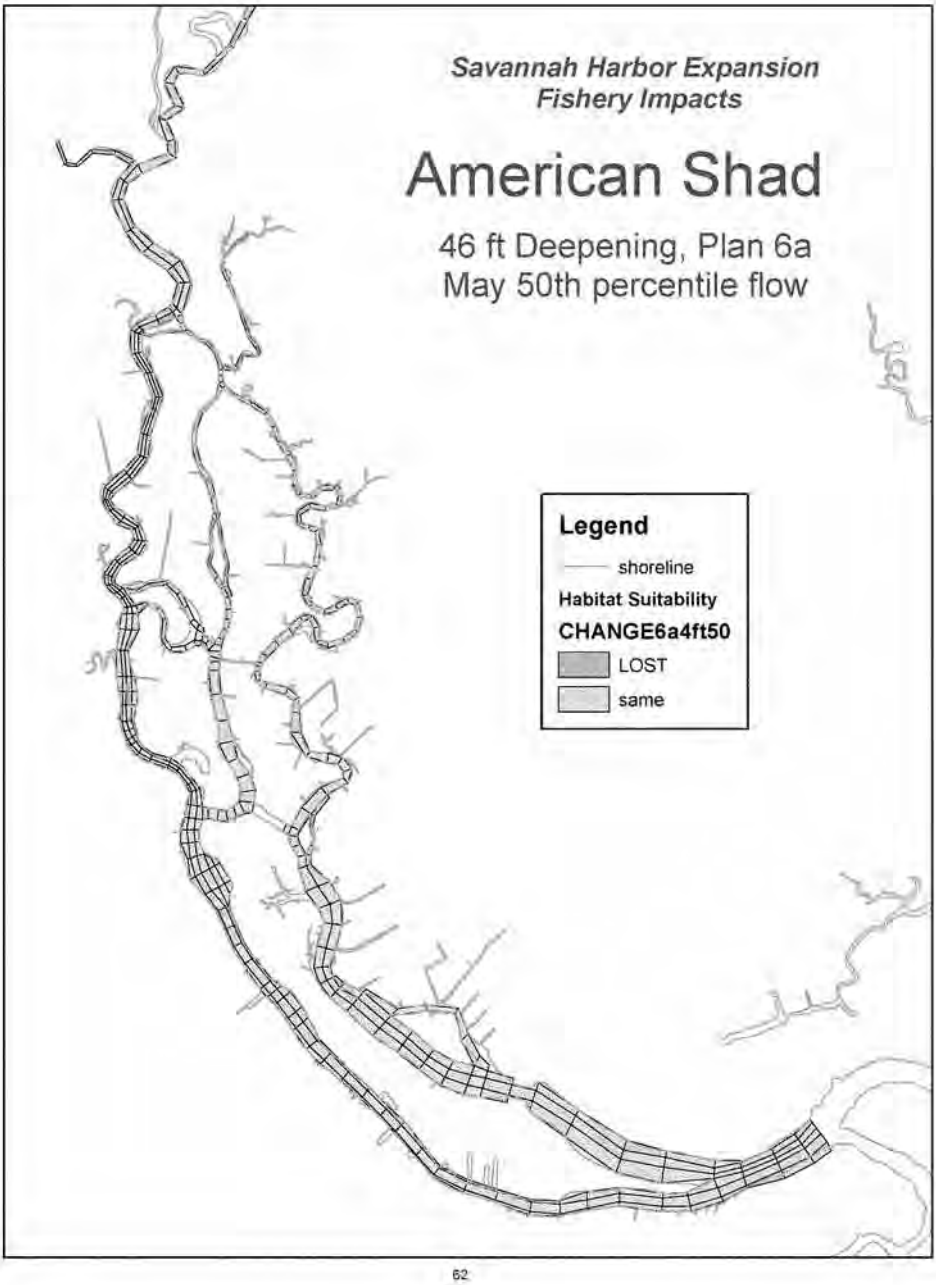
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.

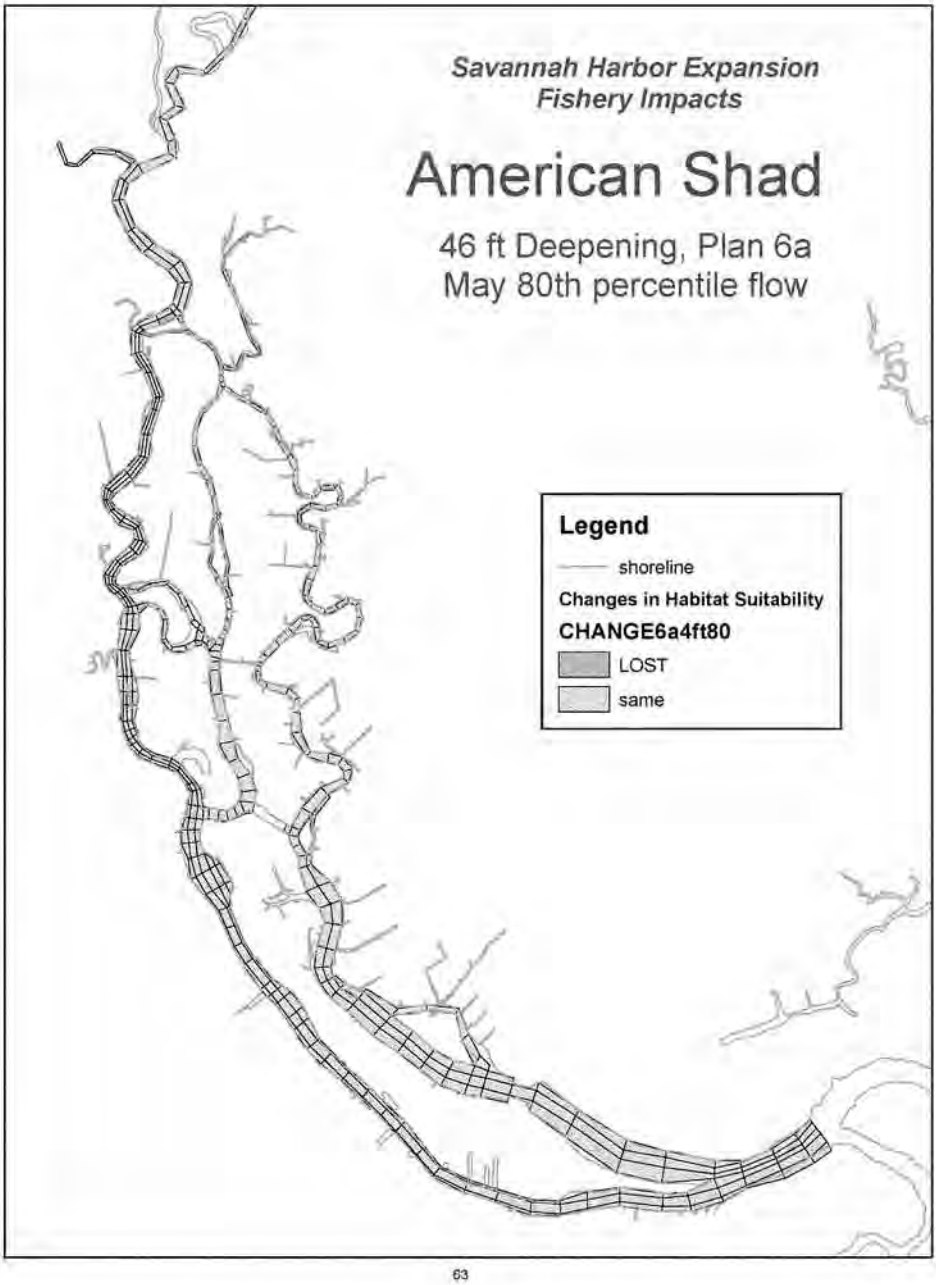

Savannah Harbor Expansion
Fishery Impacts
Southern Flounder
45 ft Deepening, Plan 6a
August, 1997 (Average) Flows
Legend
shoreline
Changes in Habitat Suitability
Change6a3ft
GAINED
same

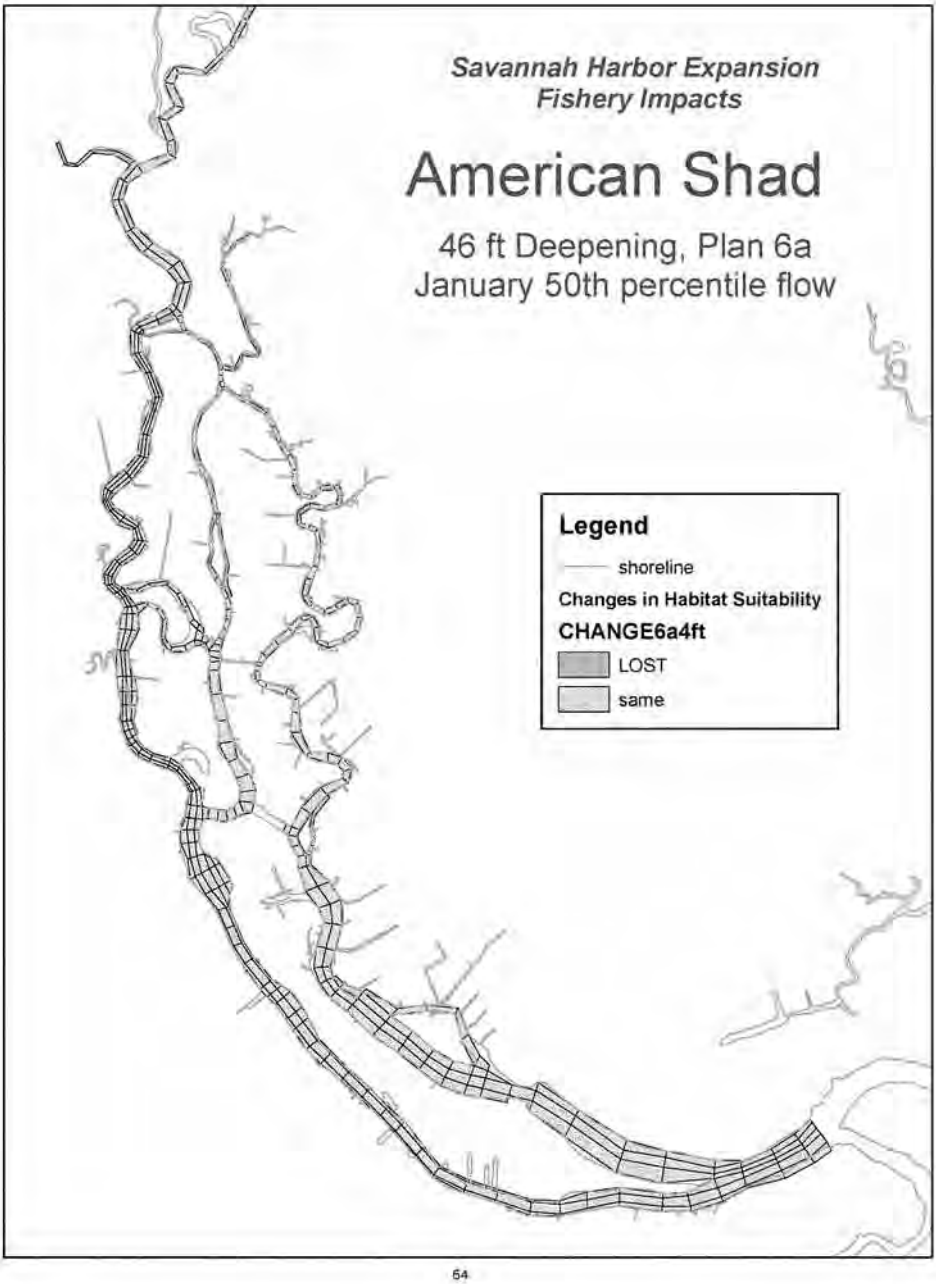
46 ft Channel Depth

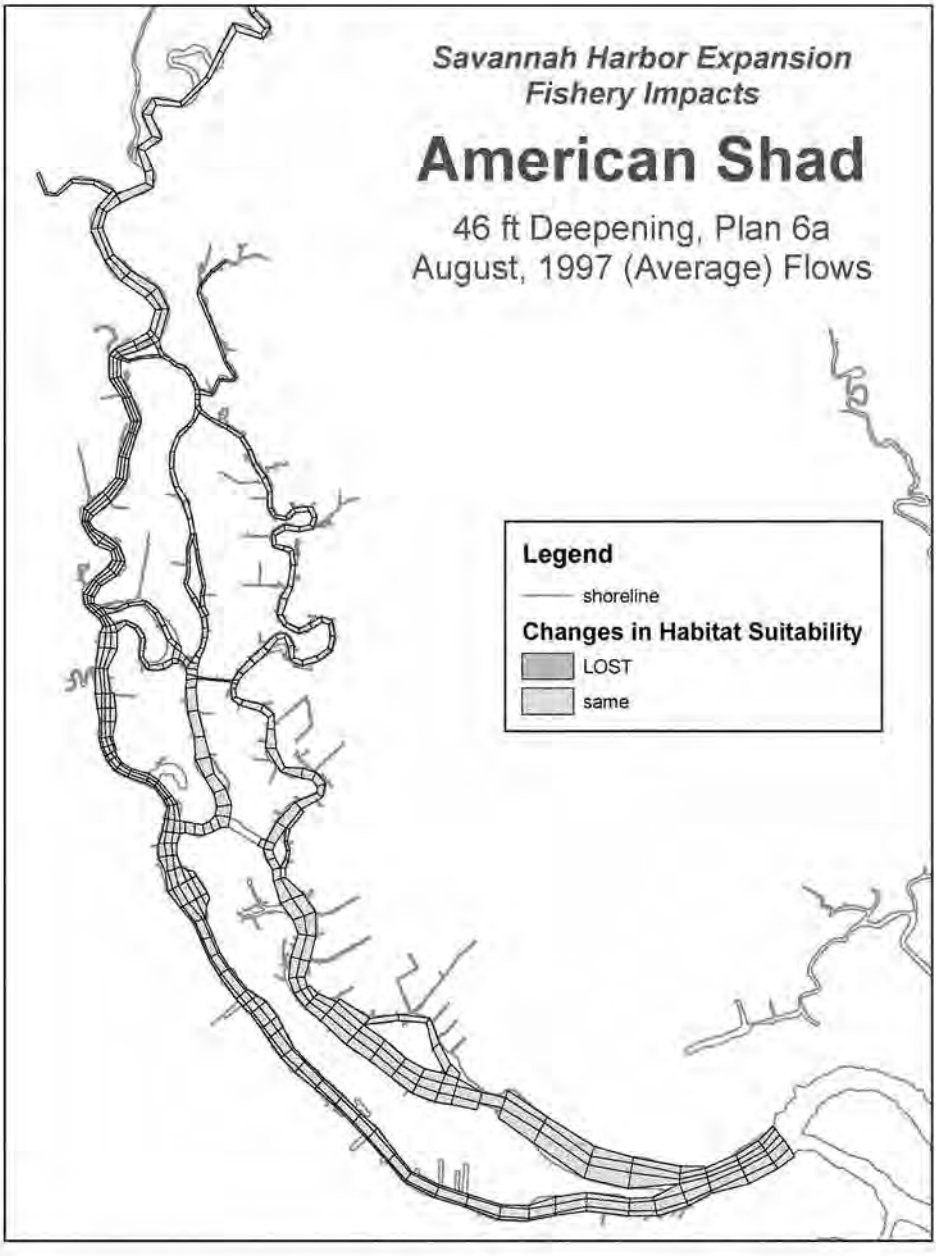
Mitigation Plan 6a

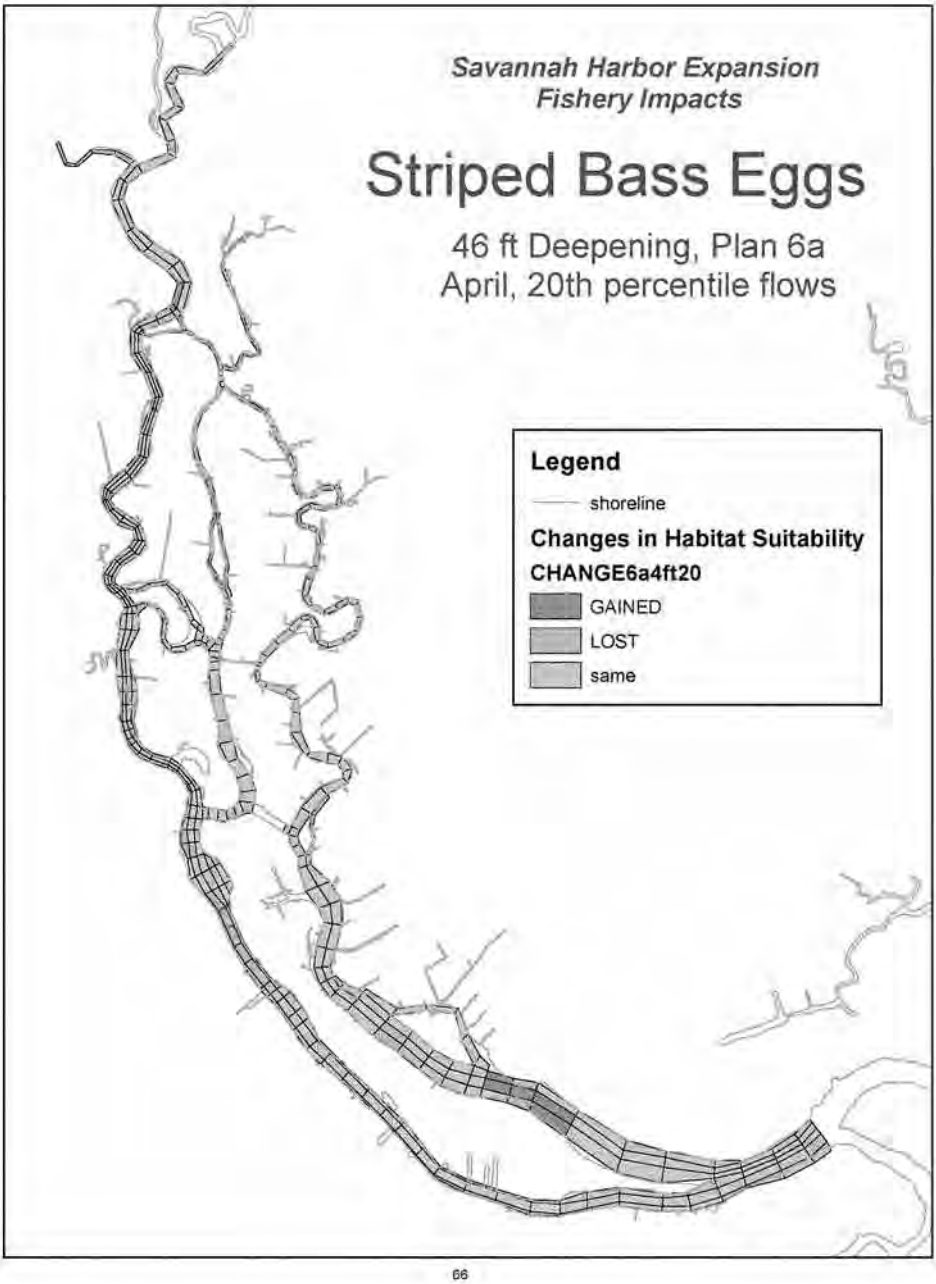

Savannah Harbor Expansion
Fishery Impacts
American Shad
46 ft Deepening, Plan 6a
May 20th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft20
LOST
same

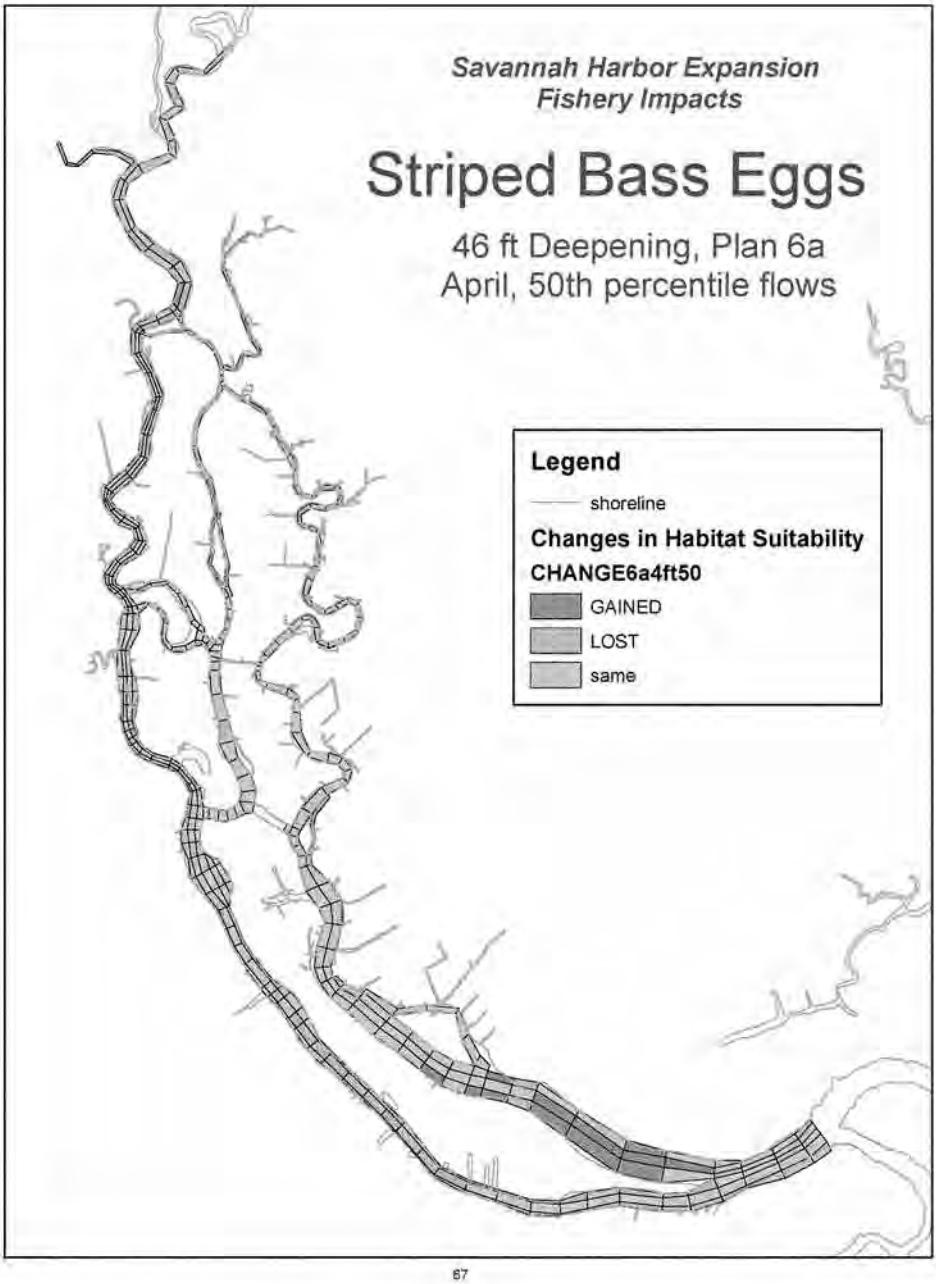

Savannah Harbor Expansion
Fishery Impacts
American Shad
46 ft Deepening, Plan 6a
May 50th percentile flow
Legend
shoreline
Habitat Suitability
CHANGE6a4ft50
LOST
same

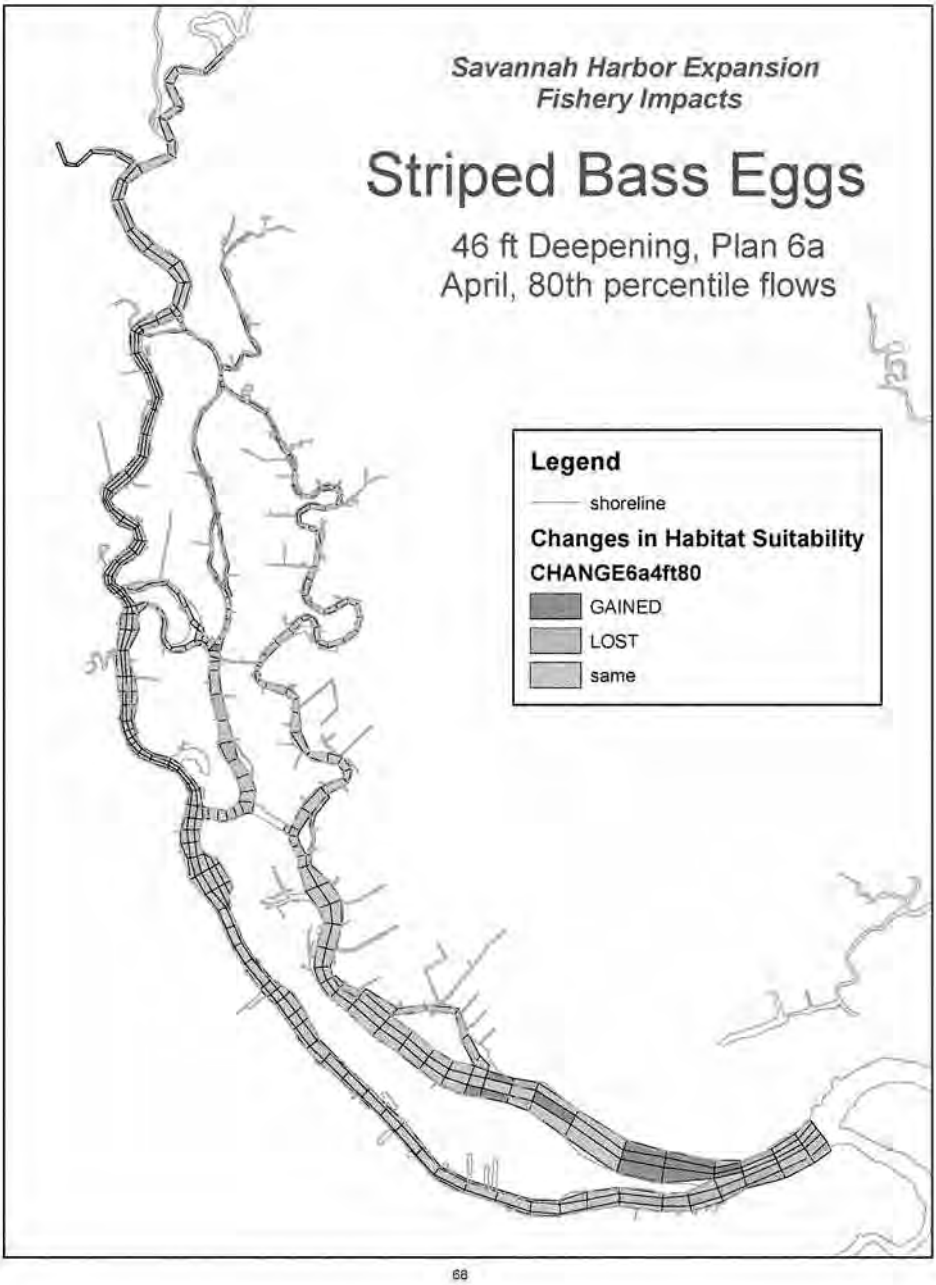

Savannah Harbor Expansion
Fishery Impacts
American Shad
46 ft Deepening, Plan 6a
May 80th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft80
LOST
same

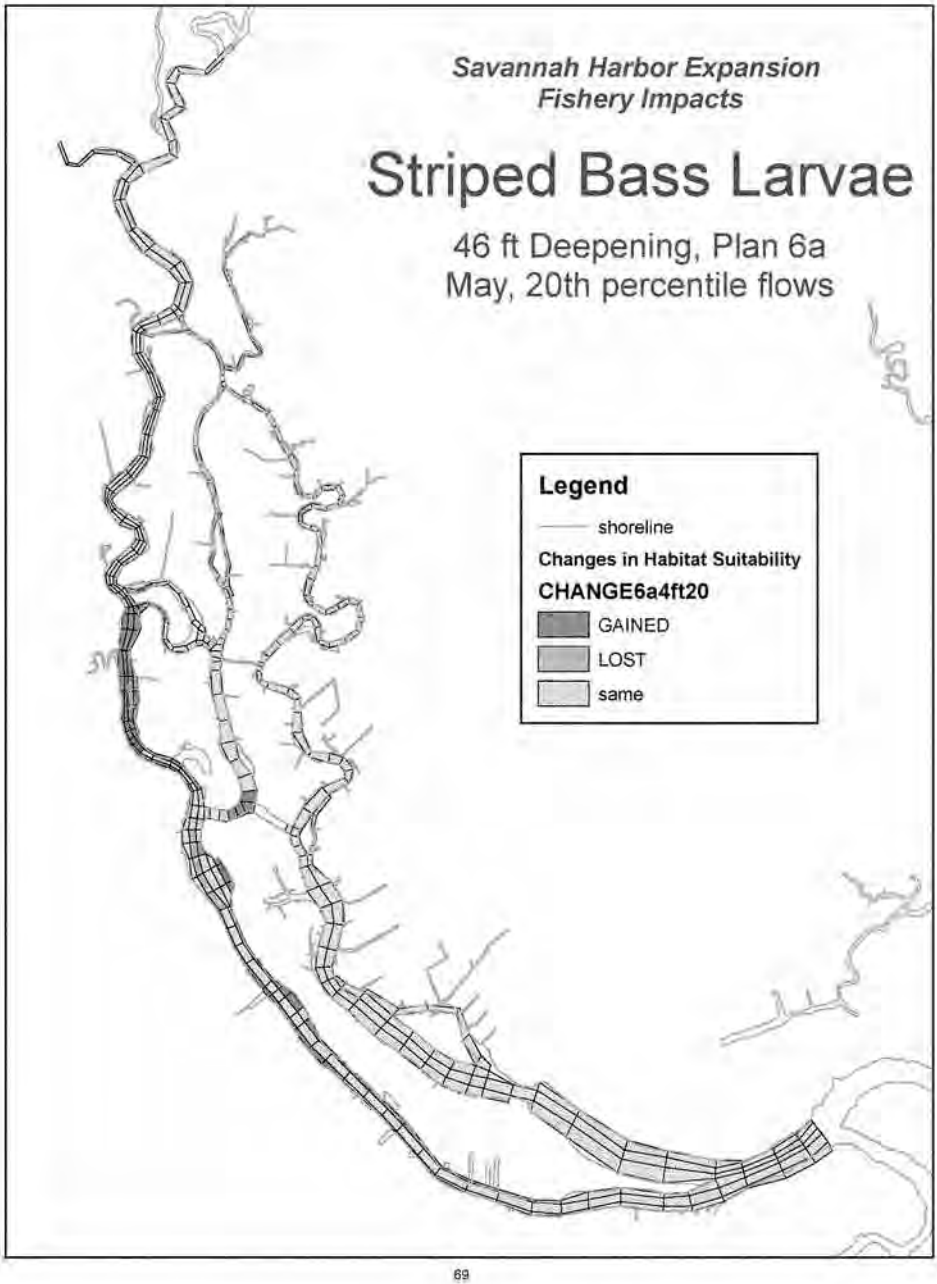

Savannah Harbor Expansion
Fishery Impacts
American Shad
46 ft Deepening, Plan 6a
January 50th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft
LOST
same

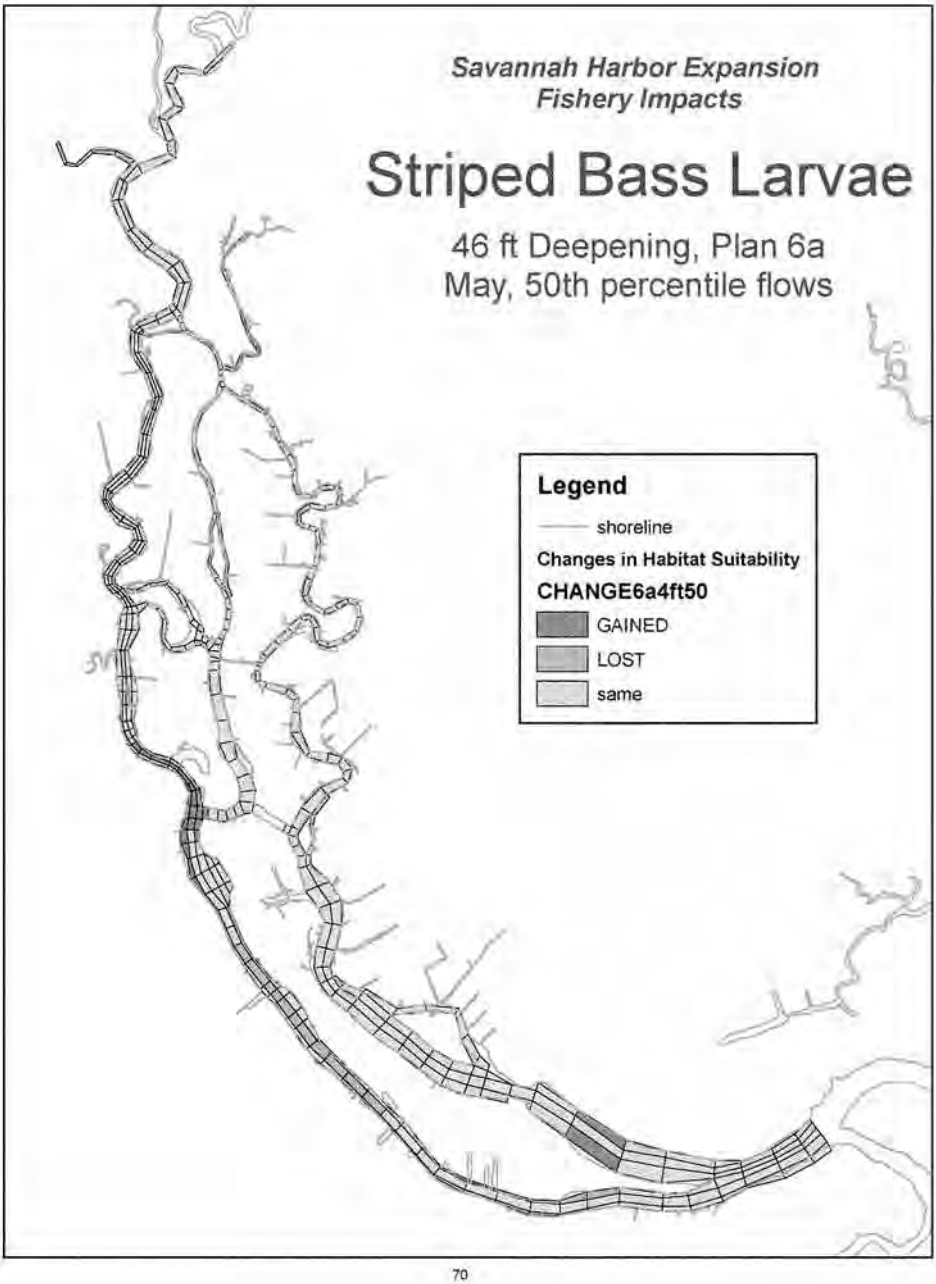

Savannah Harbor Expansion
Fishery Impacts
American Shad
46 ft Deepening, Plan 6a
August, 1997 (Average) Flows
Legend
shoreline
Changes in Habitat Suitability
LOST
same

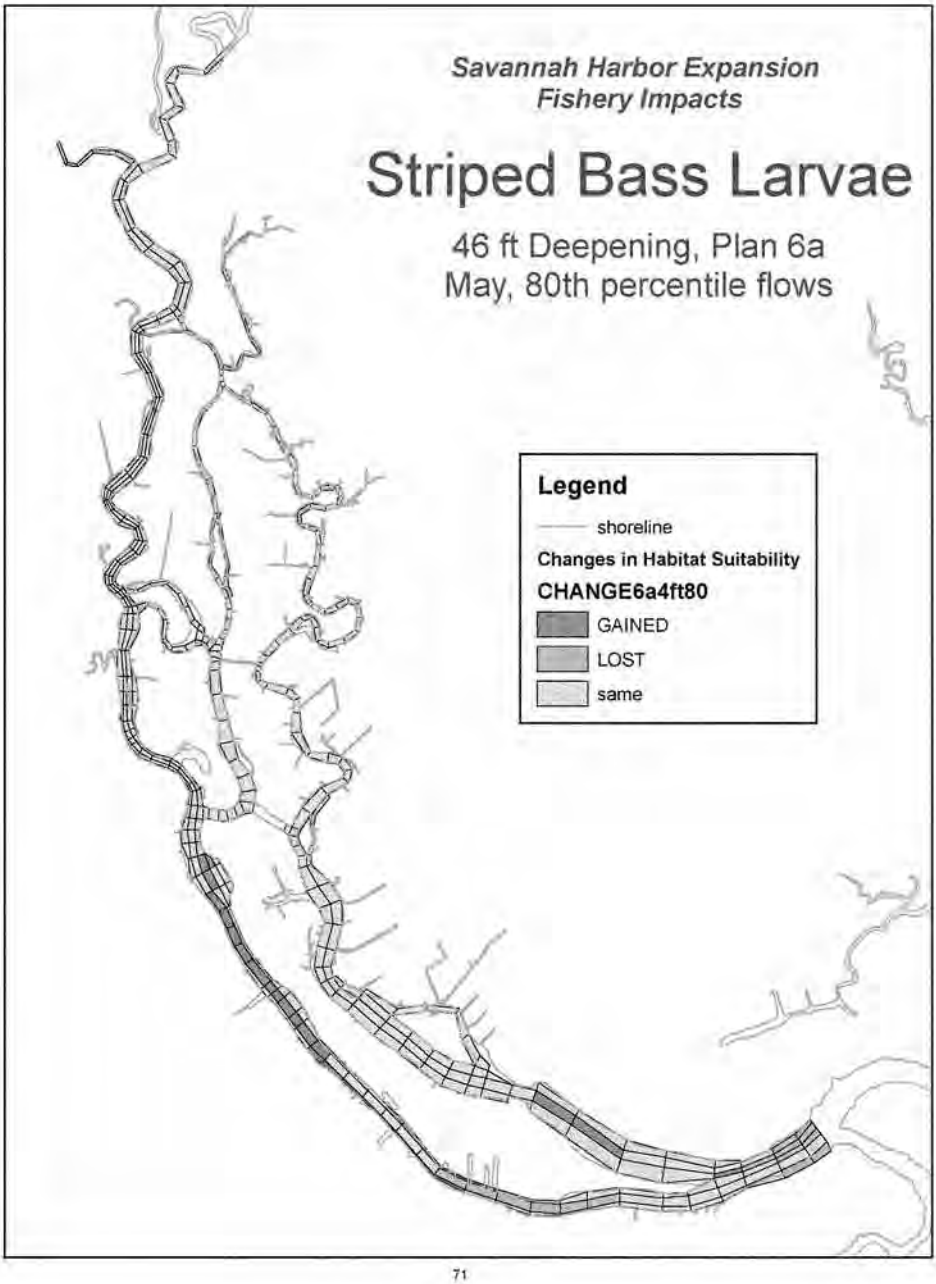

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
46 ft Deepening, Plan 6a
April, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft20
GAINED
LOST
same

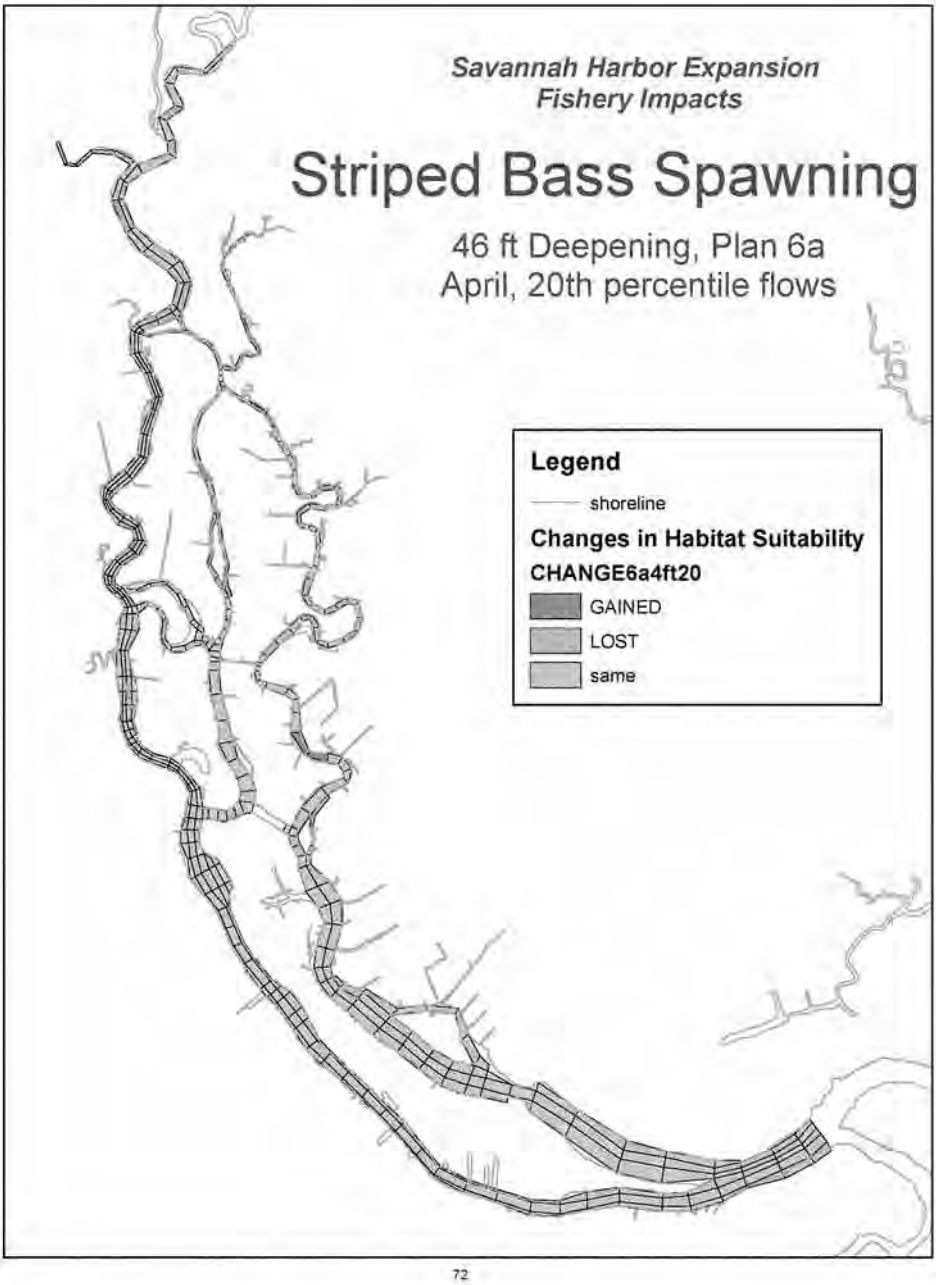

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
46 ft Deepening, Plan 6a
April, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft50
GAINED
LOST
same

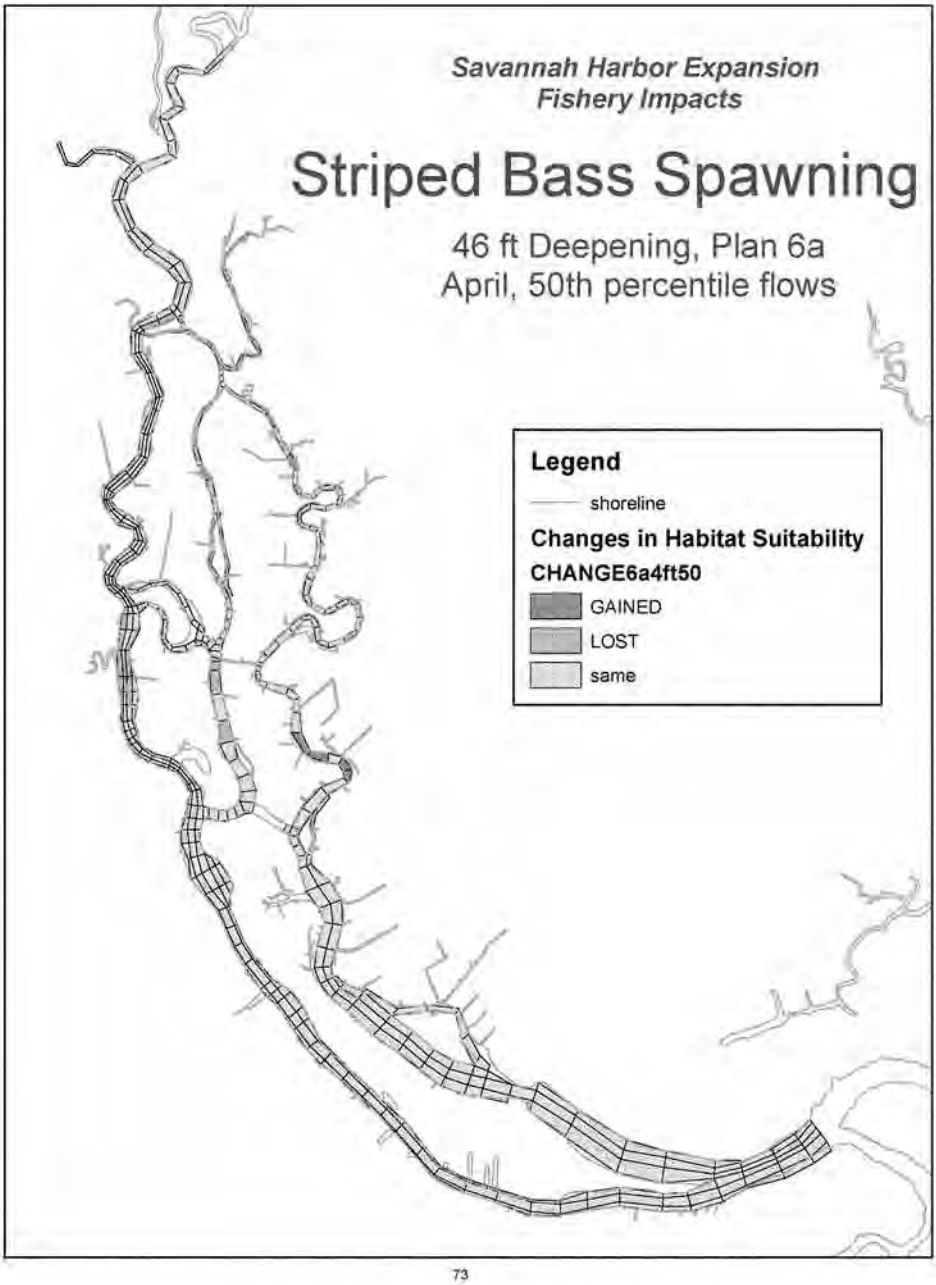

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
46 ft Deepening, Plan 6a
April, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft80
GAINED
LOST
same

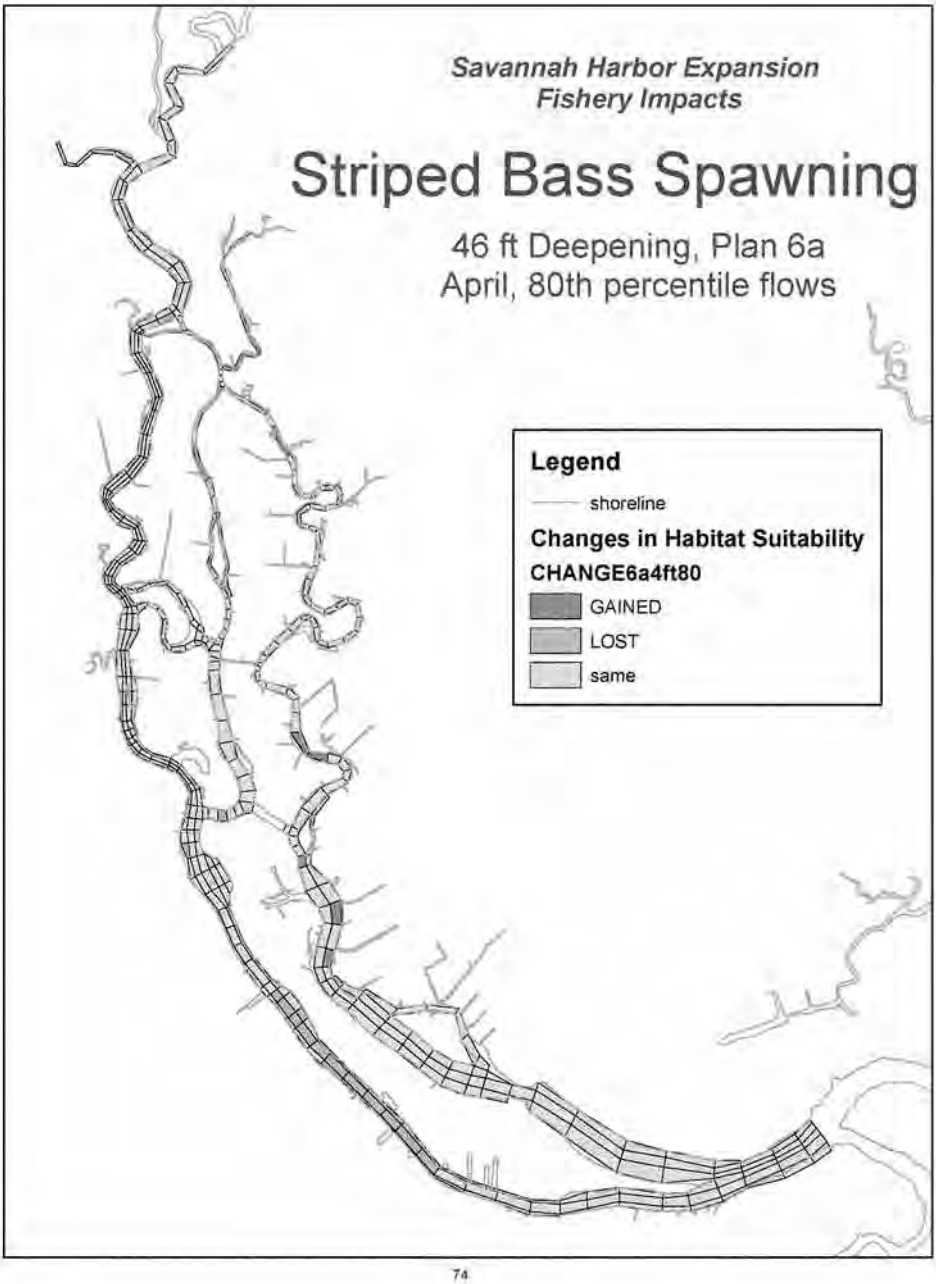

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
46 ft Deepening, Plan 6a
May, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft20
GAINED
LOST
same

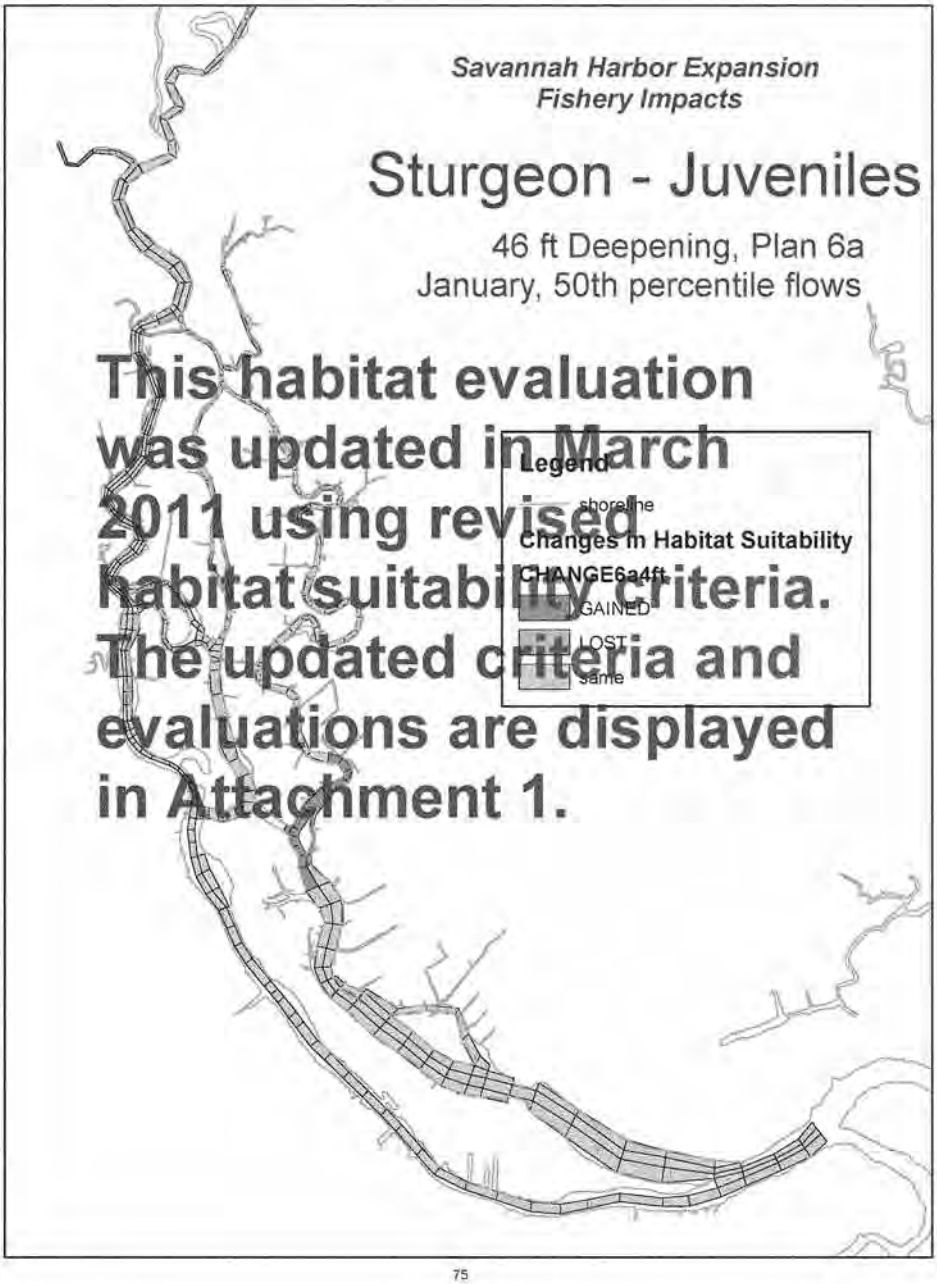

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
46 ft Deepening, Plan 6a
May, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft50
GAINED
LOST
same


Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
46 ft Deepening, Plan 6a
May, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft80
GAINED
LOST
same

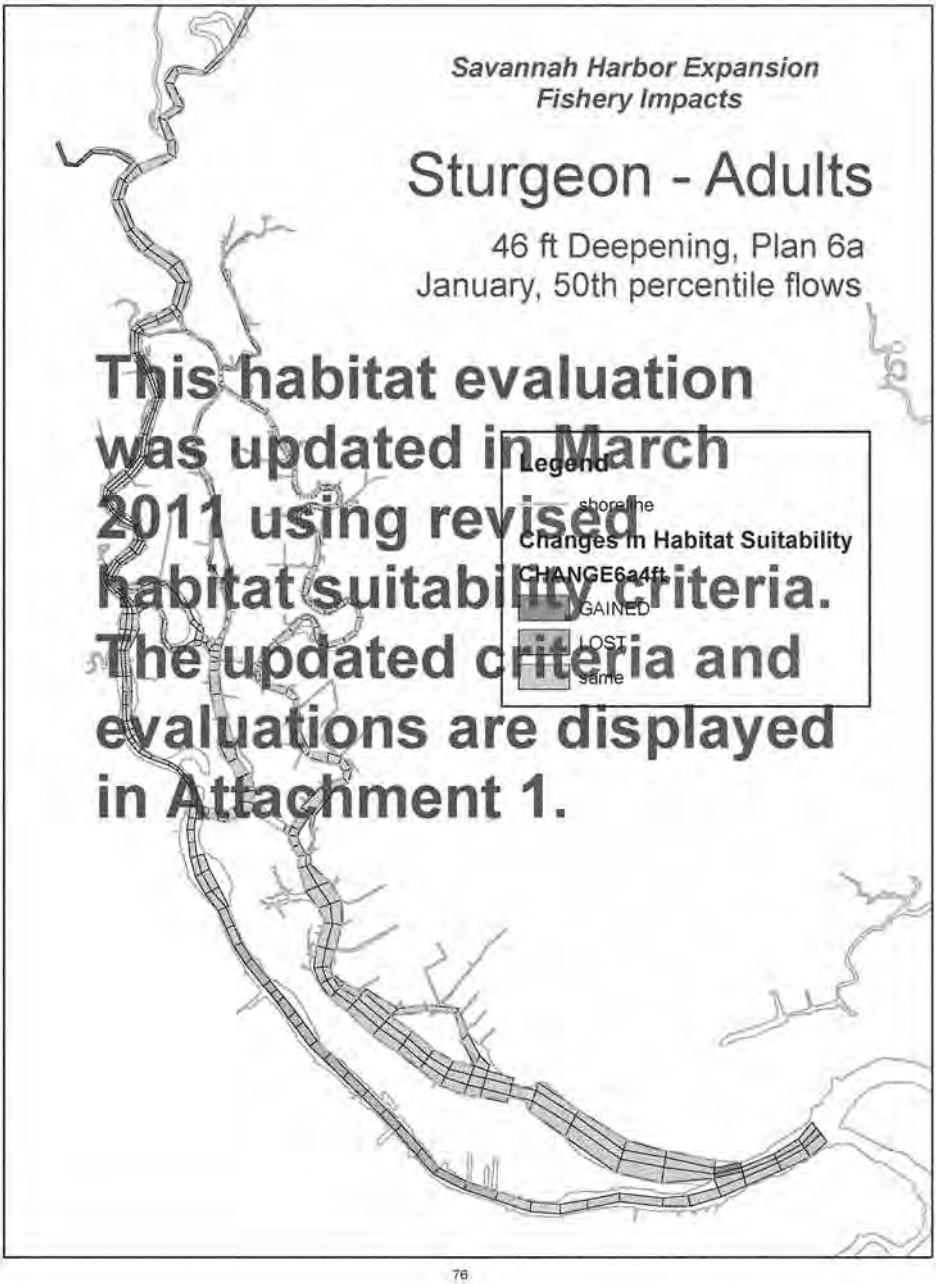

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
46 ft Deepening, Plan 6a
April, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft20
GAINED
LOST
same


Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
46 ft Deepening, Plan 6a
April, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft50
GAINED
LOST
same

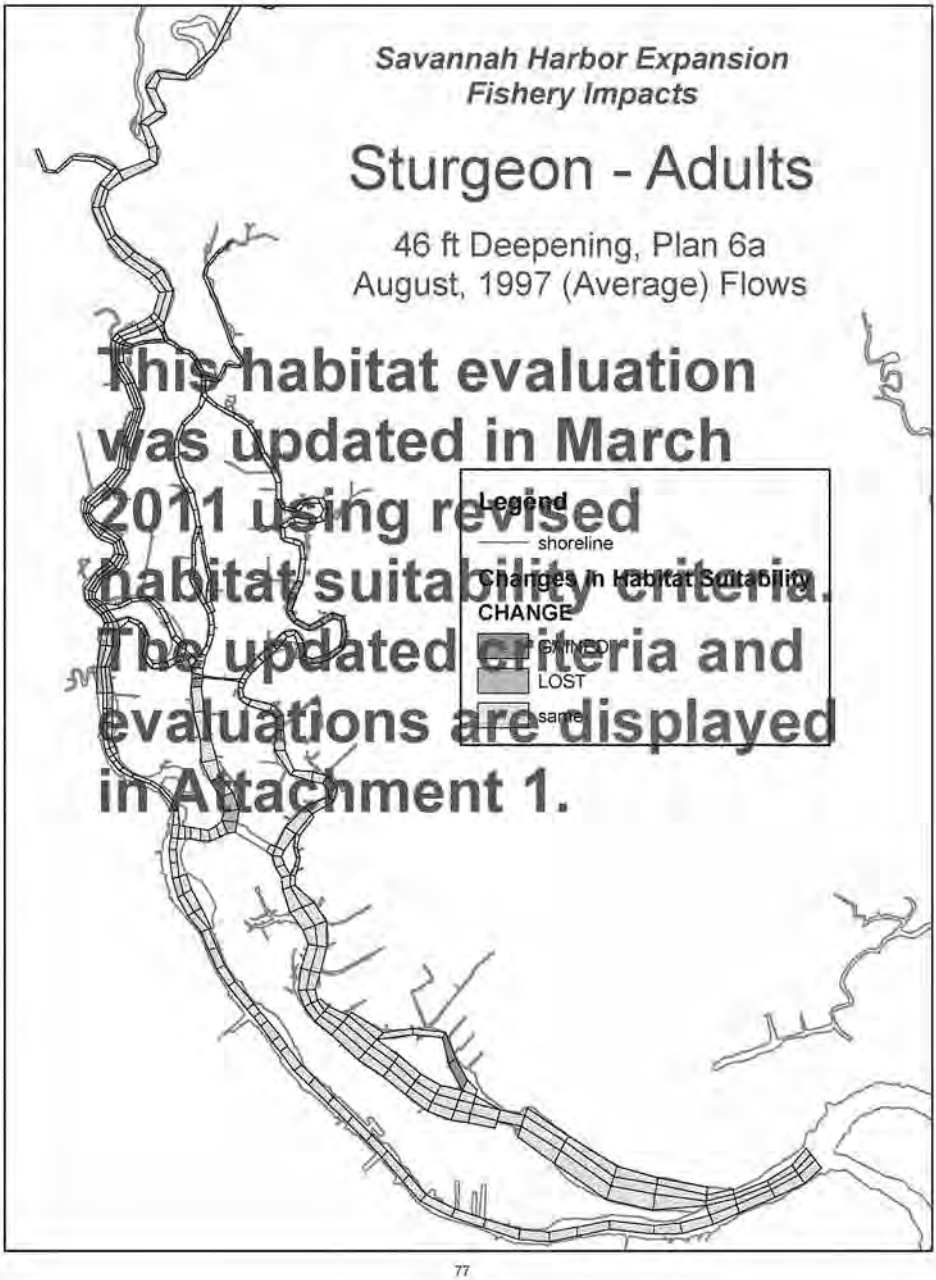

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
46 ft Deepening, Plan 6a
April, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a4ft80
GAINED
LOST
same



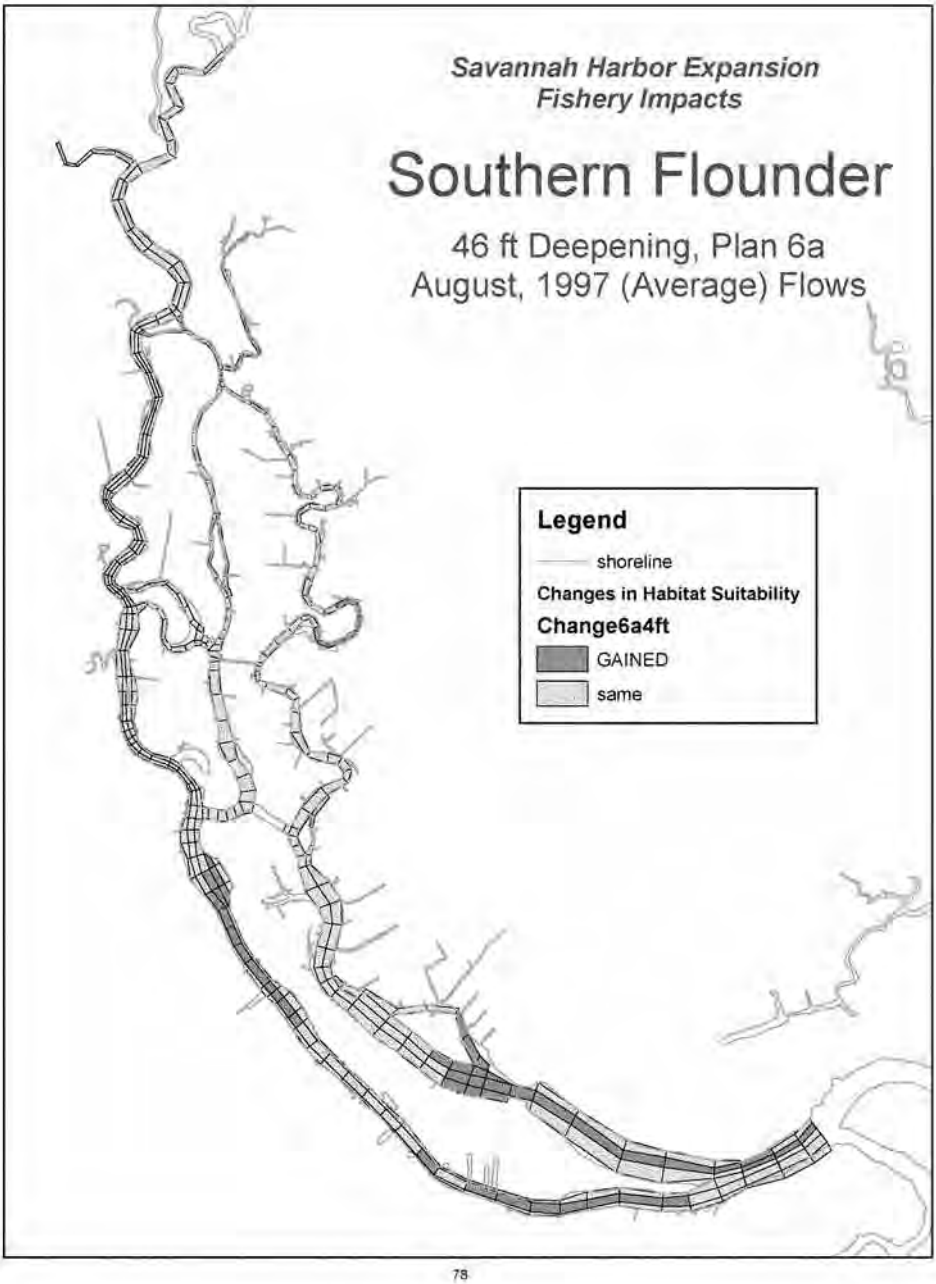
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.



This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.

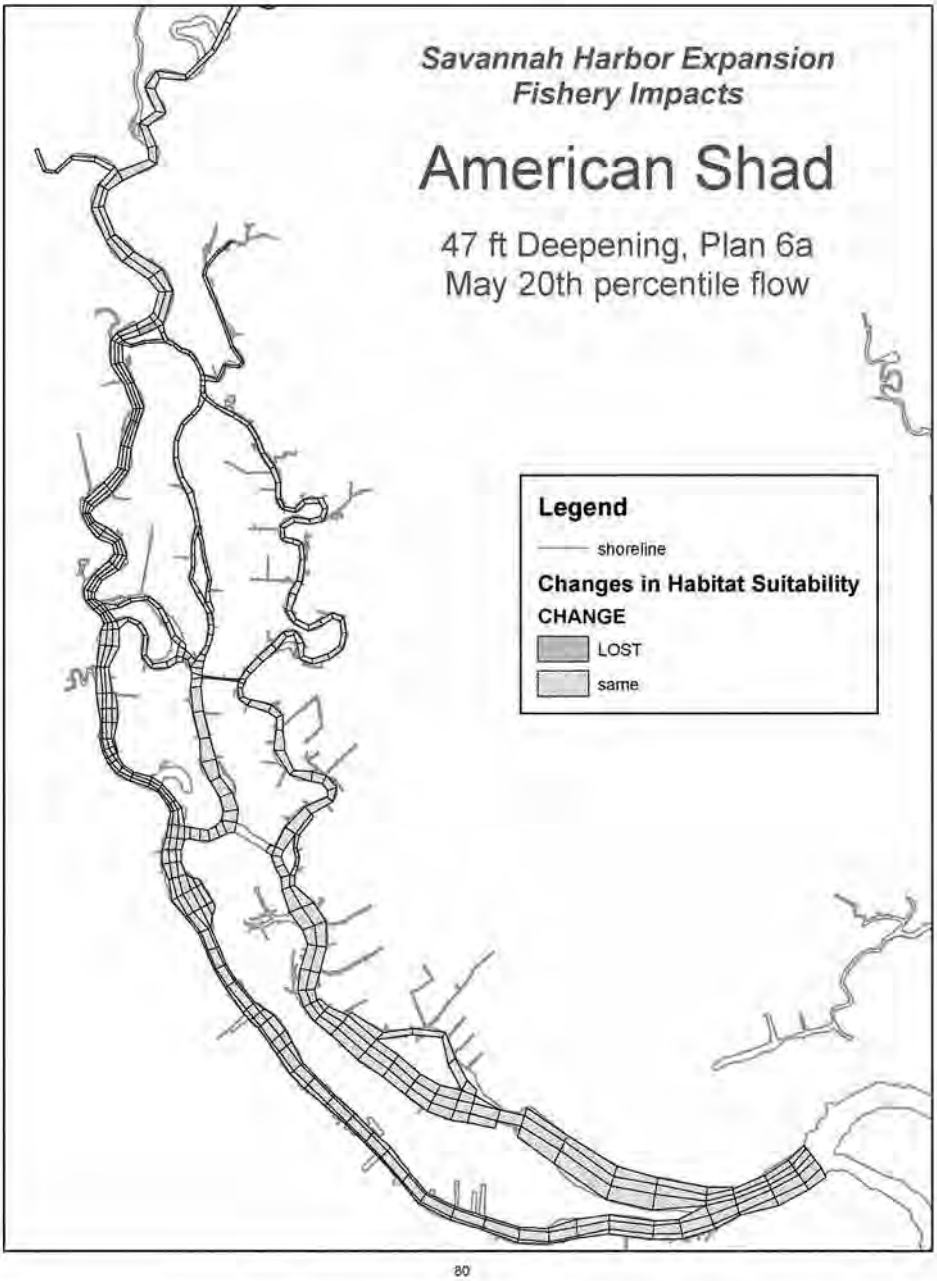


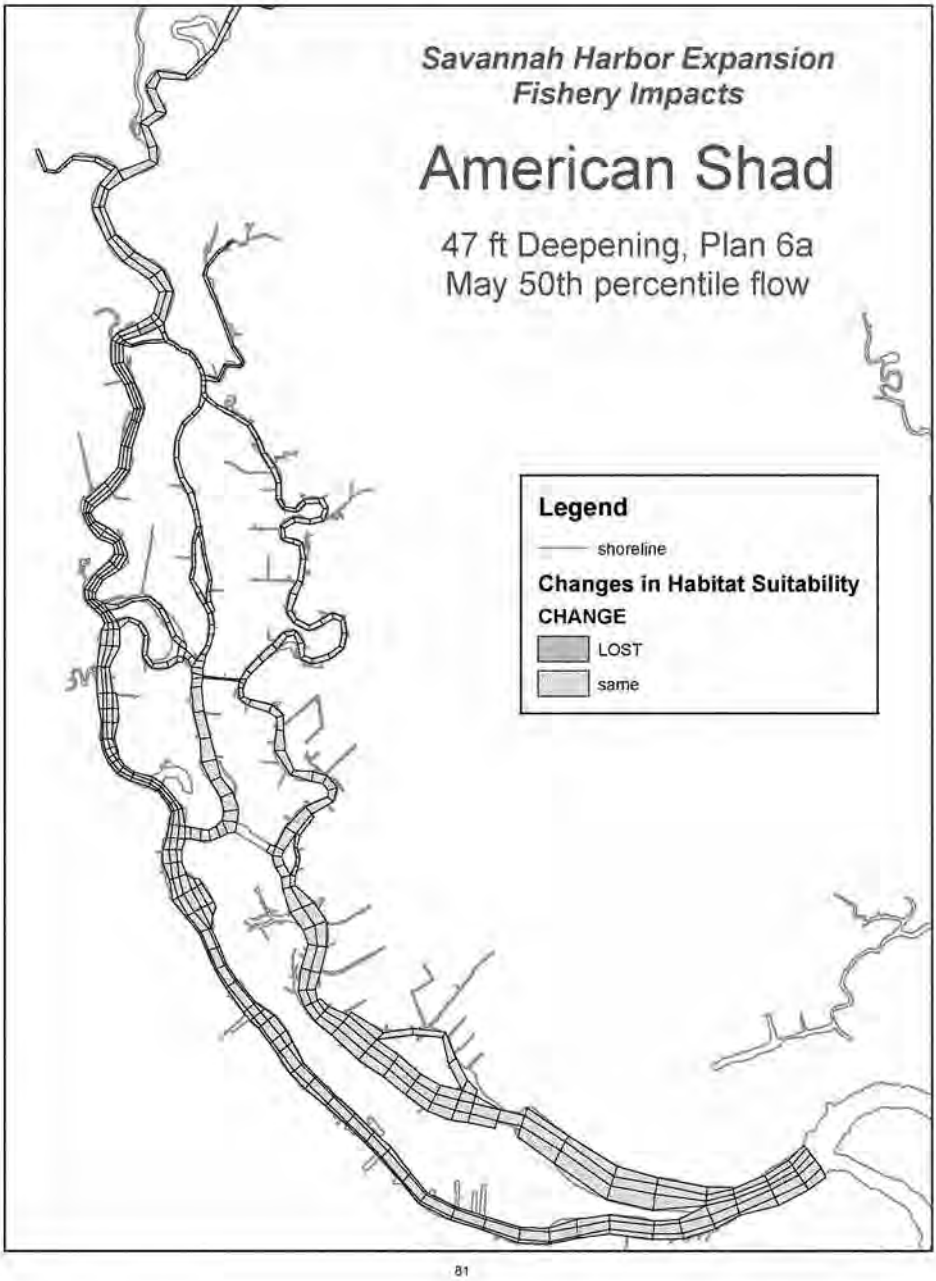
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.

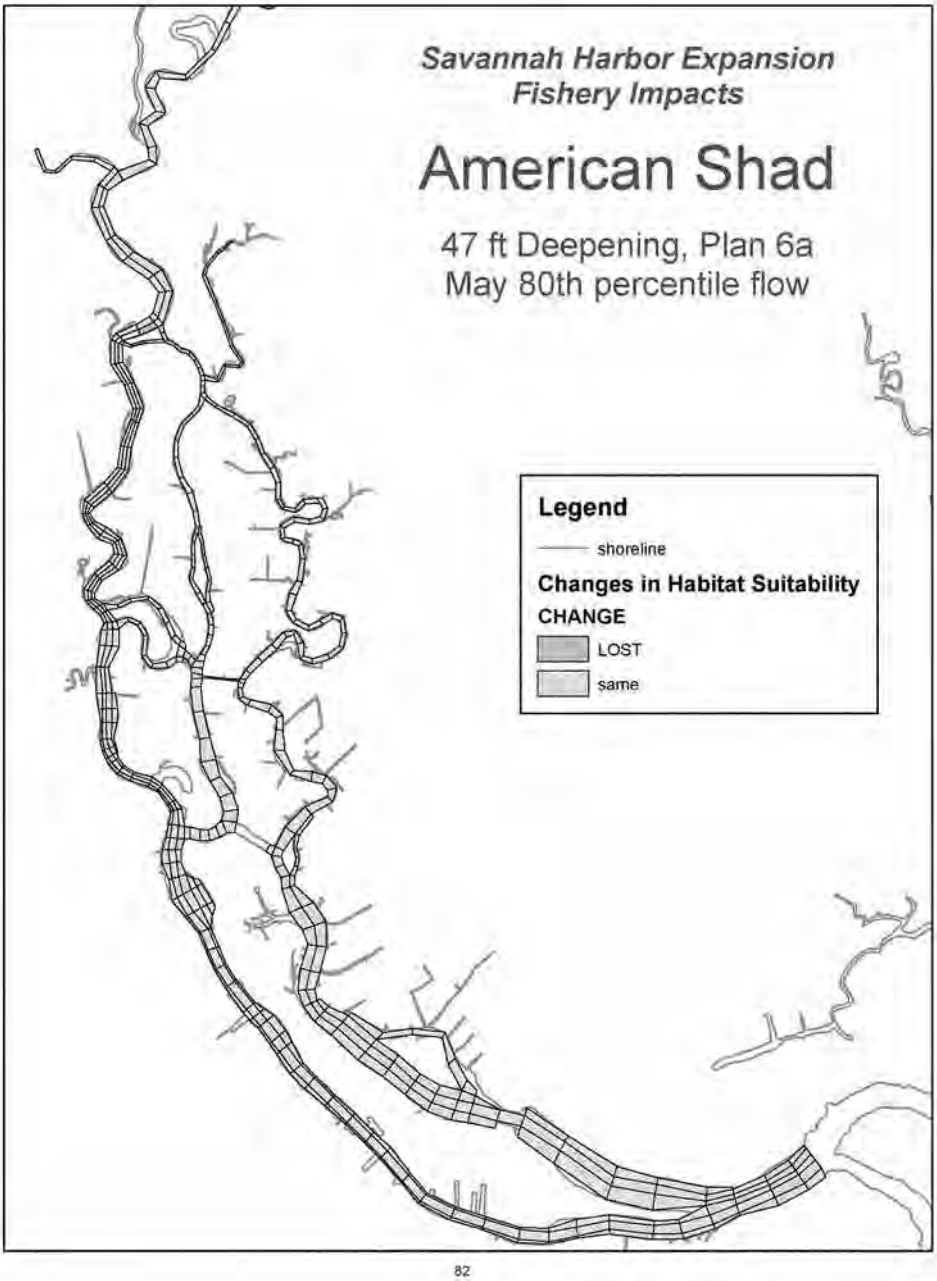

Savannah Harbor Expansion
Fishery Impacts
Southern Flounder
46 ft Deepening, Plan 6a
August, 1997 (Average) Flows
Legend
shoreline
Changes in Habitat Suitability
Change6a4ft
GAINED
same

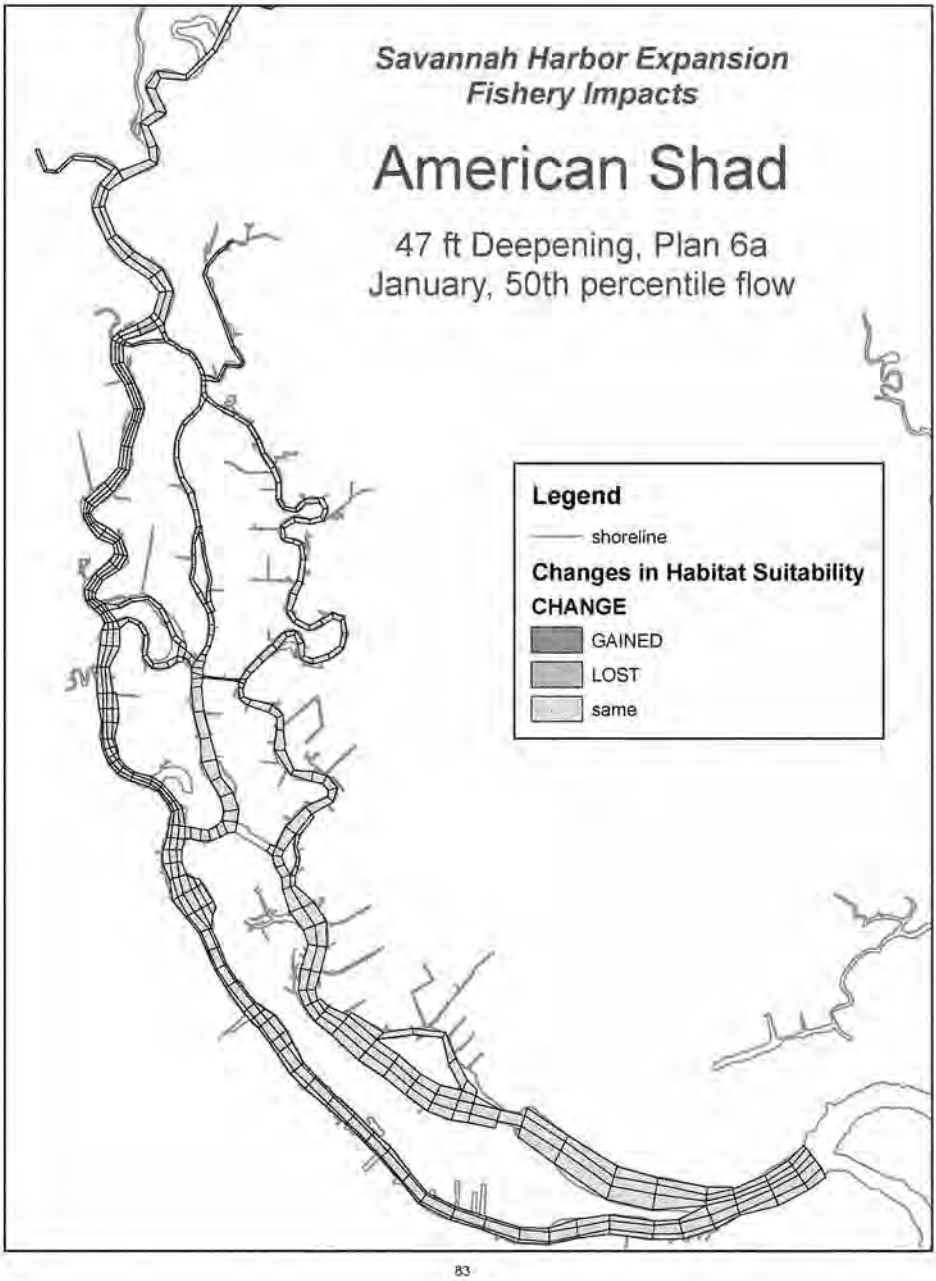
47 ft Channel Depth

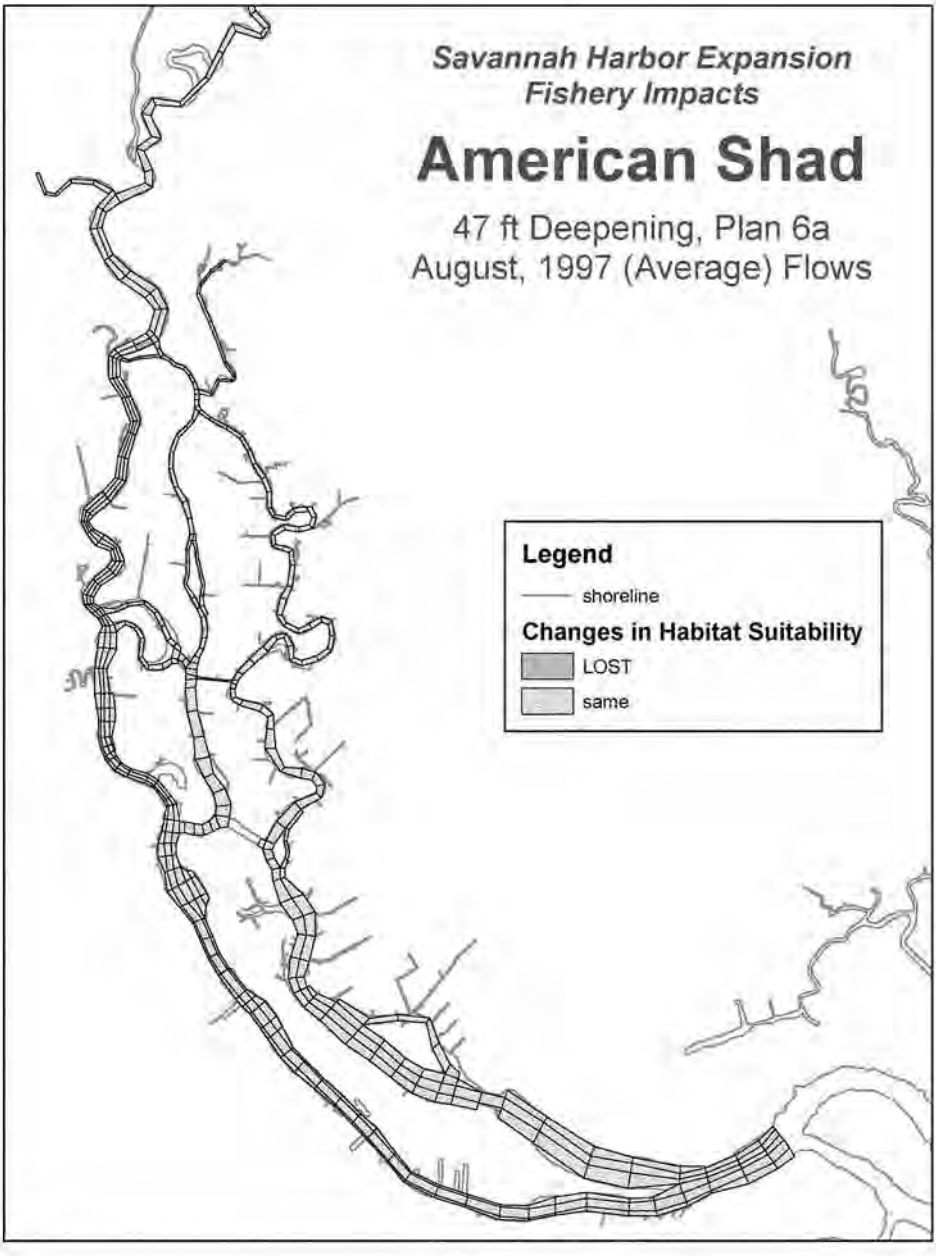
Mitigation Plan 6a

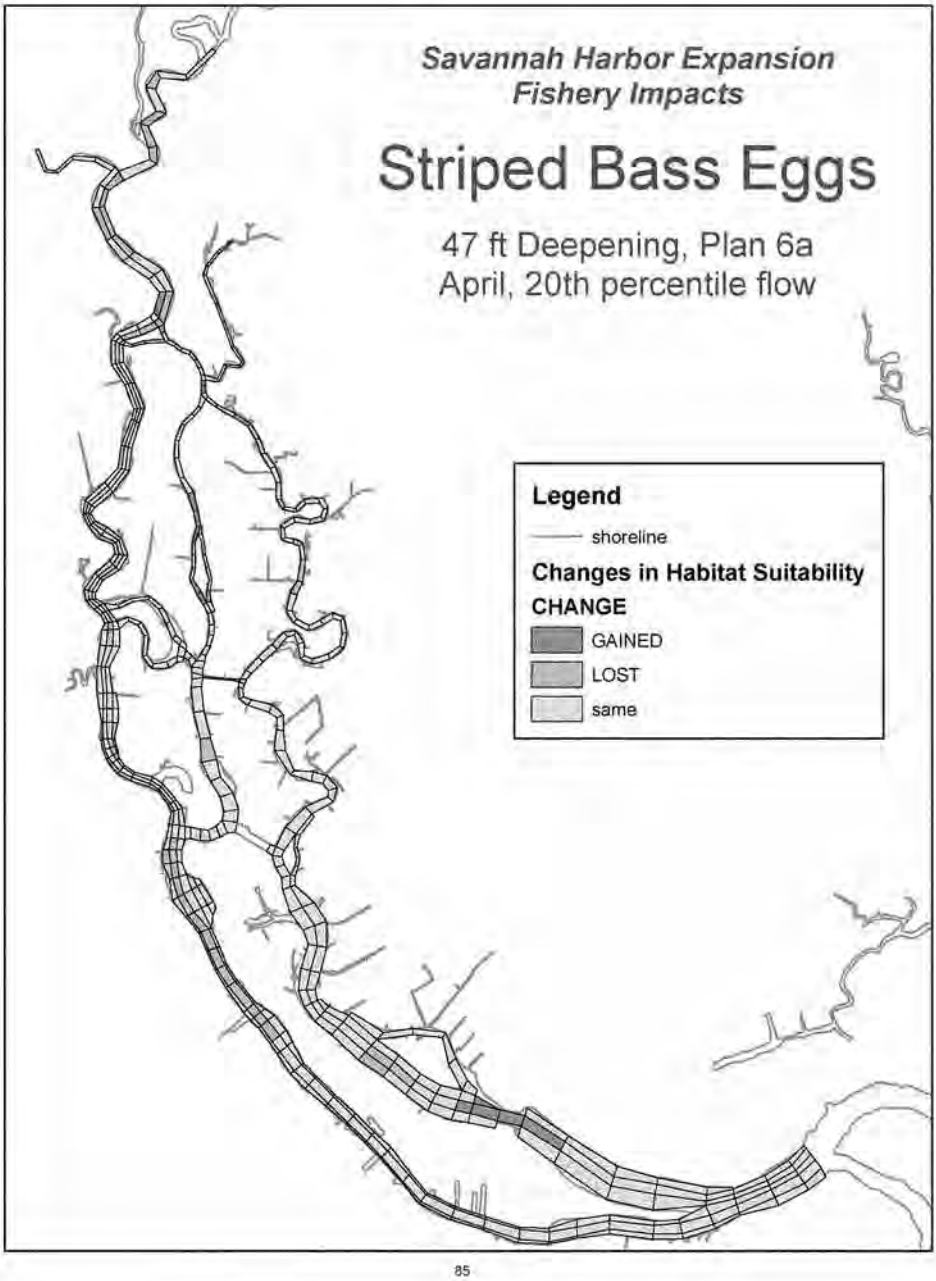

Savannah Harbor Expansion
Fishery Impacts
American Shad
47 ft Deepening, Plan 6a
May 20th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
LOST
same

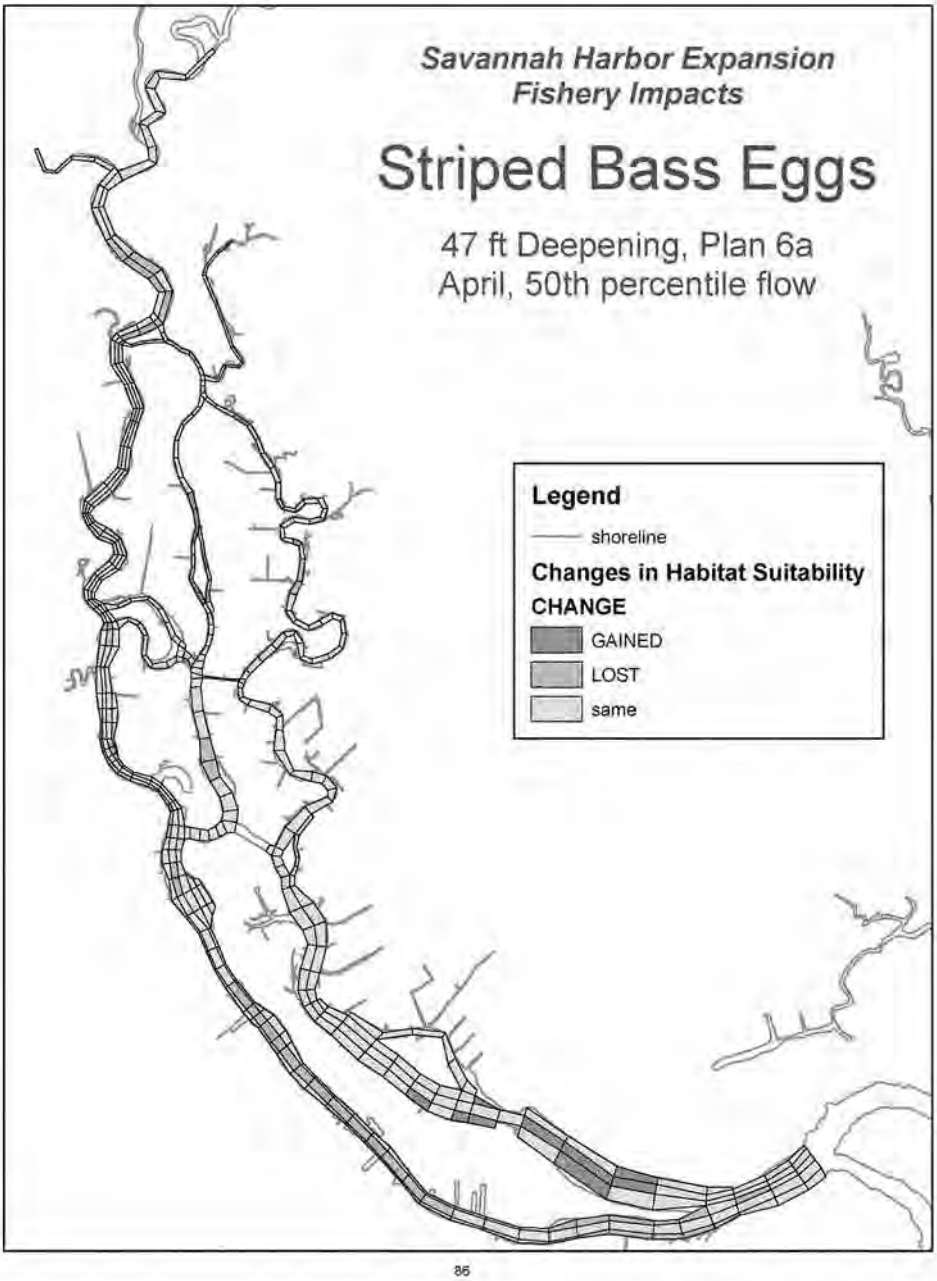

Savannah Harbor Expansion
Fishery Impacts
American Shad
47 ft Deepening, Plan 6a
May 50th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
LOST
same

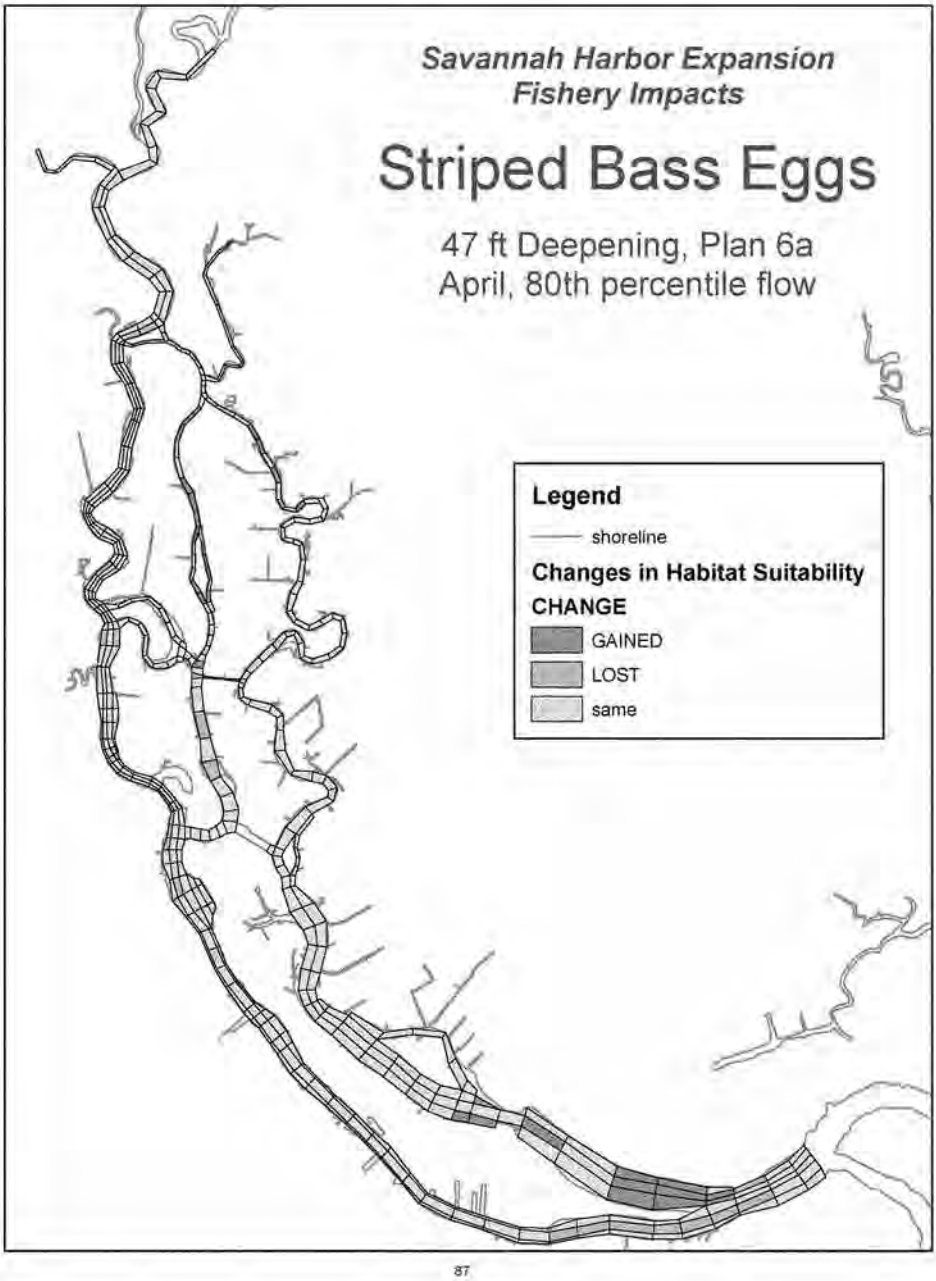

Savannah Harbor Expansion
Fishery Impacts
American Shad
47 ft Deepening, Plan 6a
May 80th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
LOST
same

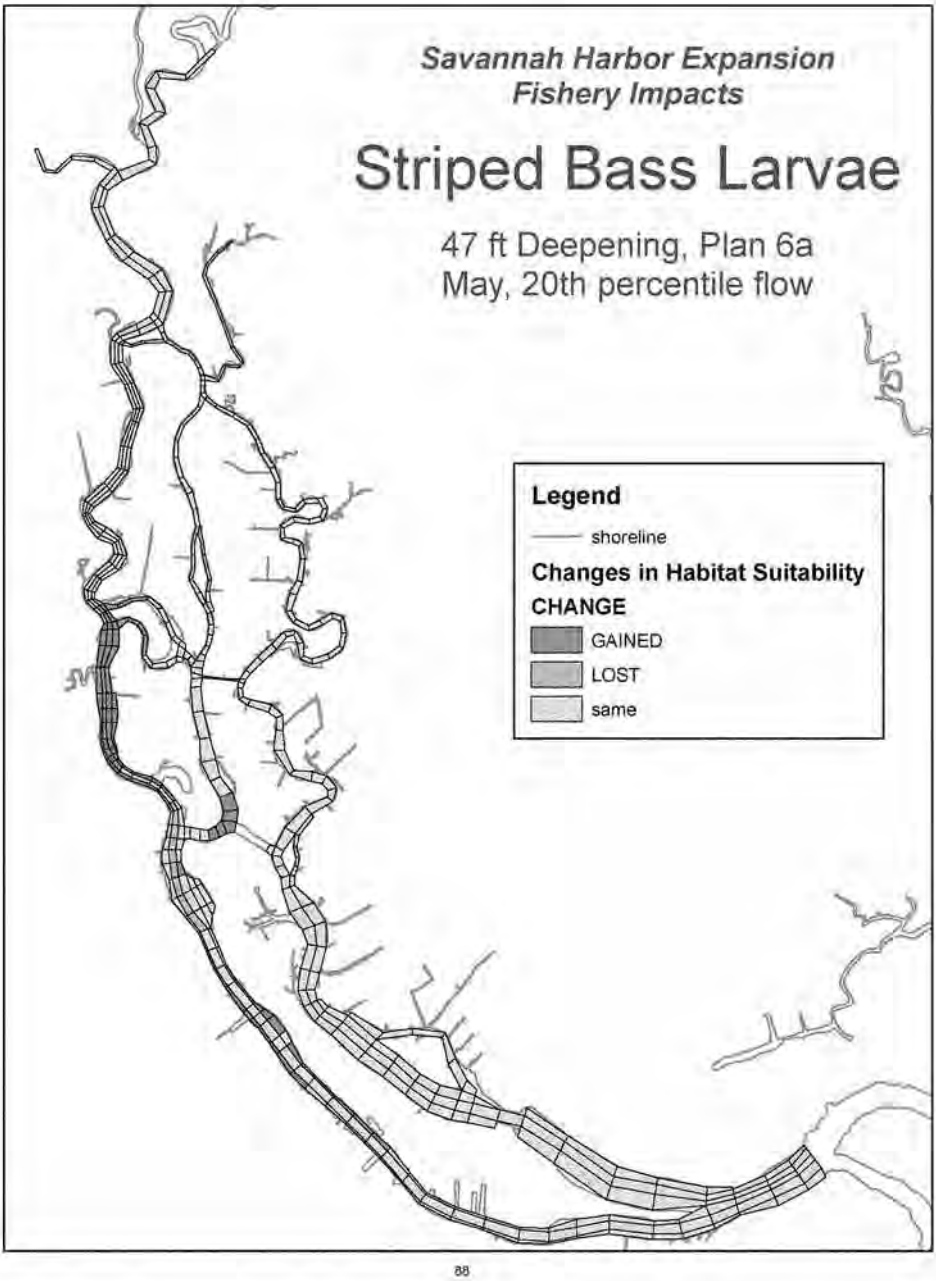

Savannah Harbor Expansion
Fishery Impacts
American Shad
47 ft Deepening, Plan 6a
January, 50th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
GAINED
LOST
same

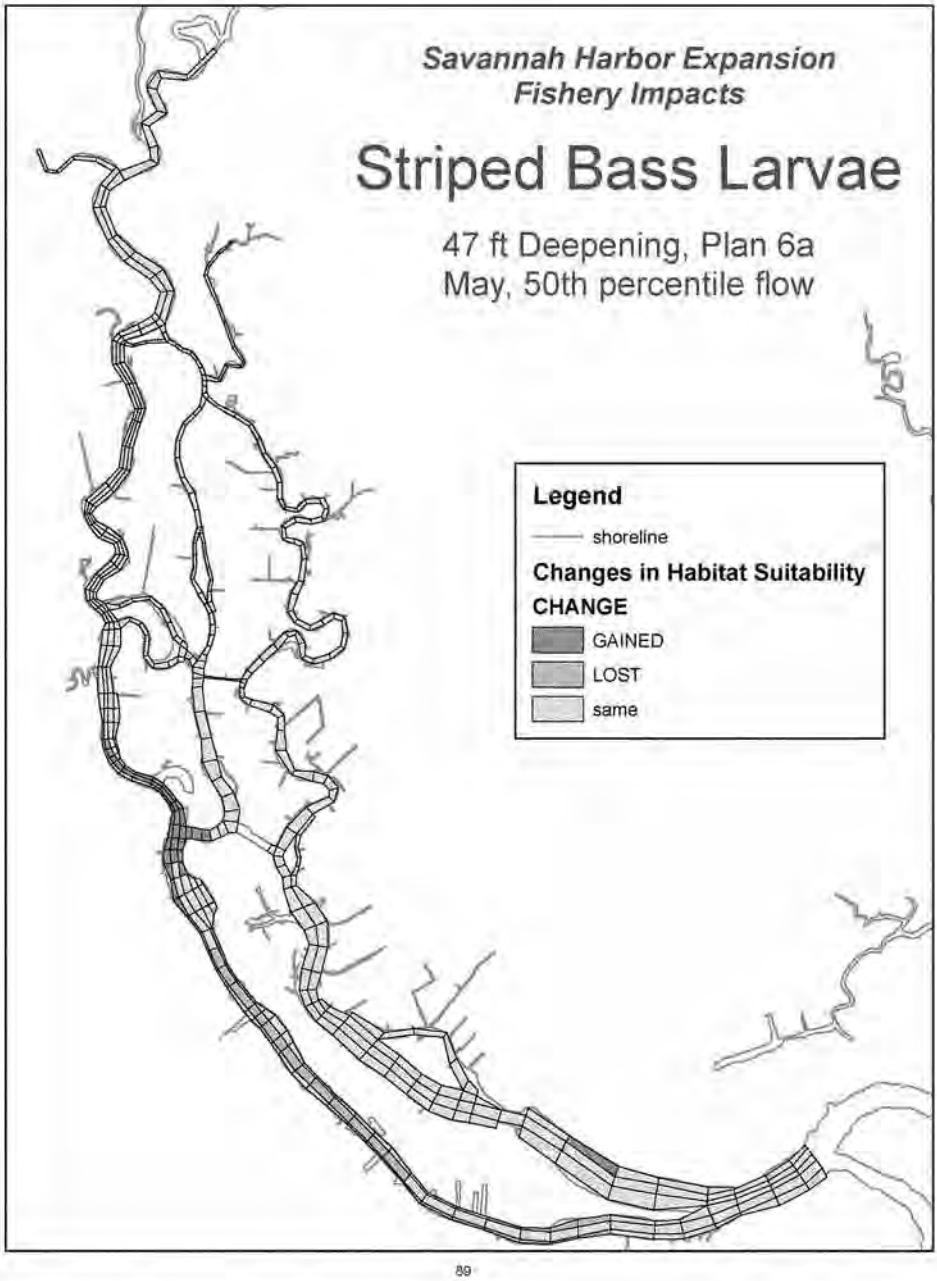

Savannah Harbor Expansion
Fishery Impacts
American Shad
47 ft Deepening, Plan 6a
August, 1997 (Average) Flows
Legend
shoreline
Changes in Habitat Suitability
LOST
same

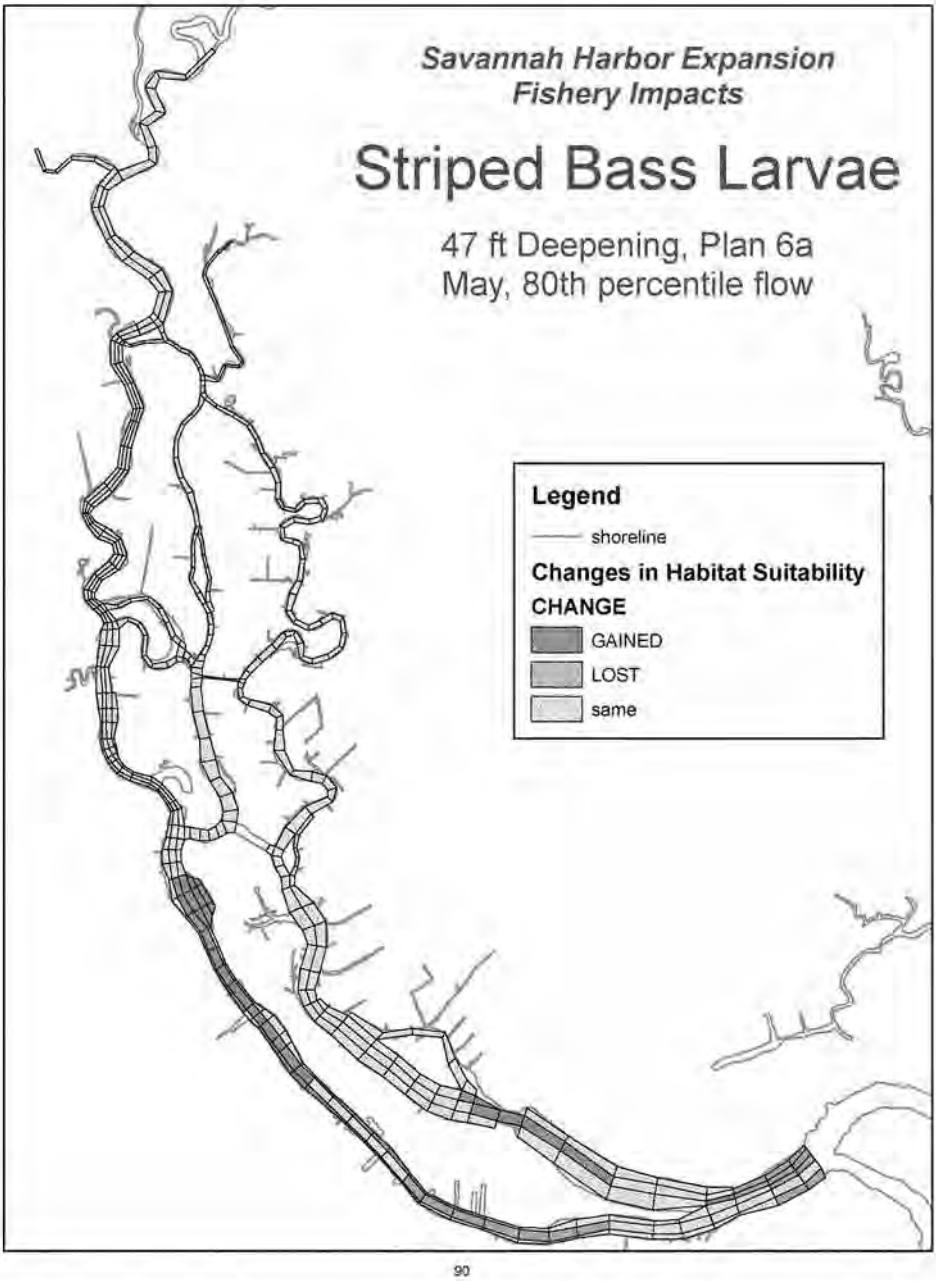

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
47 ft Deepening, Plan 6a
April, 20th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
GAINED
LOST
same

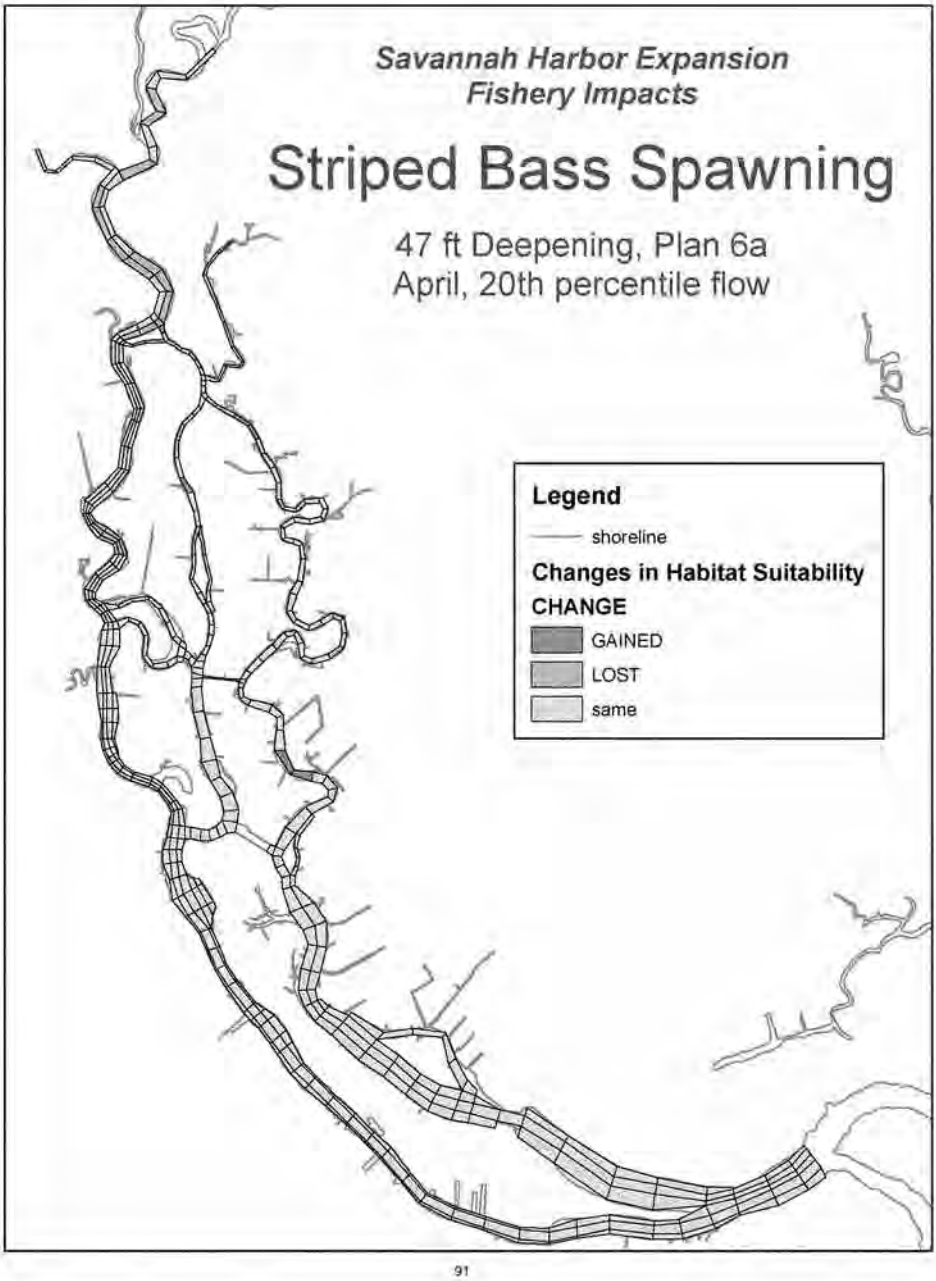

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
47 ft Deepening, Plan 6a
April, 50th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
GAINED
LOST
same

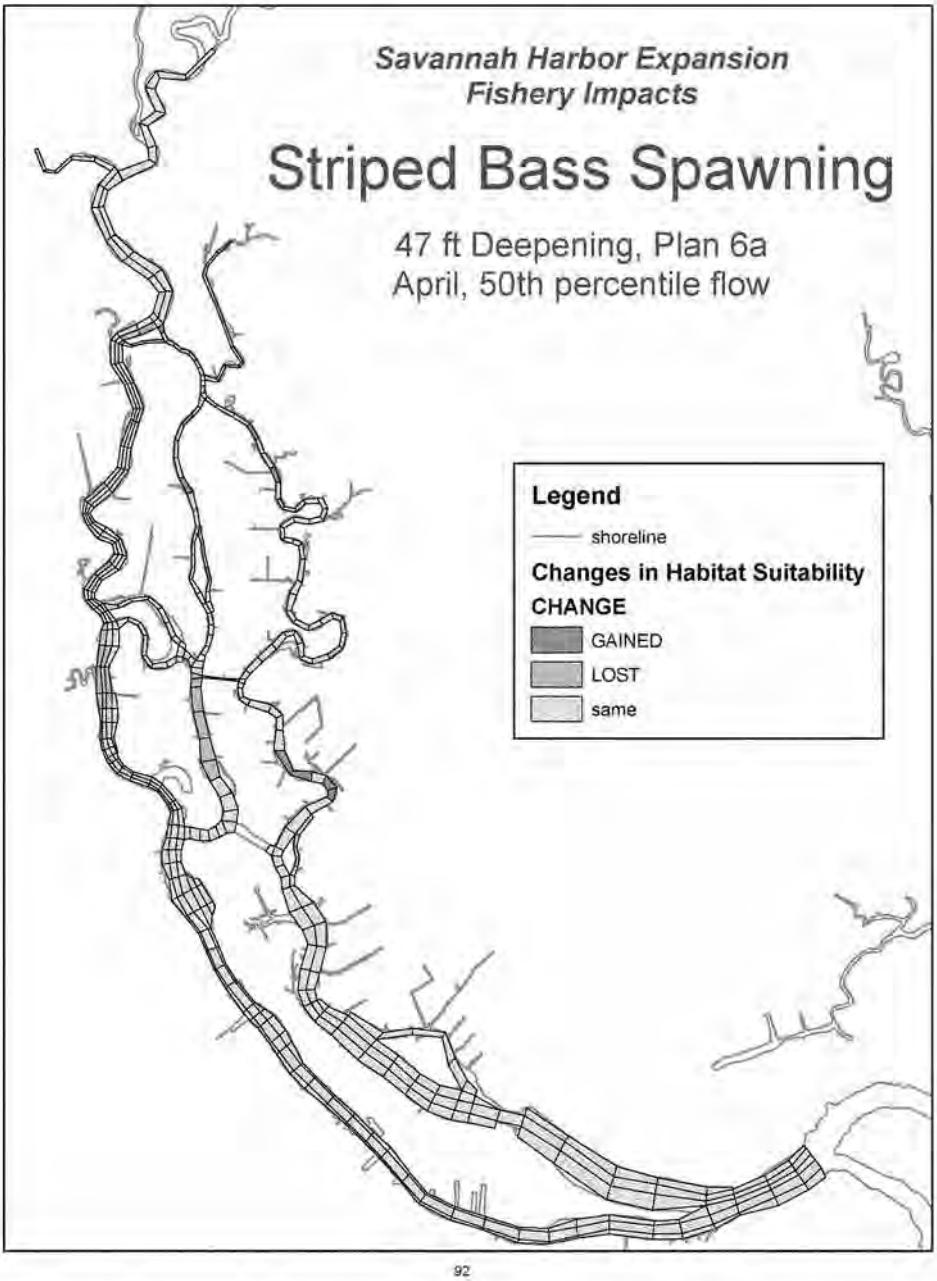

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
47 ft Deepening, Plan 6a
April, 80th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
GAINED
LOST
same

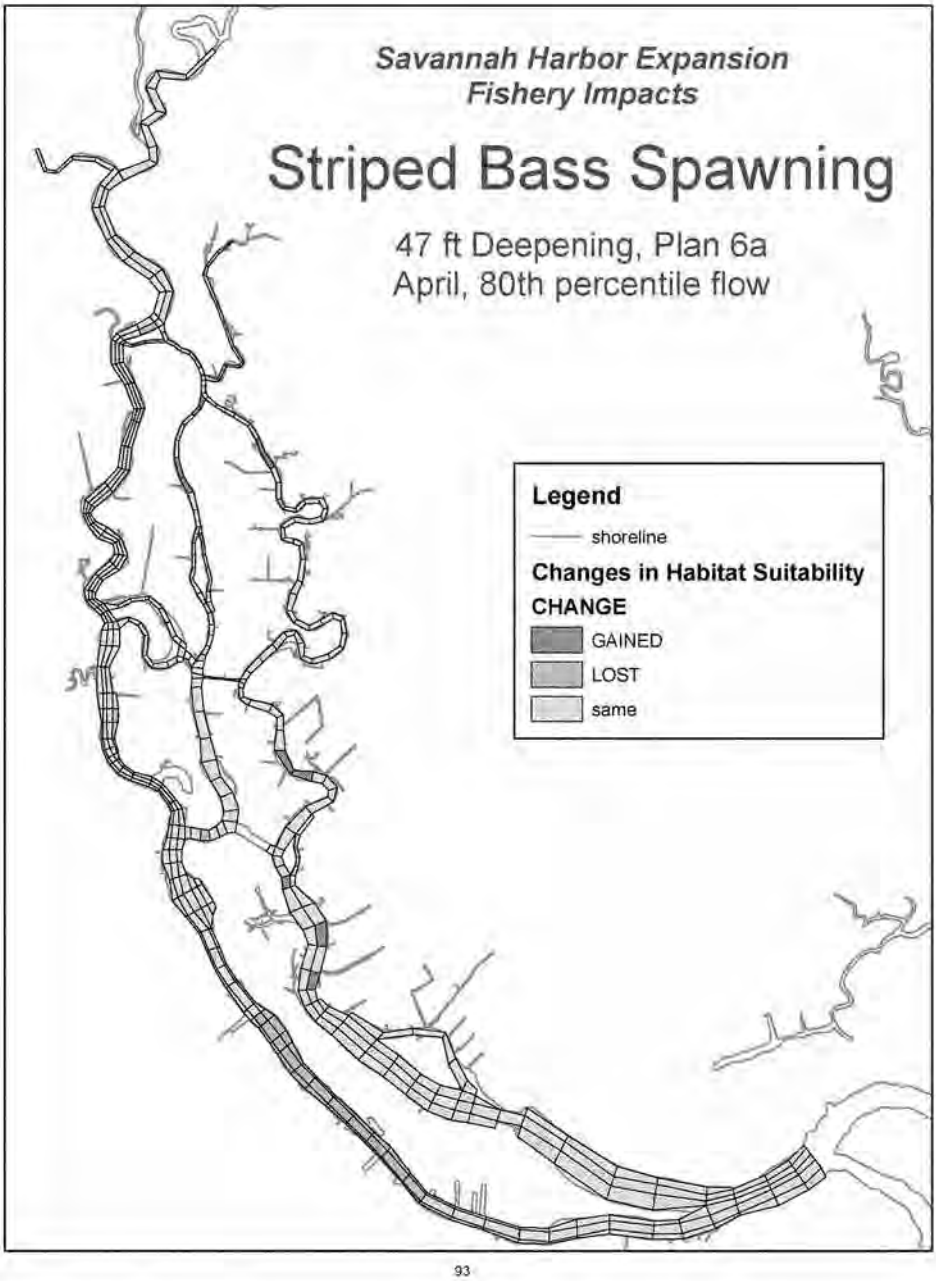

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
47 ft Deepening, Plan 6a
May, 20th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
GAINED
LOST
same

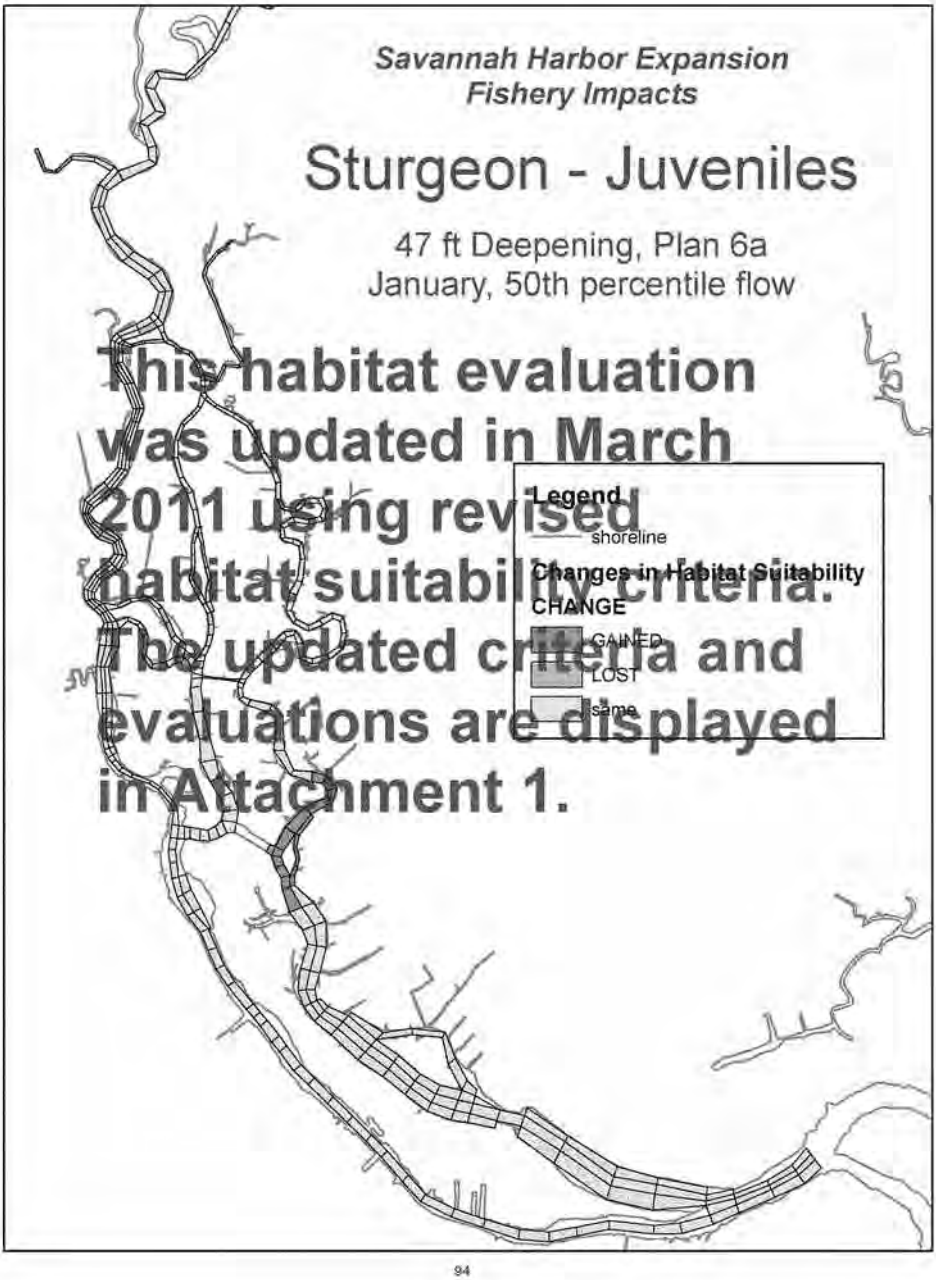

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
47 ft Deepening, Plan 6a
May, 50th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
GAINED
LOST
same


Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
47 ft Deepening, Plan 6a
May, 80th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
GAINED
LOST
same

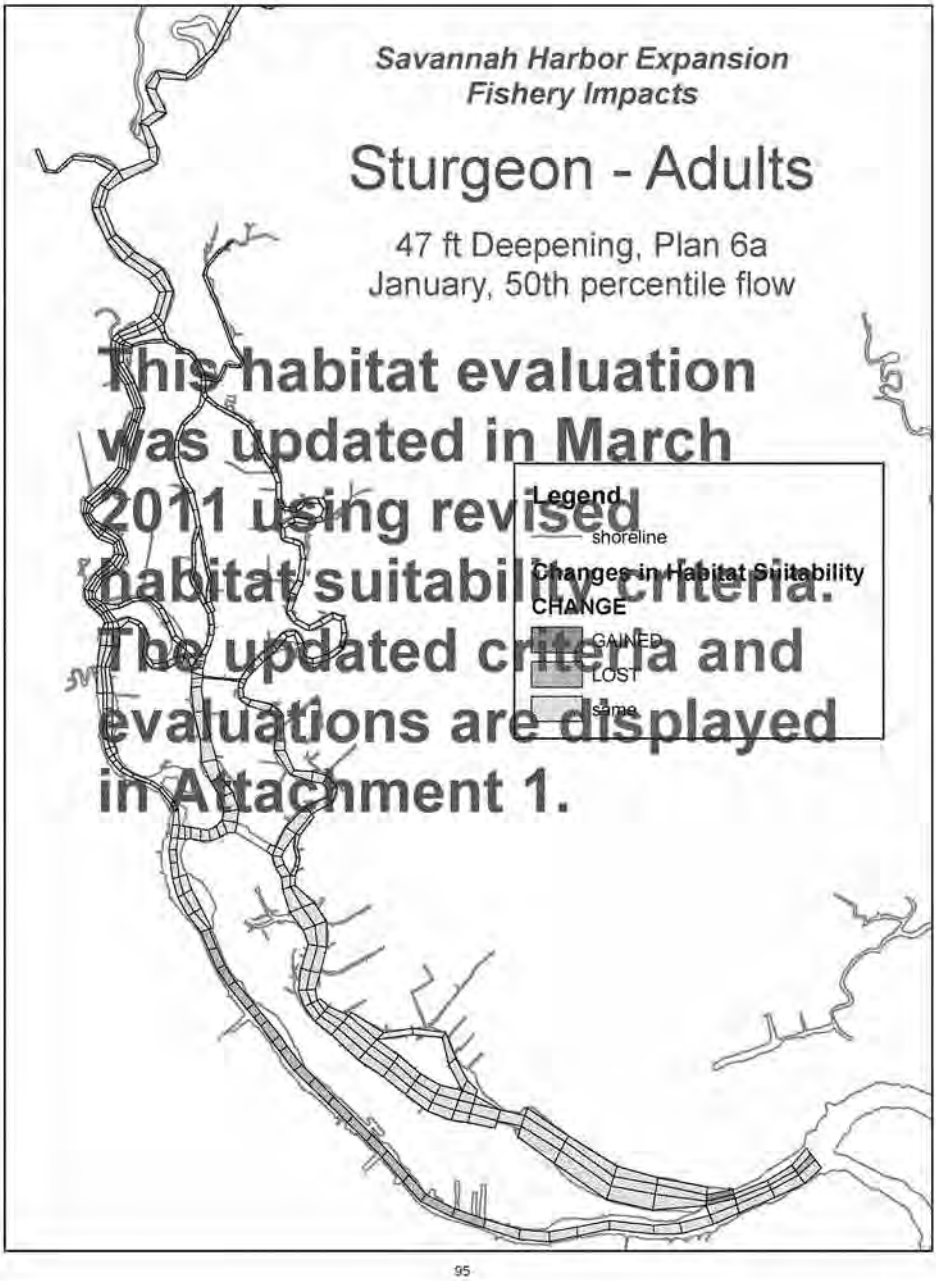

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
47 ft Deepening, Plan 6a
April, 20th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
GAINED
LOST
same


Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
47 ft Deepening, Plan 6a
April, 50th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
GAINED
LOST
same

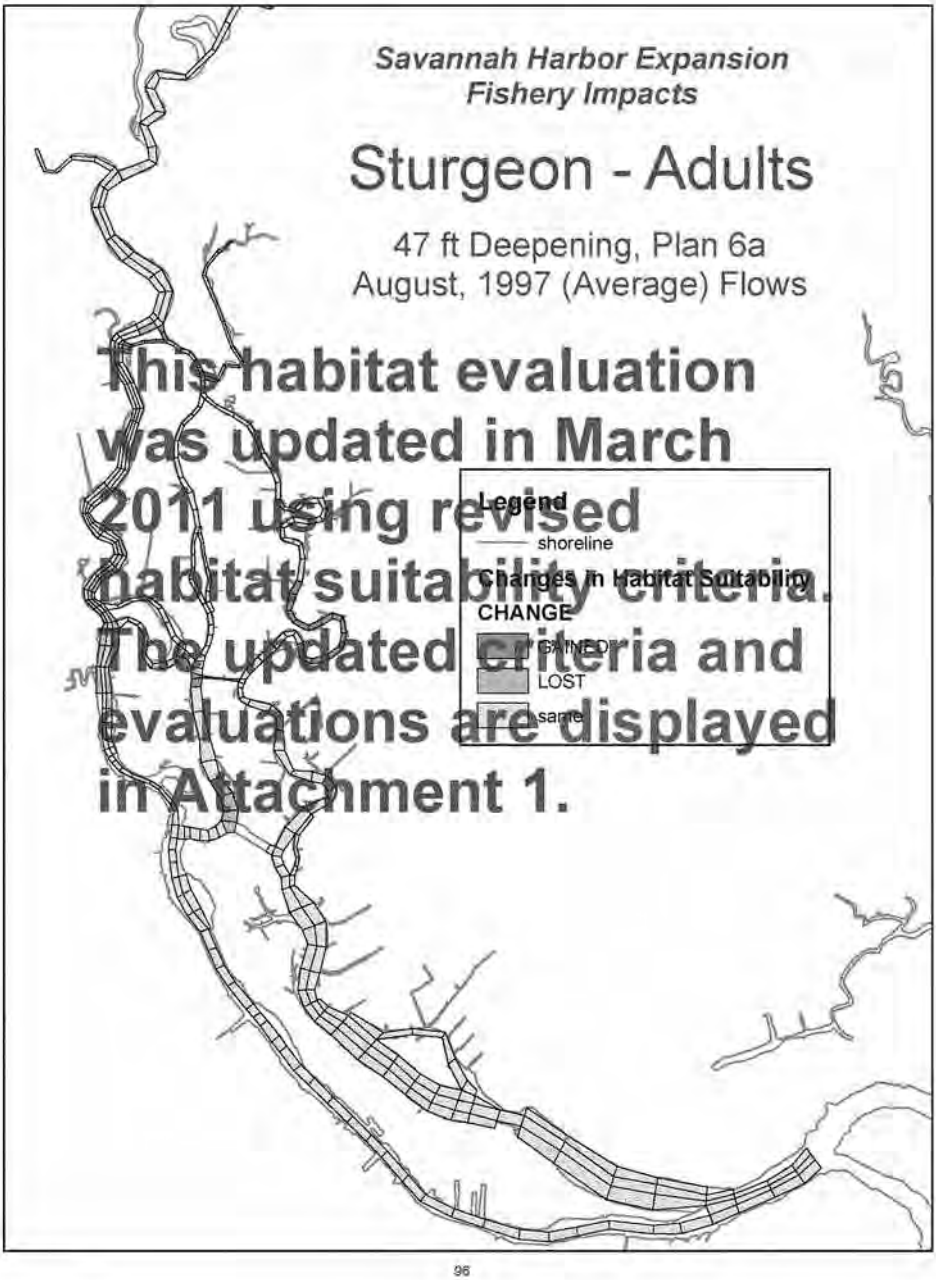

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
47 ft Deepening, Plan 6a
April, 80th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE
GAINED
LOST
same



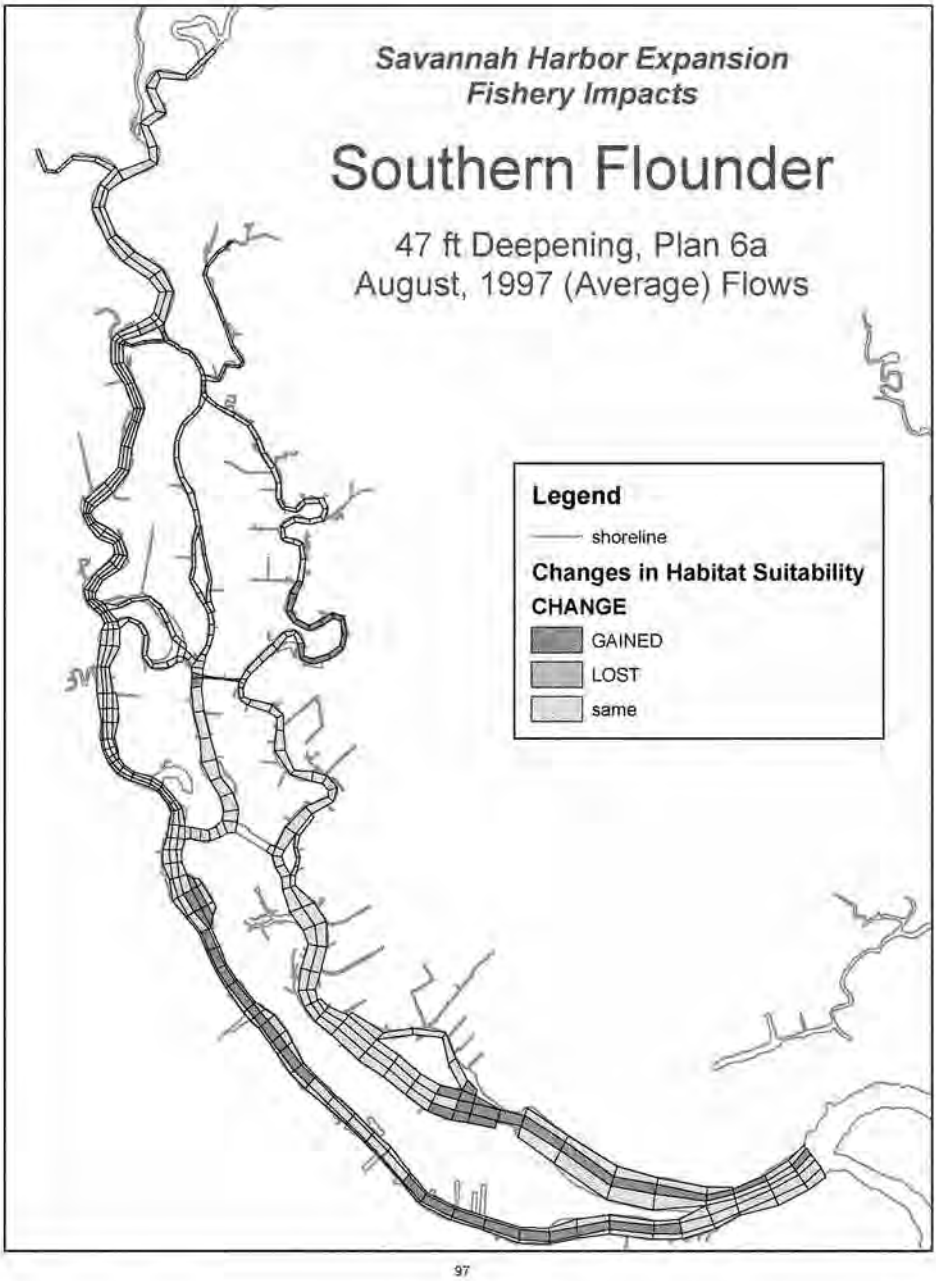
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.



This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.

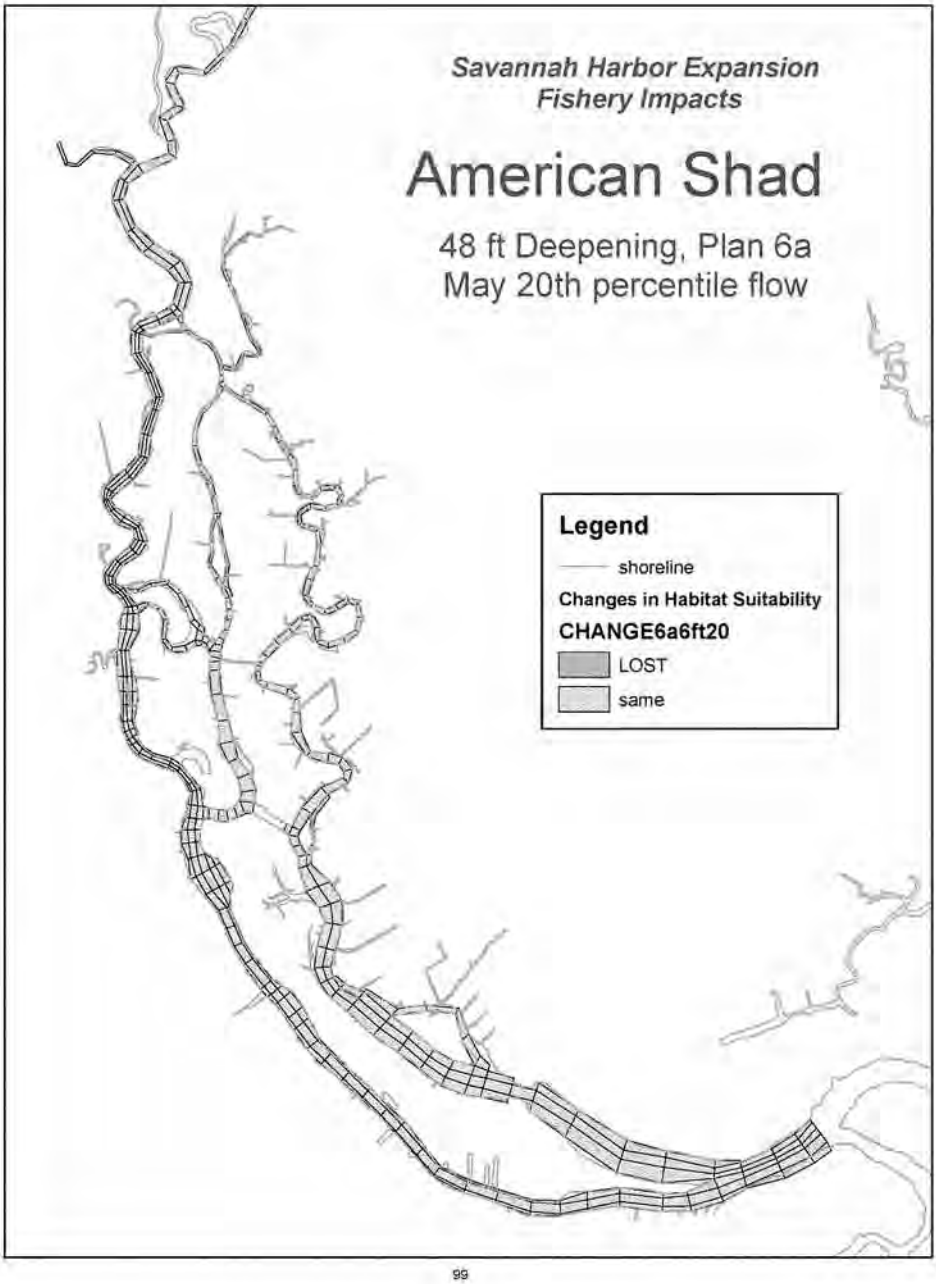


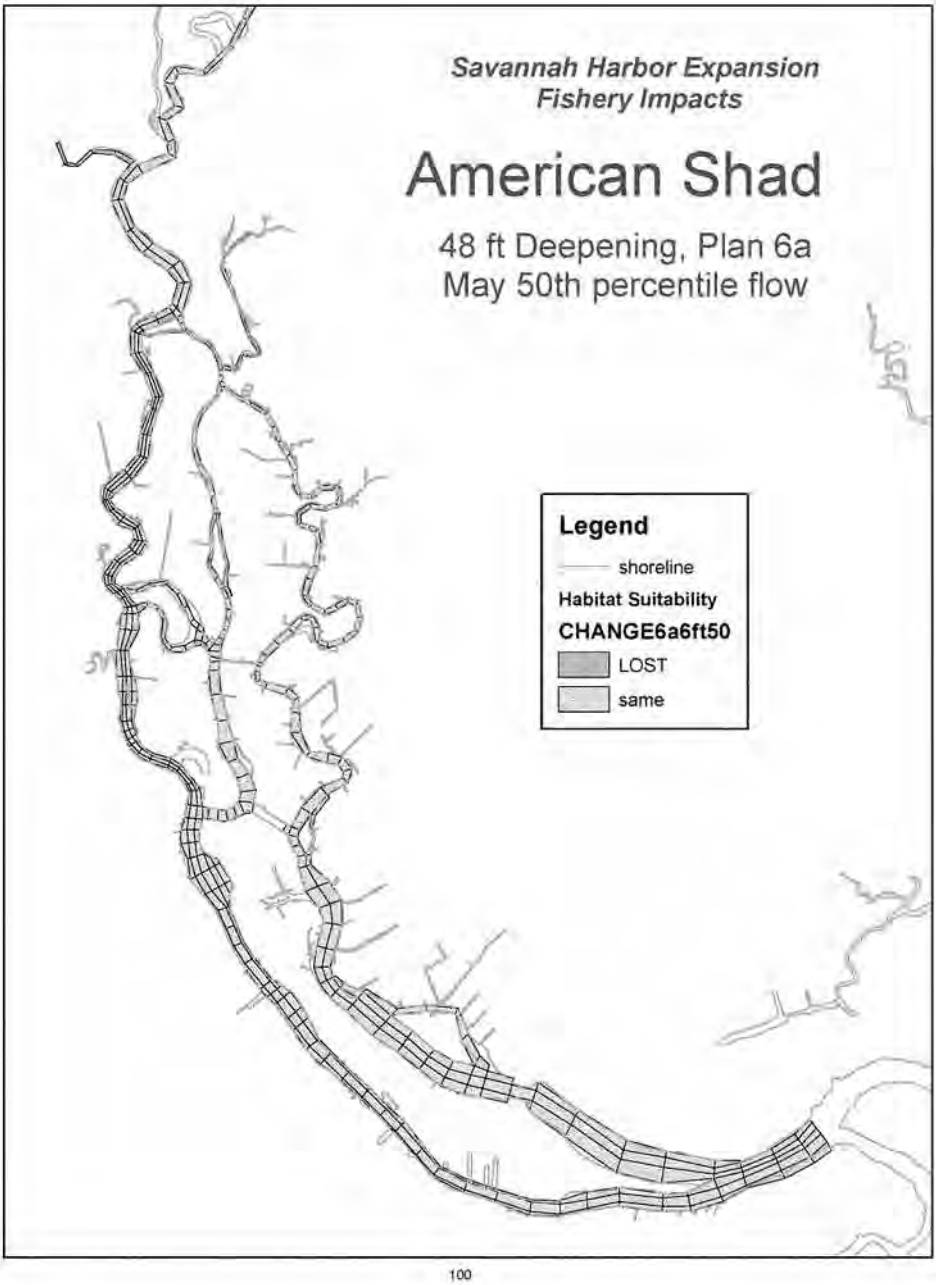
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.

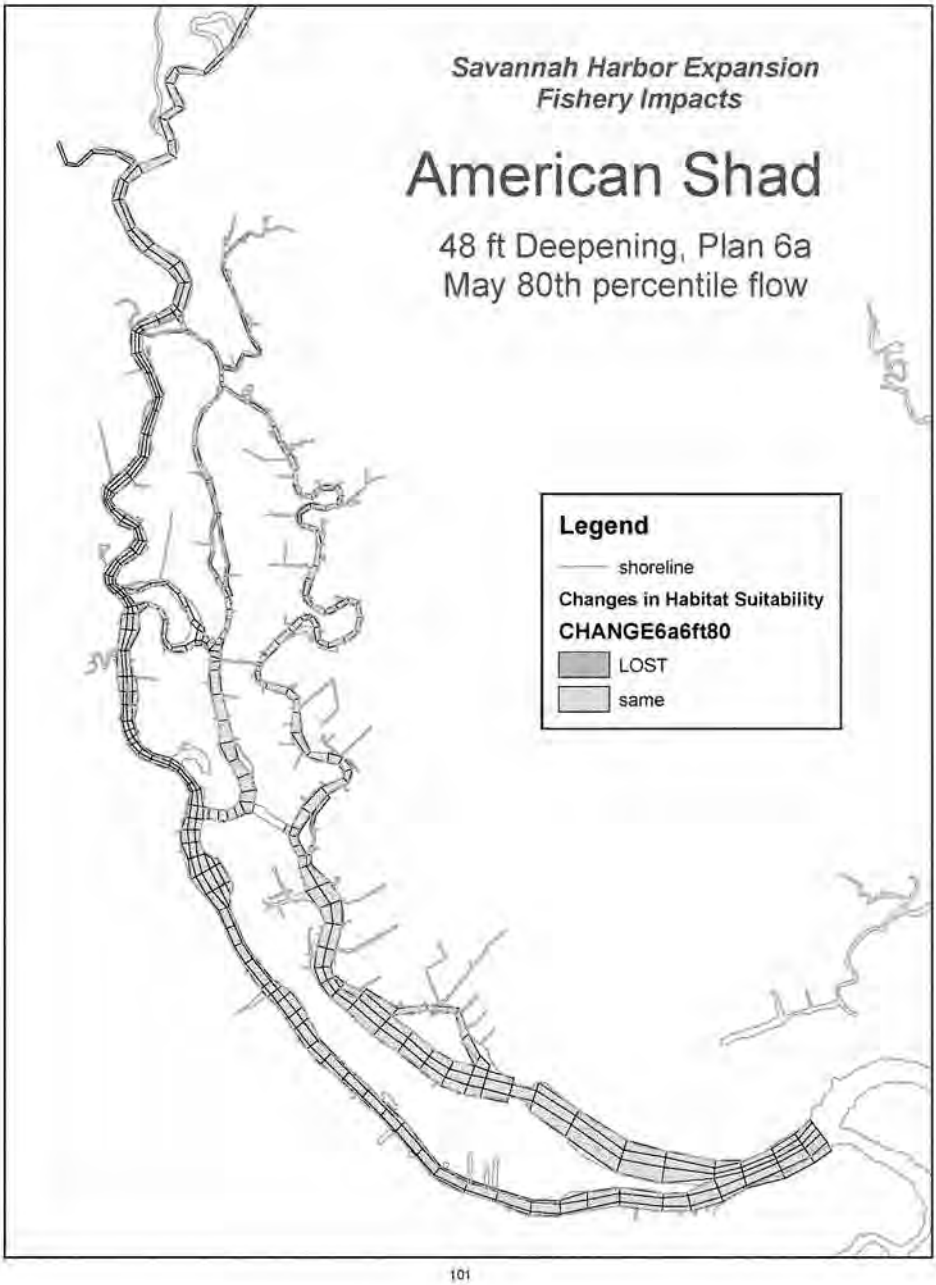

Savannah Harbor Expansion
Fishery Impacts
Southern Flounder
47 ft Deepening, Plan 6a
August, 1997 (Average) Flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE
GAINED
LOST
same

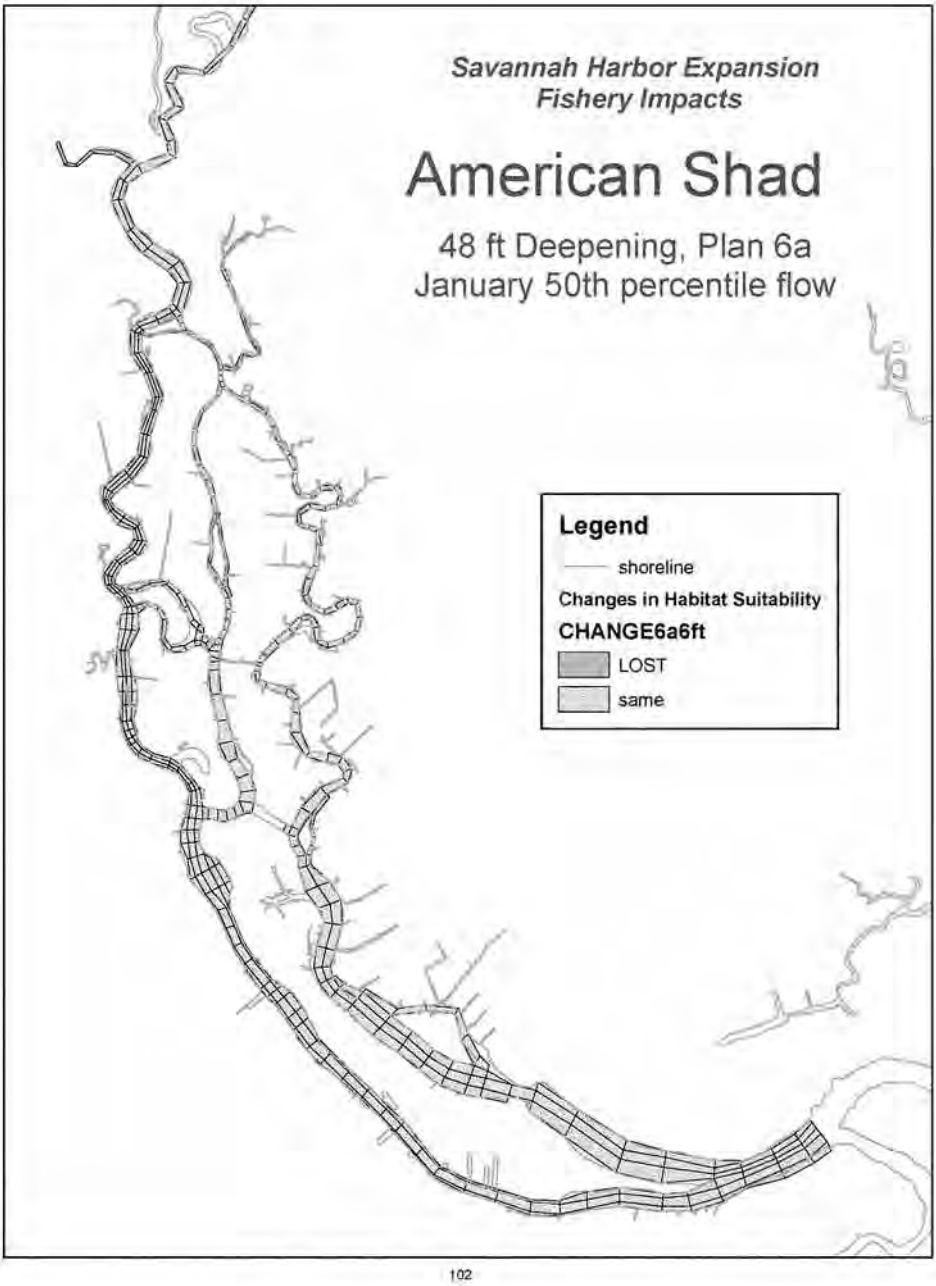
48 ft Channel Depth

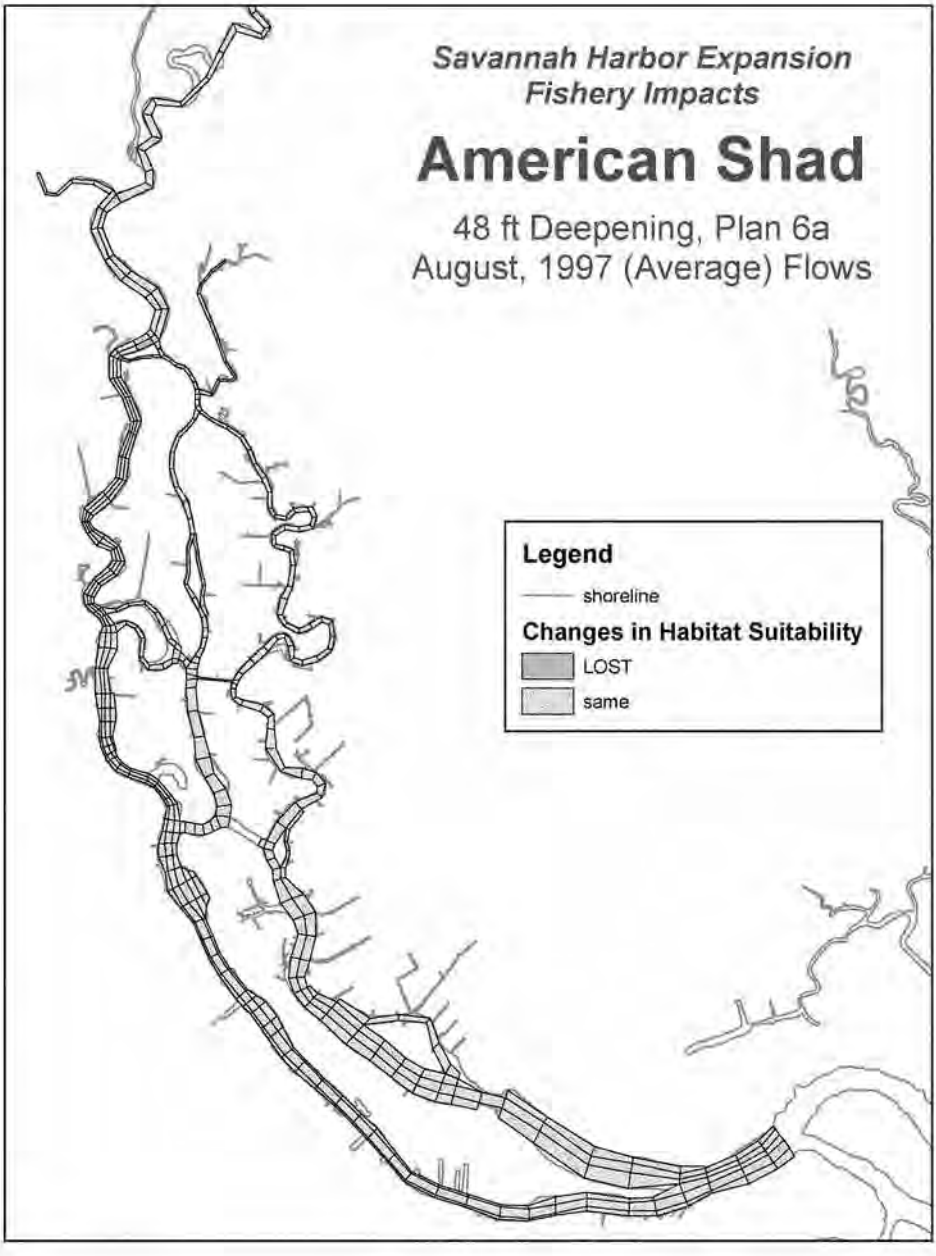
Mitigation Plan 6a

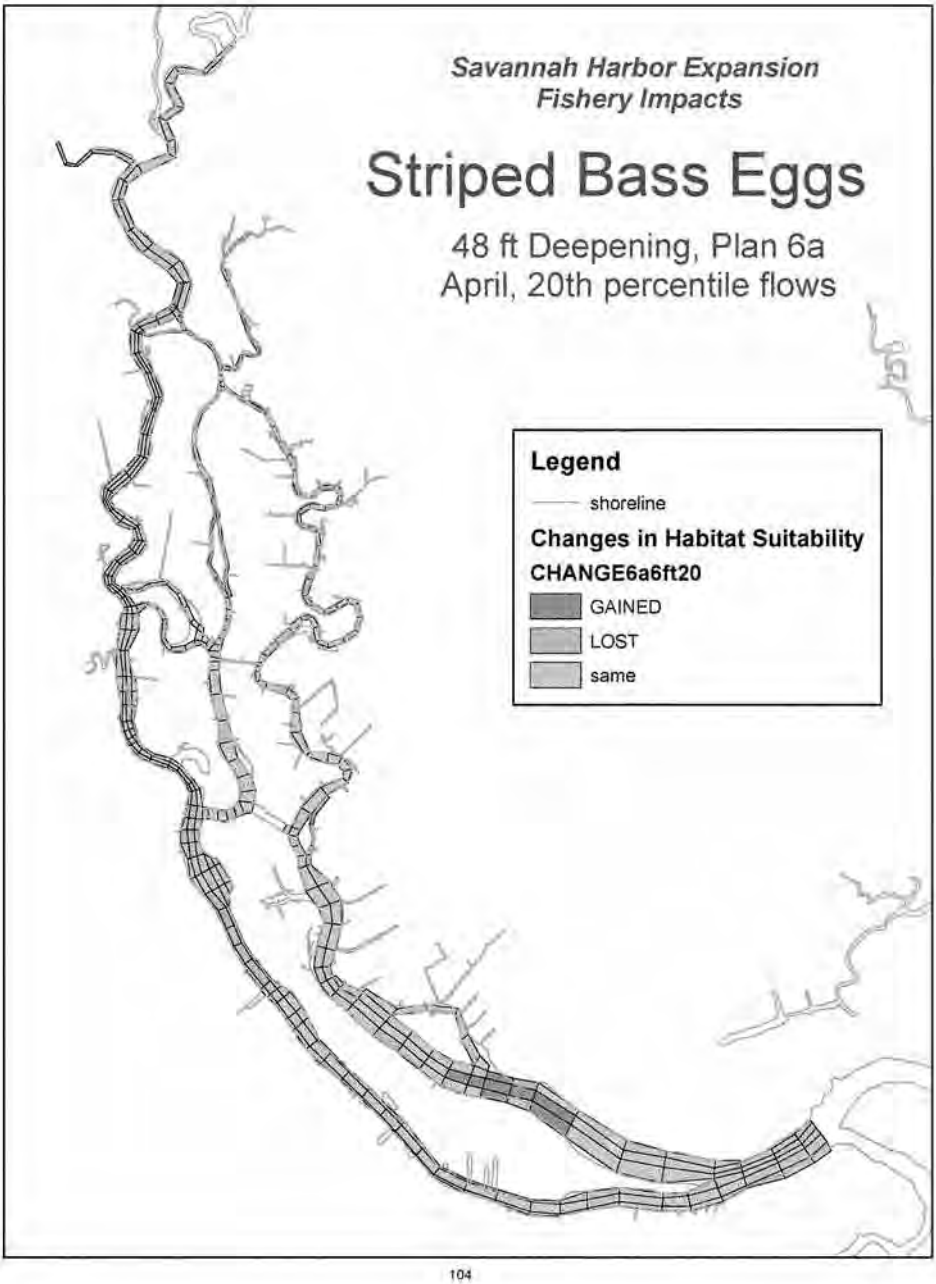

Savannah Harbor Expansion
Fishery Impacts
American Shad
48 ft Deepening, Plan 6a
May 20th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft20
LOST
same

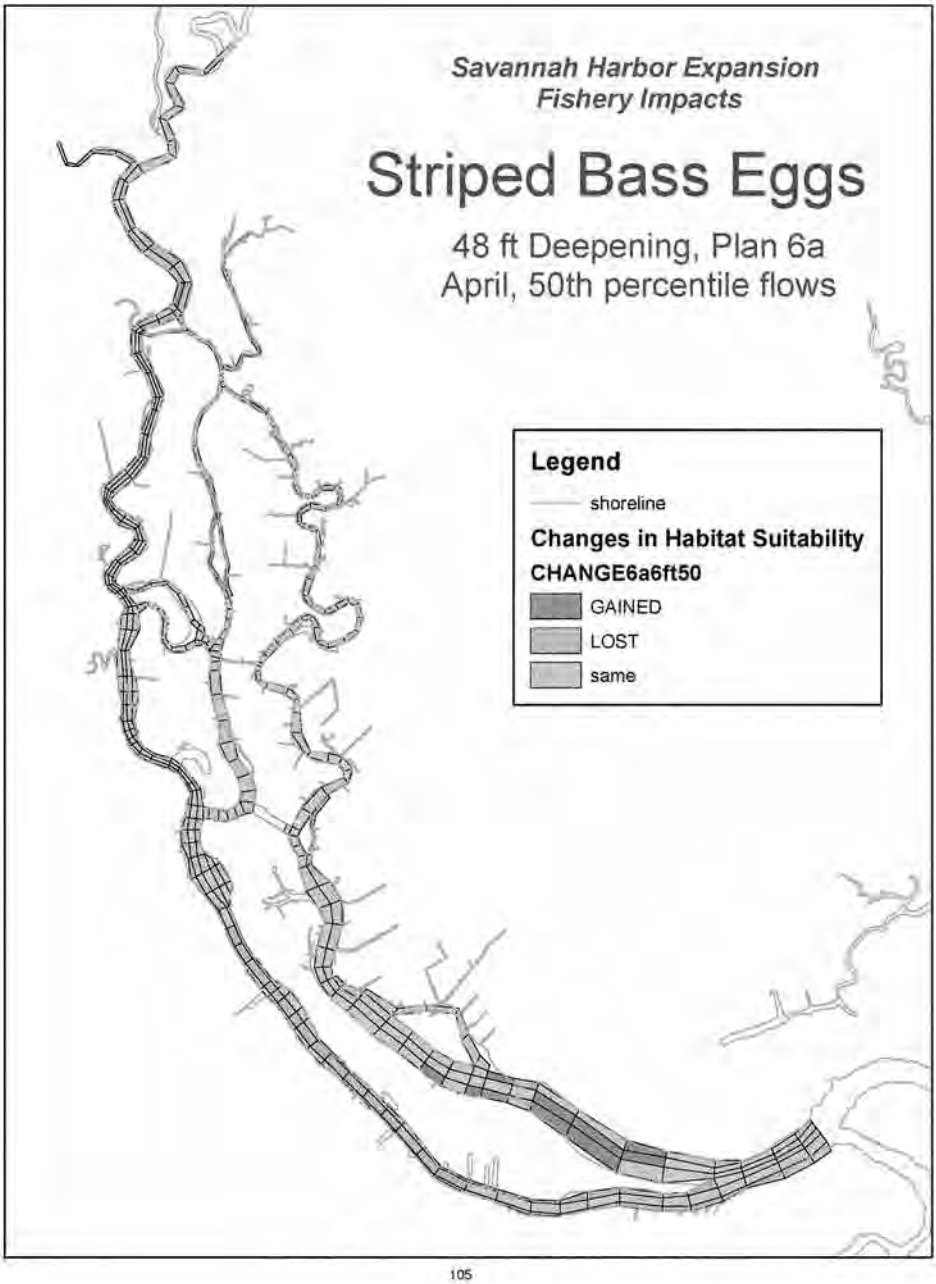

Savannah Harbor Expansion
Fishery Impacts
American Shad
48 ft Deepening, Plan 6a
May 50th percentile flow
Legend
shoreline
Habitat Suitability
CHANGE6a6ft50
LOST
same

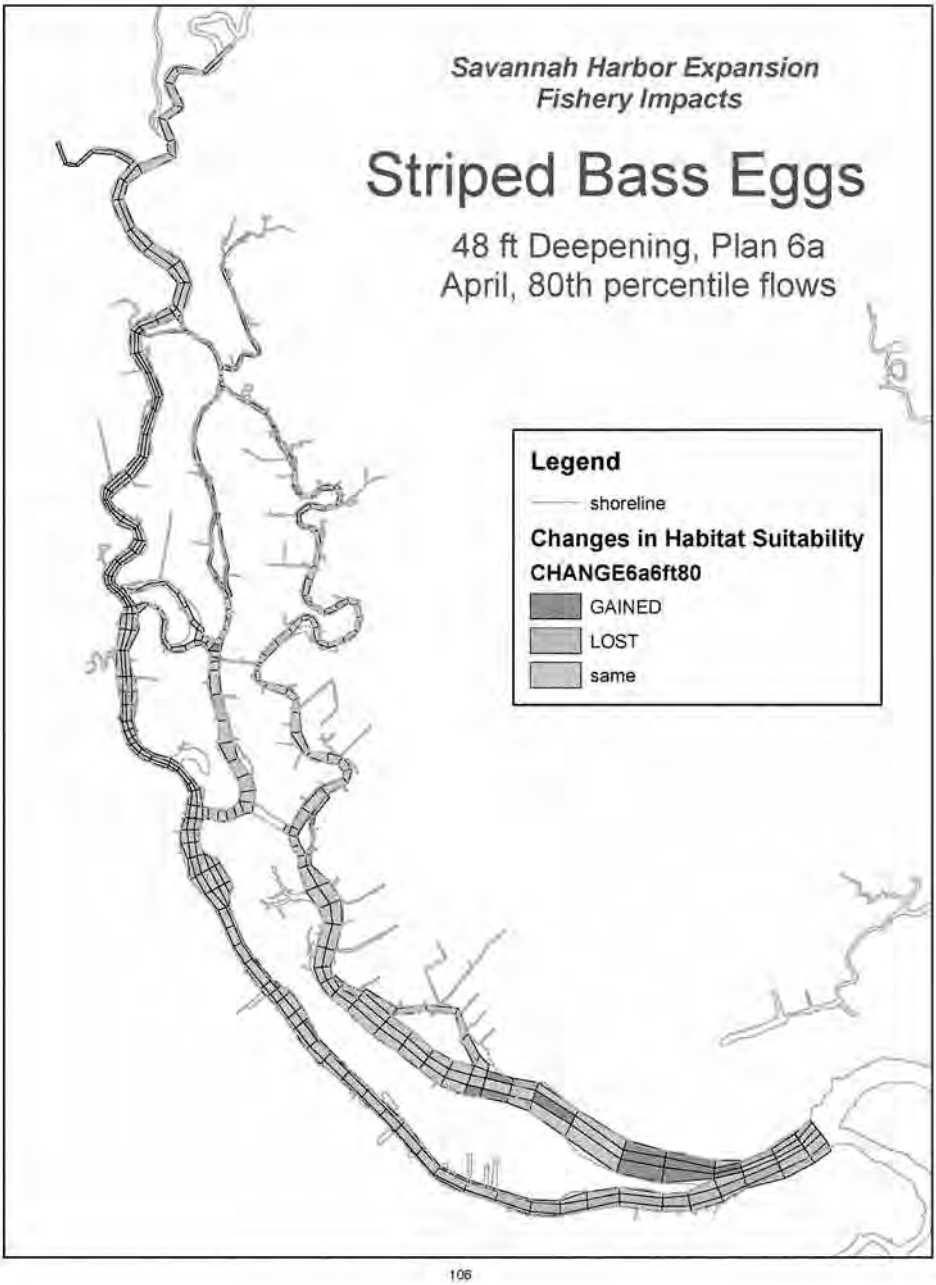

Savannah Harbor Expansion
Fishery Impacts
American Shad
48 ft Deepening, Plan 6a
May 80th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft80
LOST
same

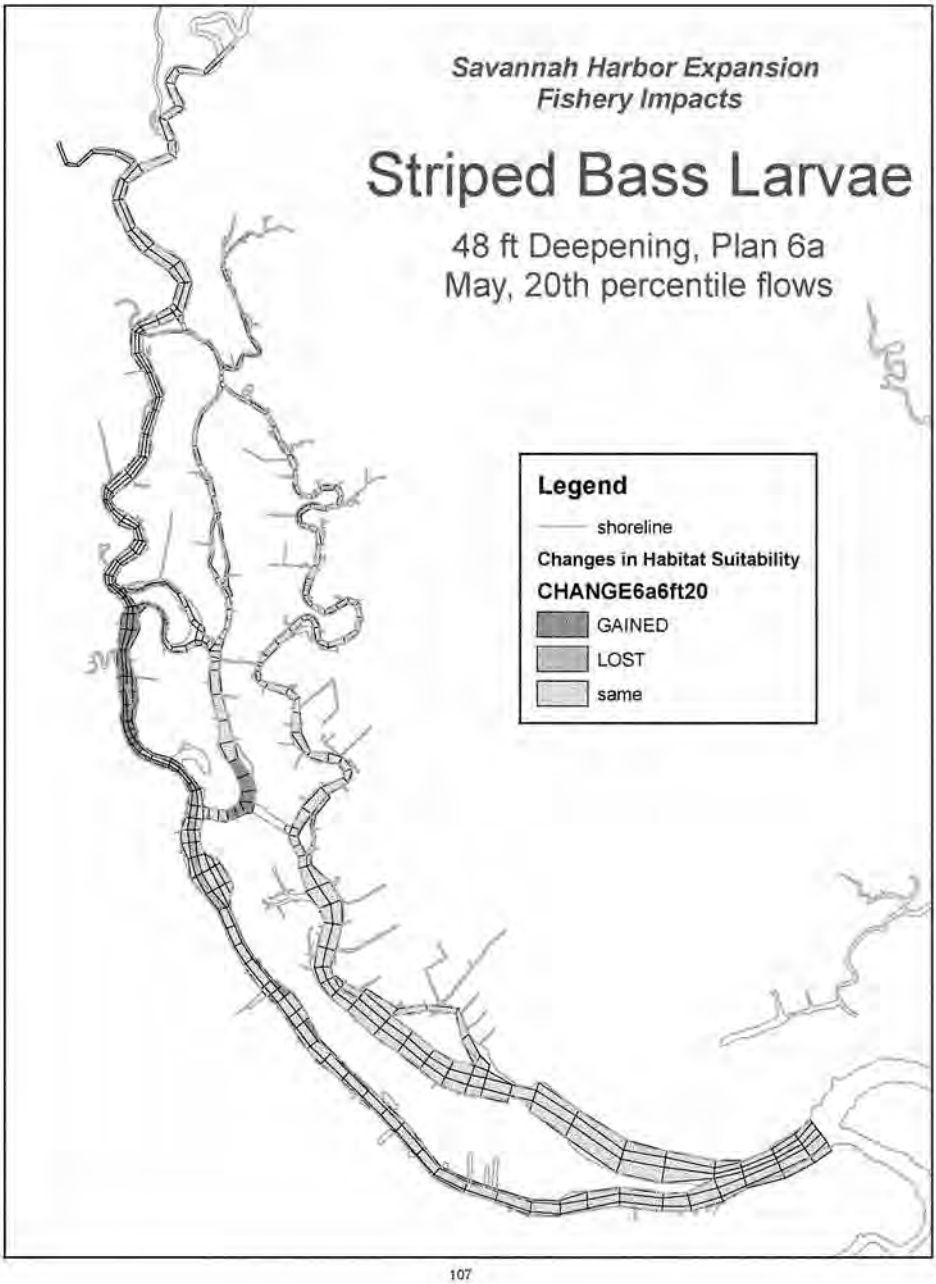

Savannah Harbor Expansion
Fishery Impacts
American Shad
48 ft Deepening, Plan 6a
January 50th percentile flow
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft
LOST
same

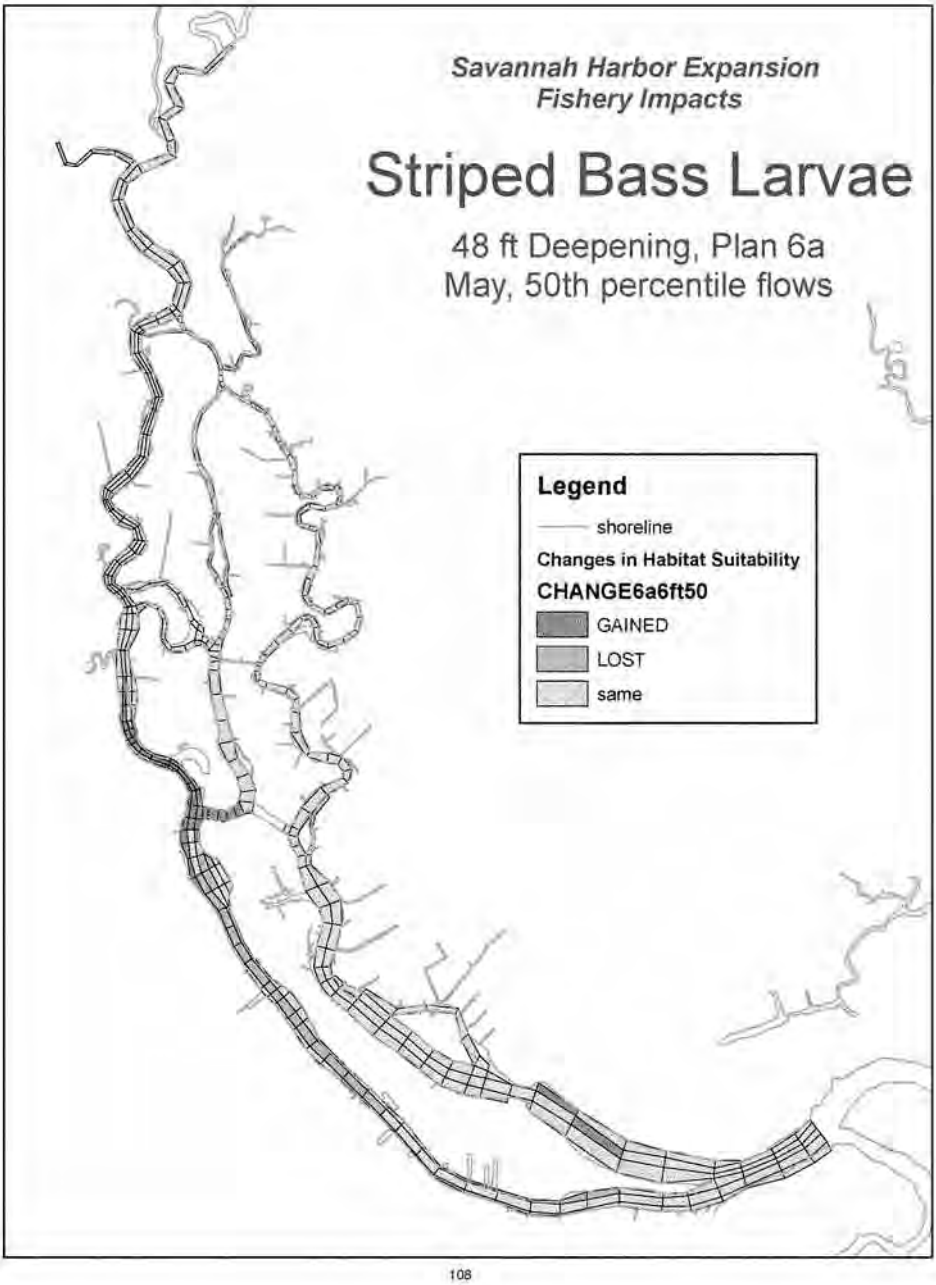

Savannah Harbor Expansion
Fishery Impacts
American Shad
48 ft Deepening, Plan 6a
August, 1997 (Average) Flows
Legend
shoreline
Changes in Habitat Suitability
LOST
same

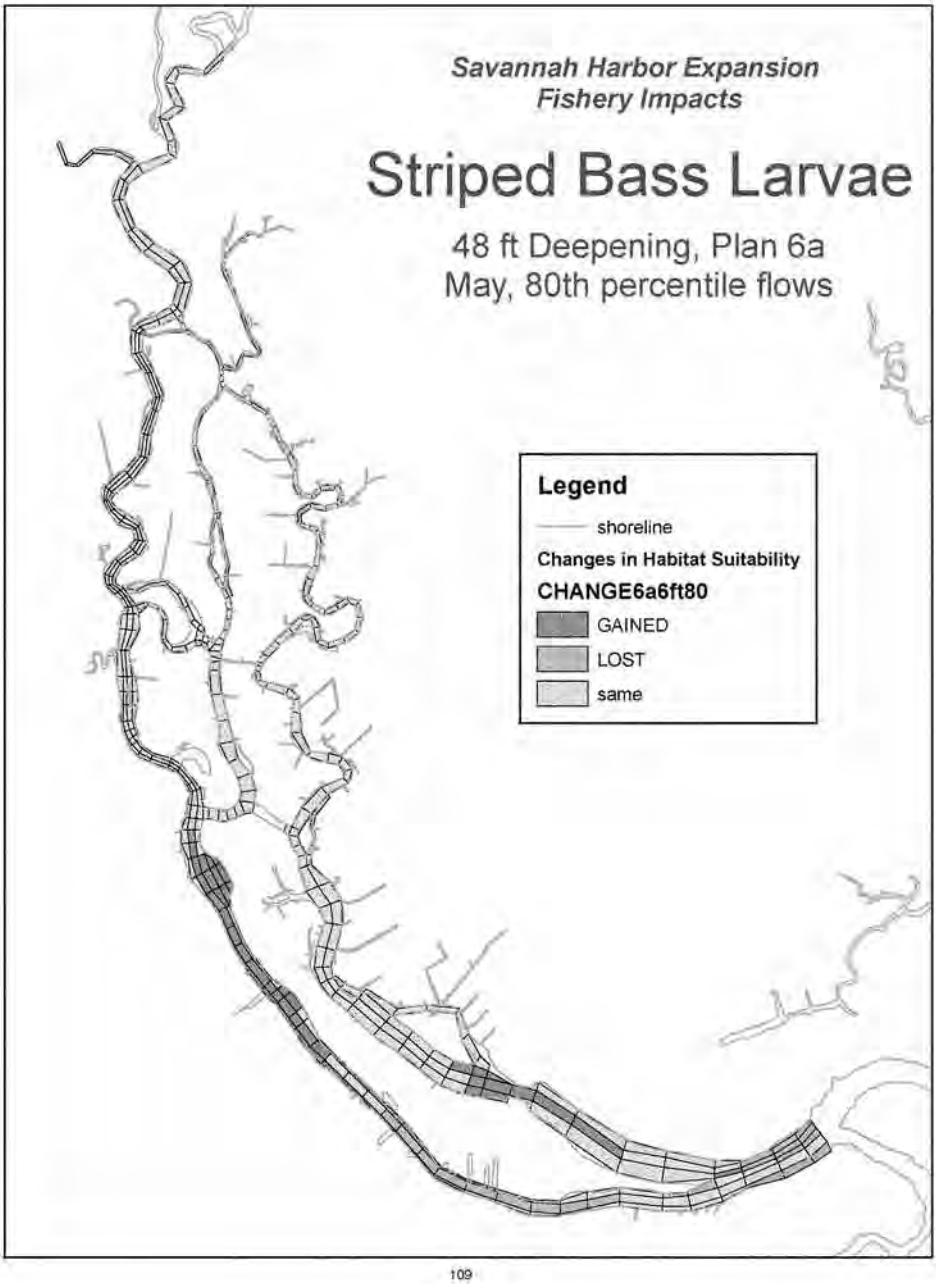

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
48 ft Deepening, Plan 6a
April, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft20
GAINED
LOST
same

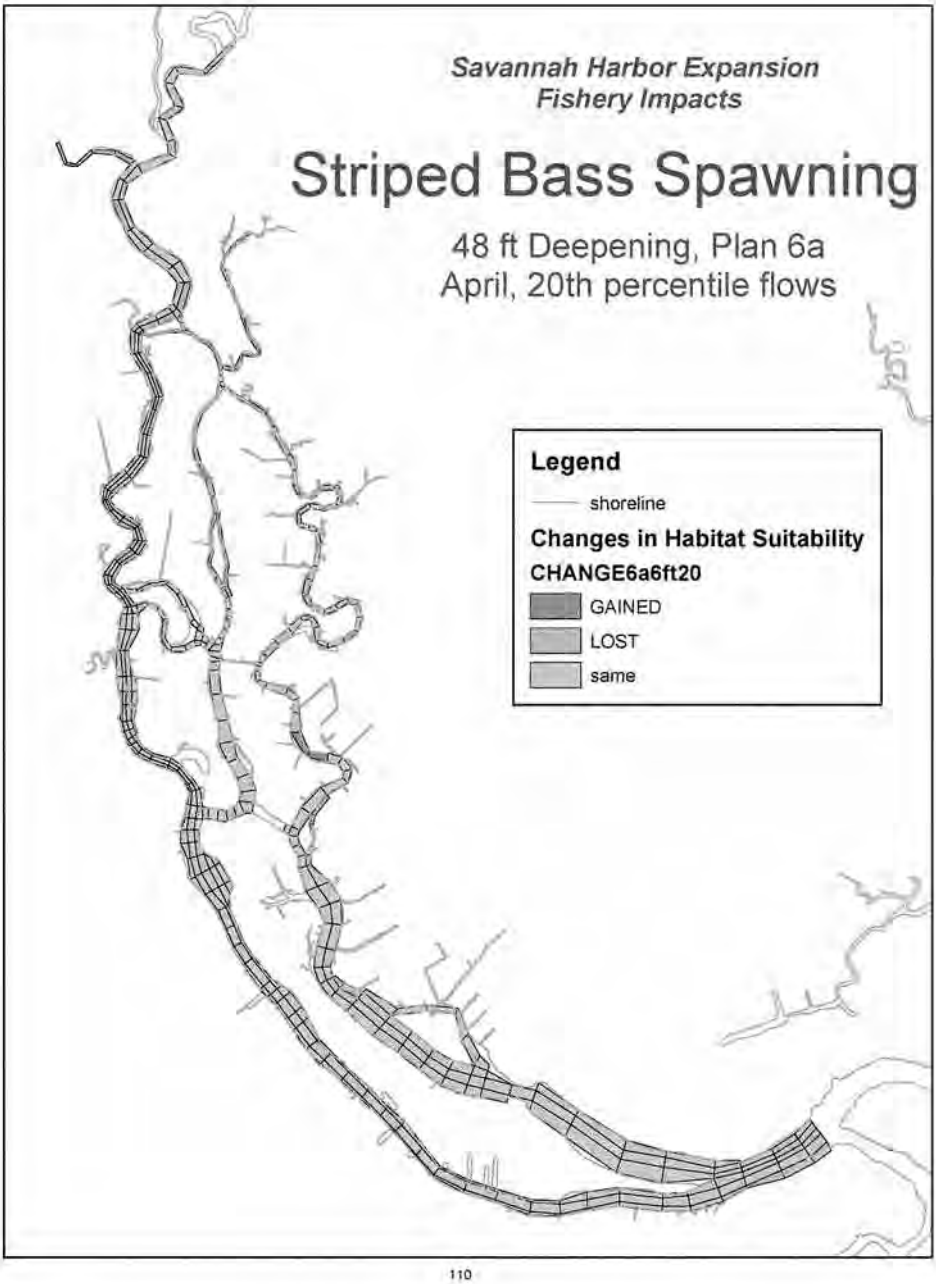

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
48 ft Deepening, Plan 6a
April, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft50
GAINED
LOST
same

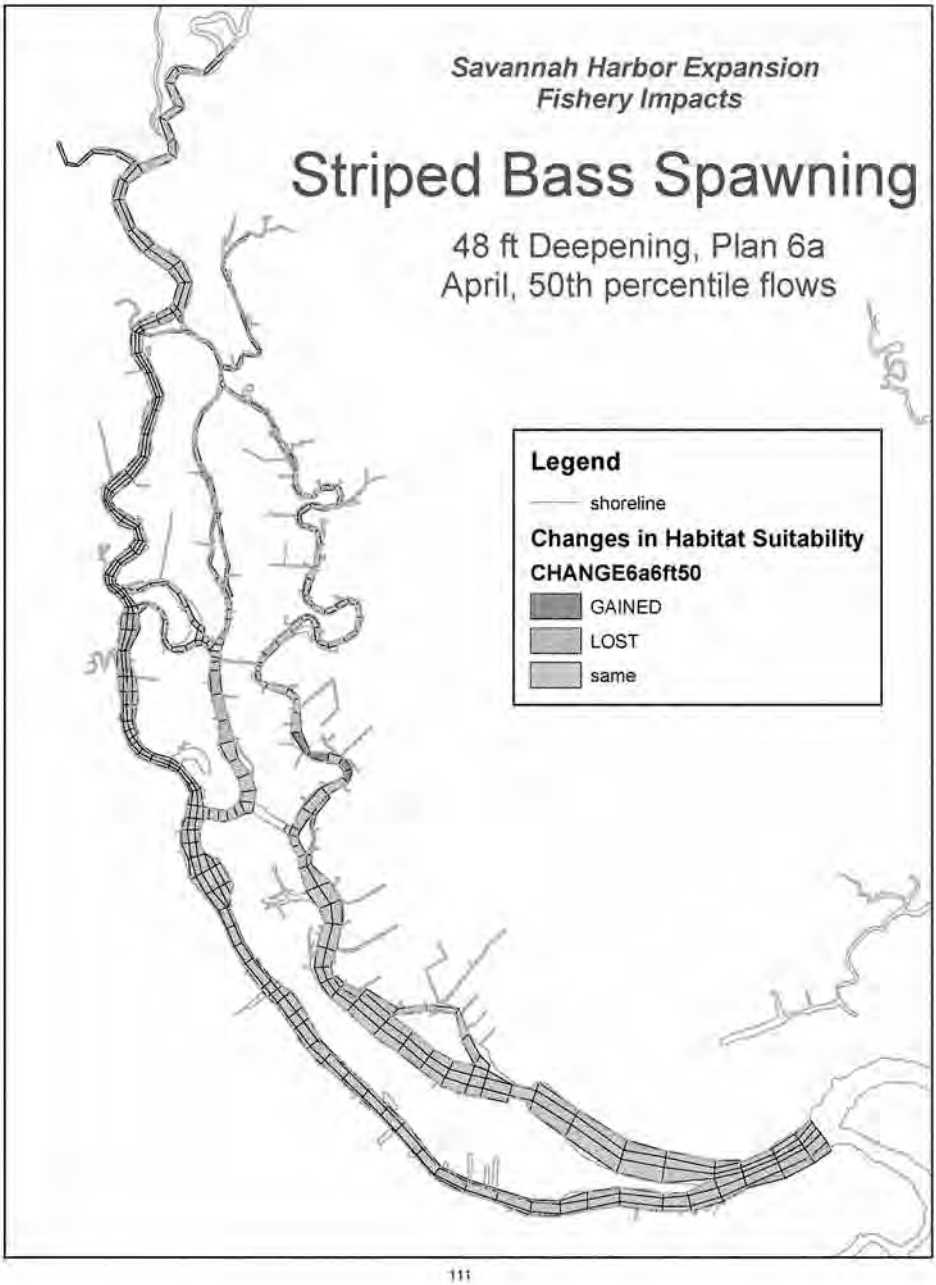

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Eggs
48 ft Deepening, Plan 6a
April, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft80
GAINED
LOST
same

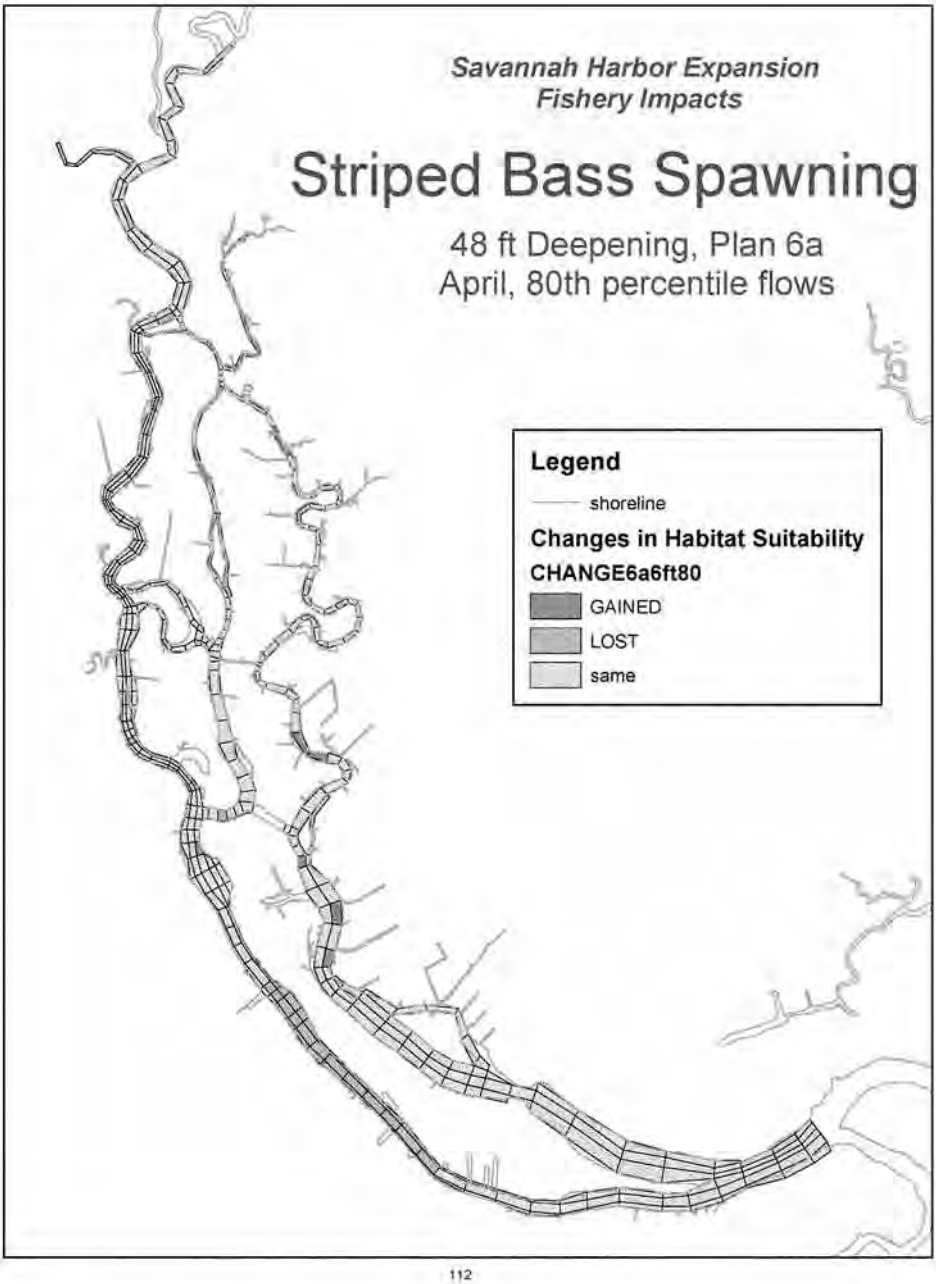

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
48 ft Deepening, Plan 6a
May, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft20
GAINED
LOST
same

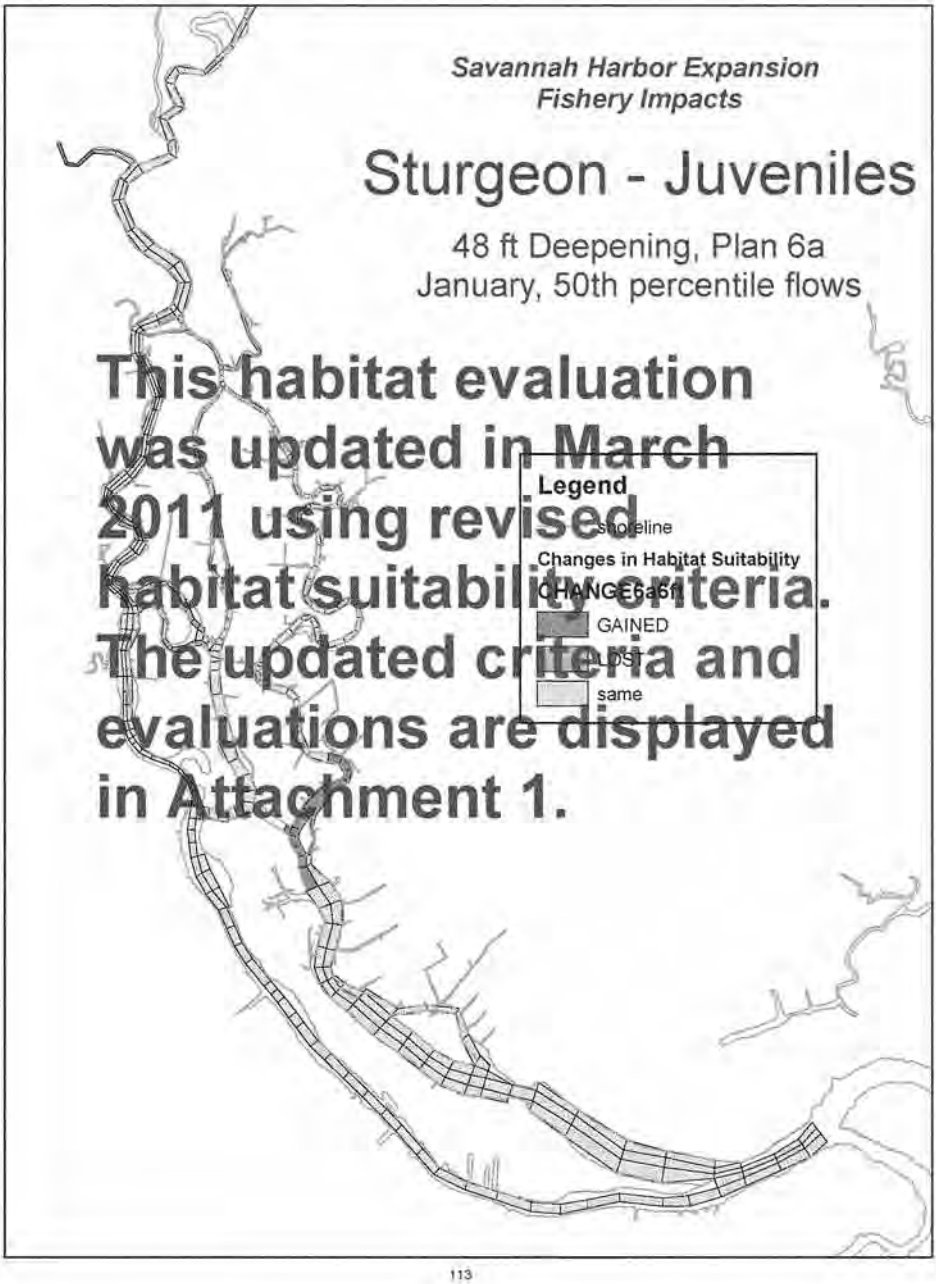

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
48 ft Deepening, Plan 6a
May, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft50
GAINED
LOST
same


Savannah Harbor Expansion
Fishery Impacts
Striped Bass Larvae
48 ft Deepening, Plan 6a
May, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft80
GAINED
LOST
same

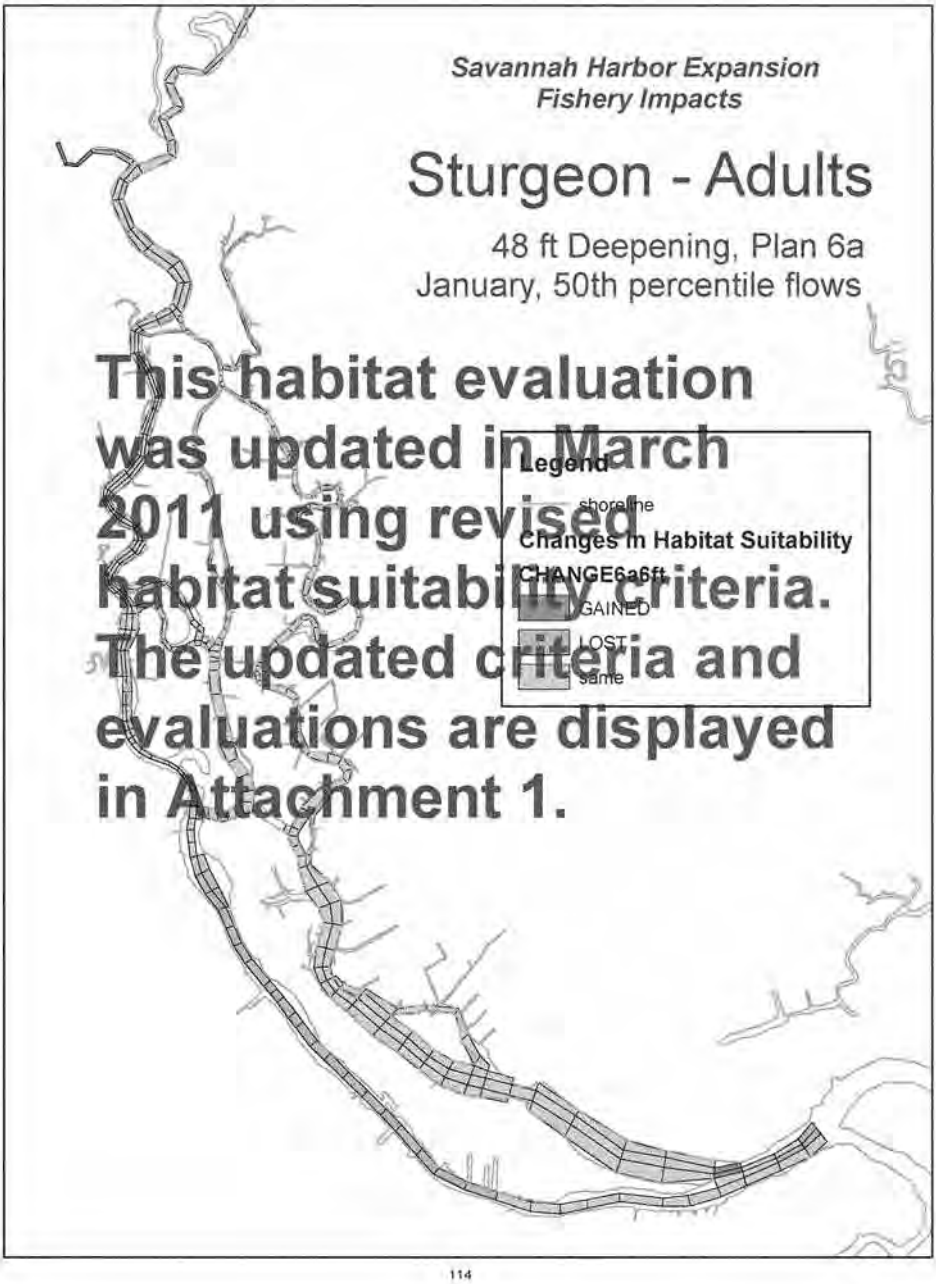

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
48 ft Deepening, Plan 6a
April, 20th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft20
GAINED
LOST
same


Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
48 ft Deepening, Plan 6a
April, 50th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft50
GAINED
LOST
same

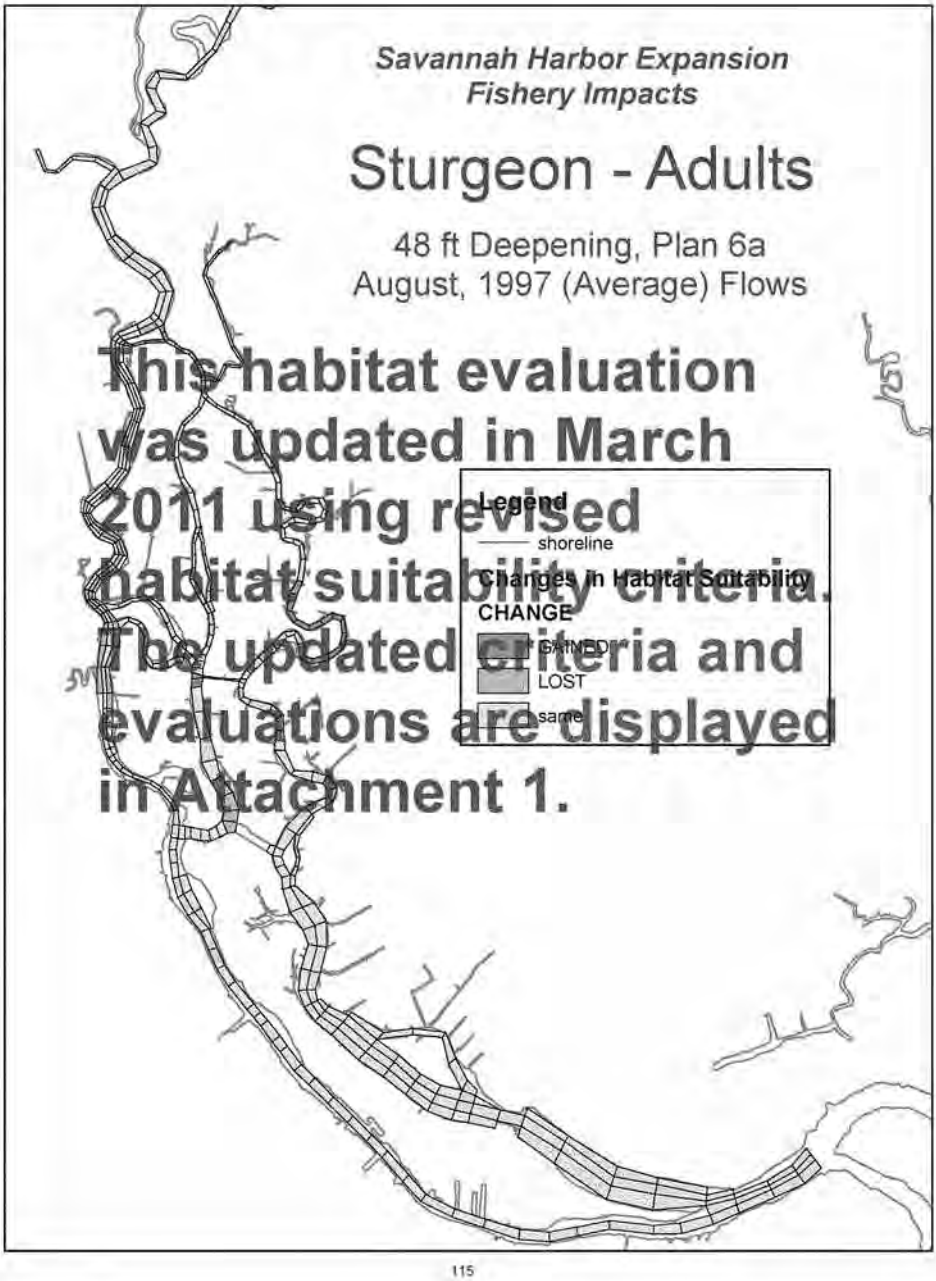

Savannah Harbor Expansion
Fishery Impacts
Striped Bass Spawning
48 ft Deepening, Plan 6a
April, 80th percentile flows
Legend
shoreline
Changes in Habitat Suitability
CHANGE6a6ft80
GAINED
LOST
same



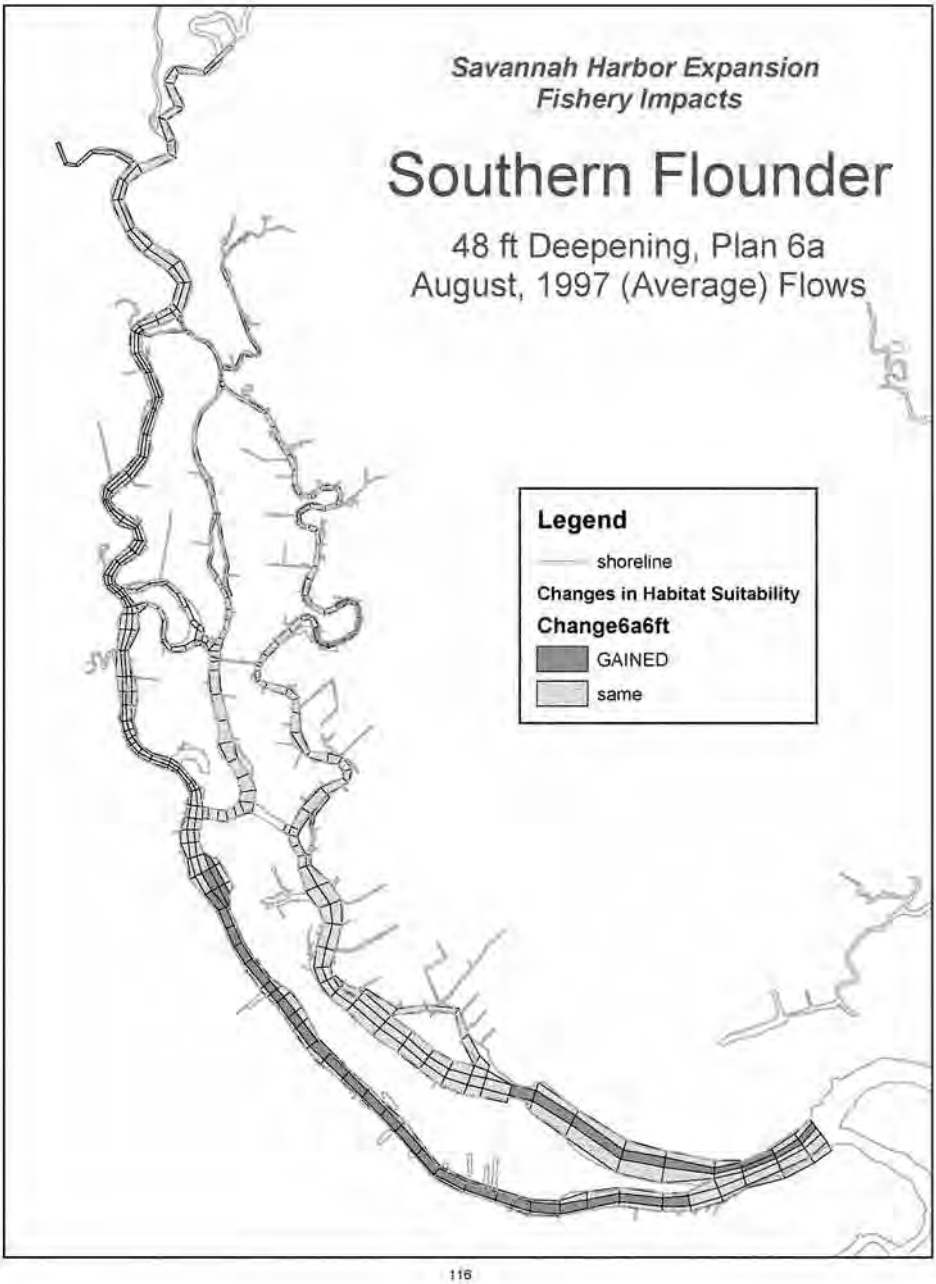
This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.



This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.



This habitat evaluation was updated in March 2011 using revised habitat suitability criteria. The updated criteria and evaluations are displayed in Attachment 1.


Savannah Harbor Expansion
Fishery Impacts
Southern Flounder
48 ft Deepening, Plan 6a
August, 1997 (Average) Flows
Legend
shoreline
Changes in Habitat Suitability
Change6a6ft
GAINED
same

ENVIRONMENTAL IMPACT STATEMENT
APPENDIX P: Fishery Habitat Maps

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

ATTACHMENT 1

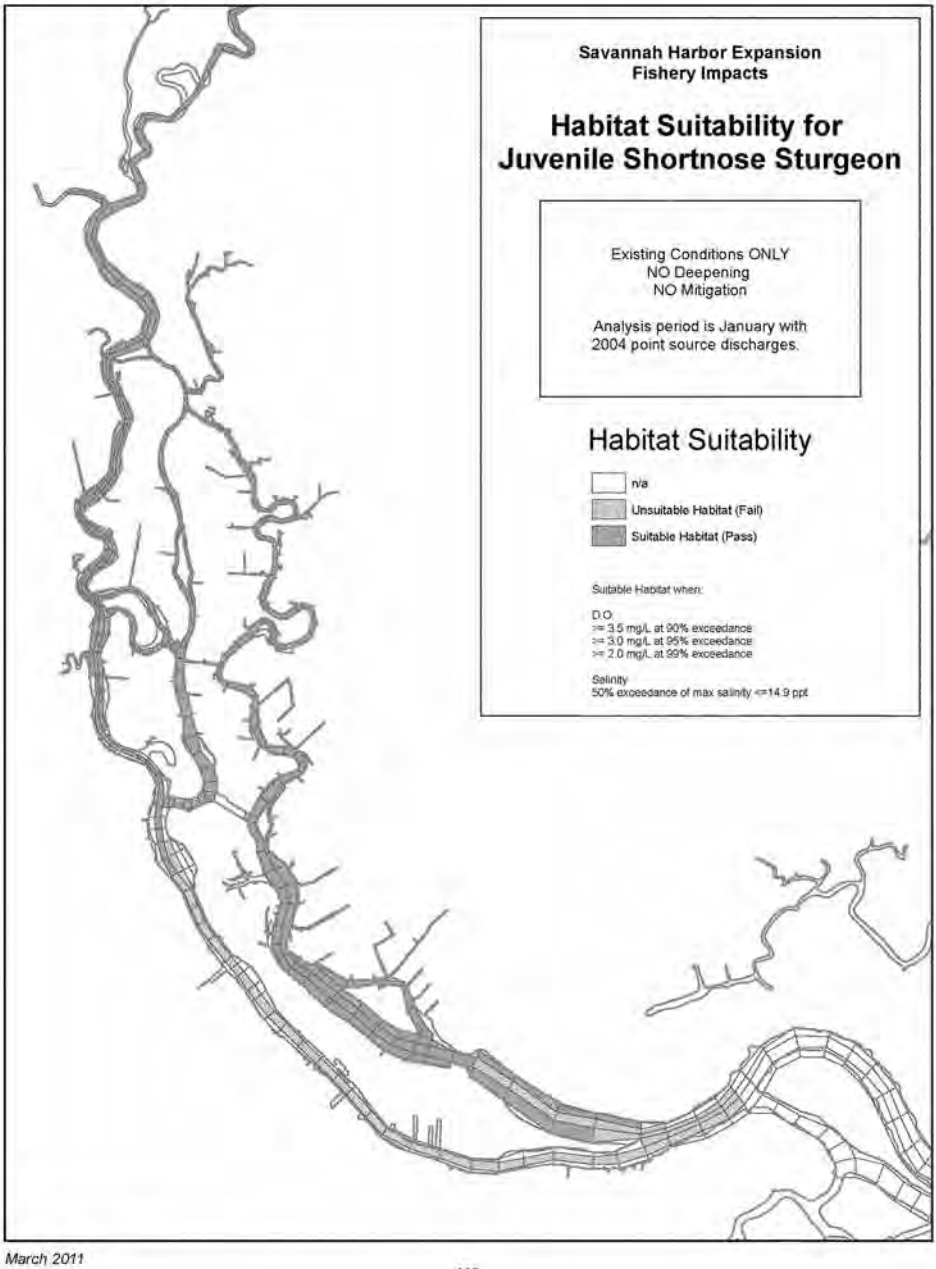
Revised Shortnose Sturgeon Habitat Maps
March 2011

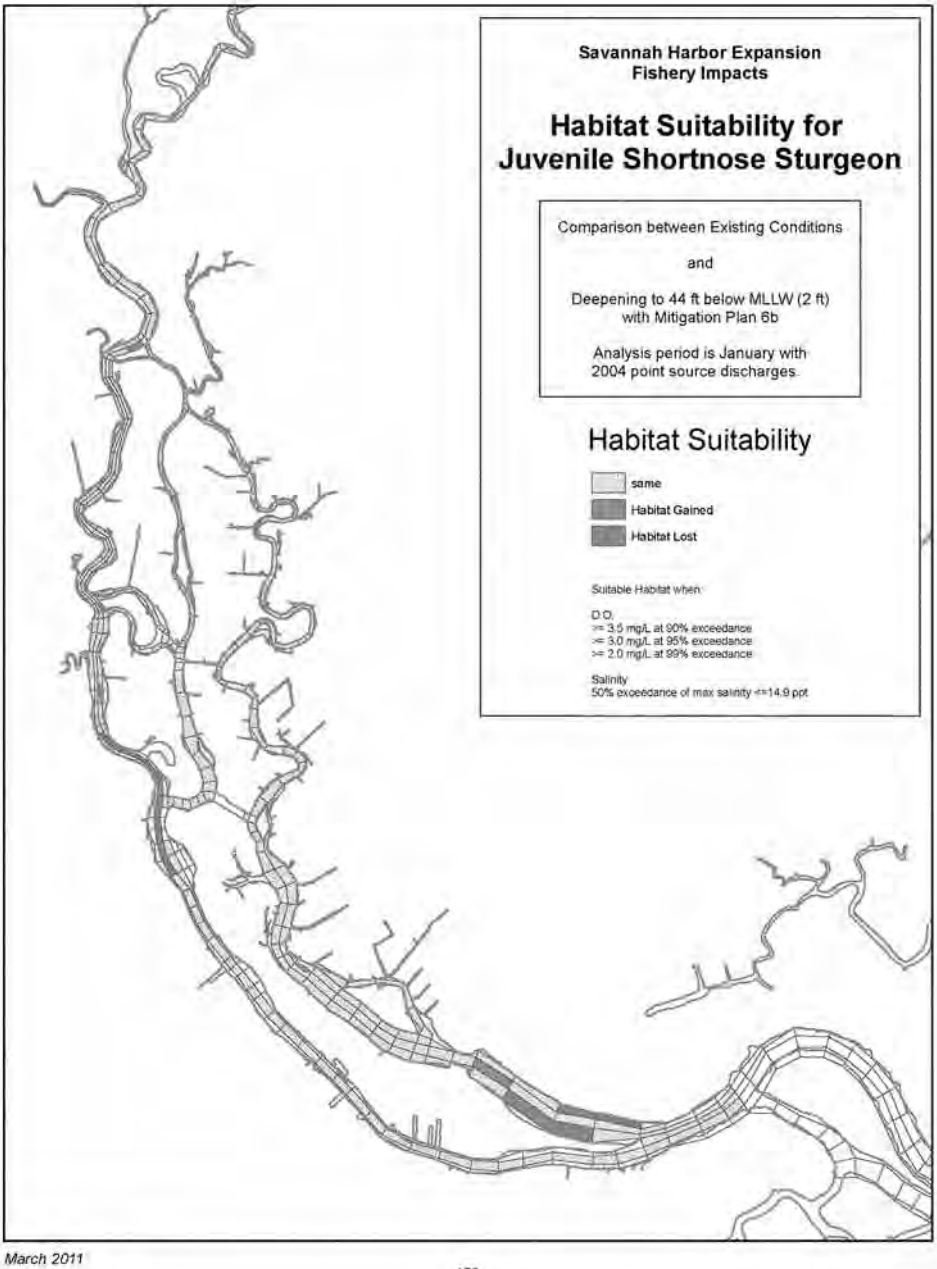
US Army Corps of Engineers
Savannah District
South Atlantic Division

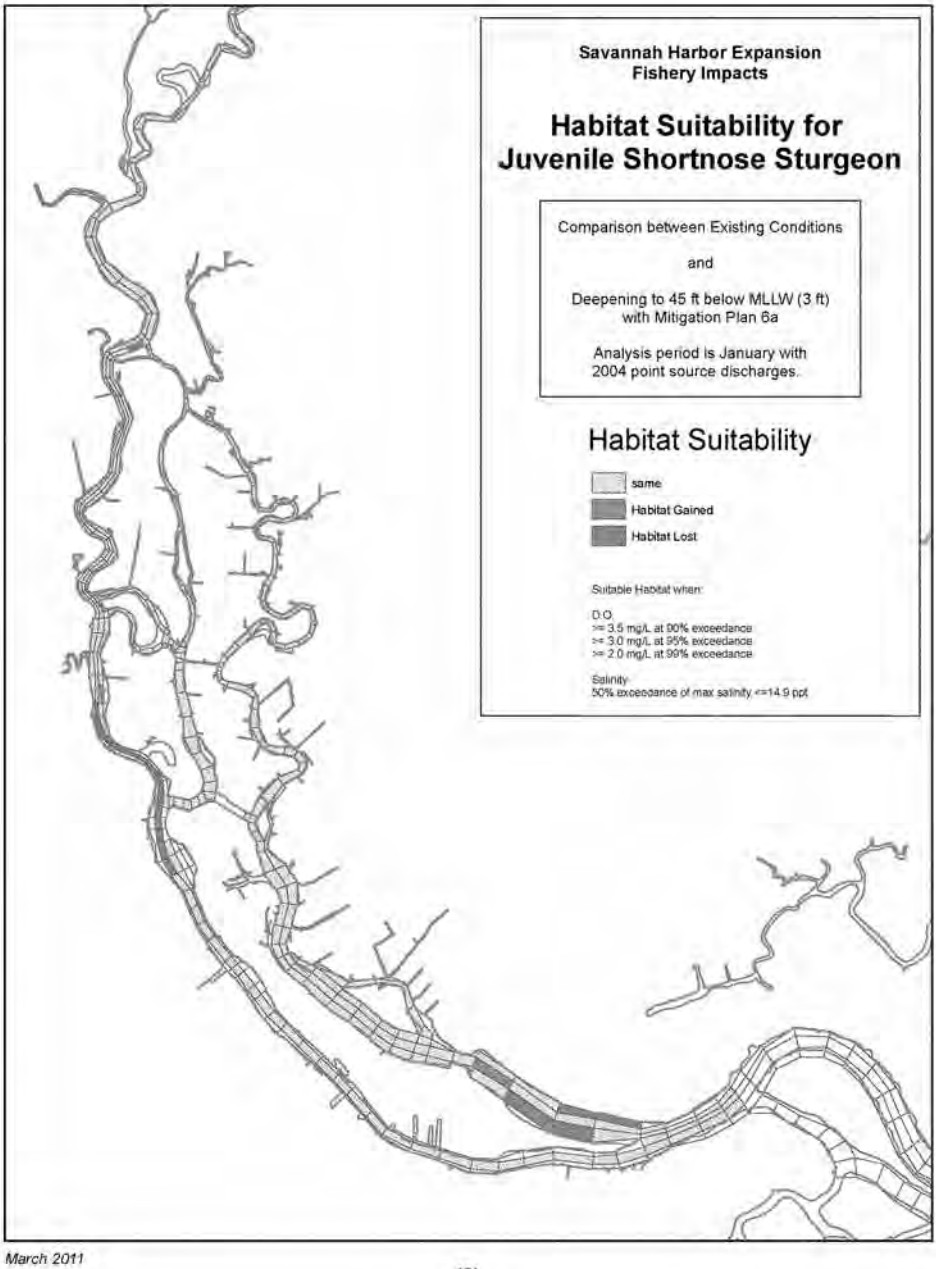
After release of the draft EIS in November 2010, the Corps coordinated with NMFS and the Fisheries Interagency Coordination Team to perform expanded modeling analyses on Shortnose sturgeon habitat. As a result of the coordination, the habitat suitability criteria for juvenile Shortnose sturgeon during the winter was revised to define "suitable" as the following:

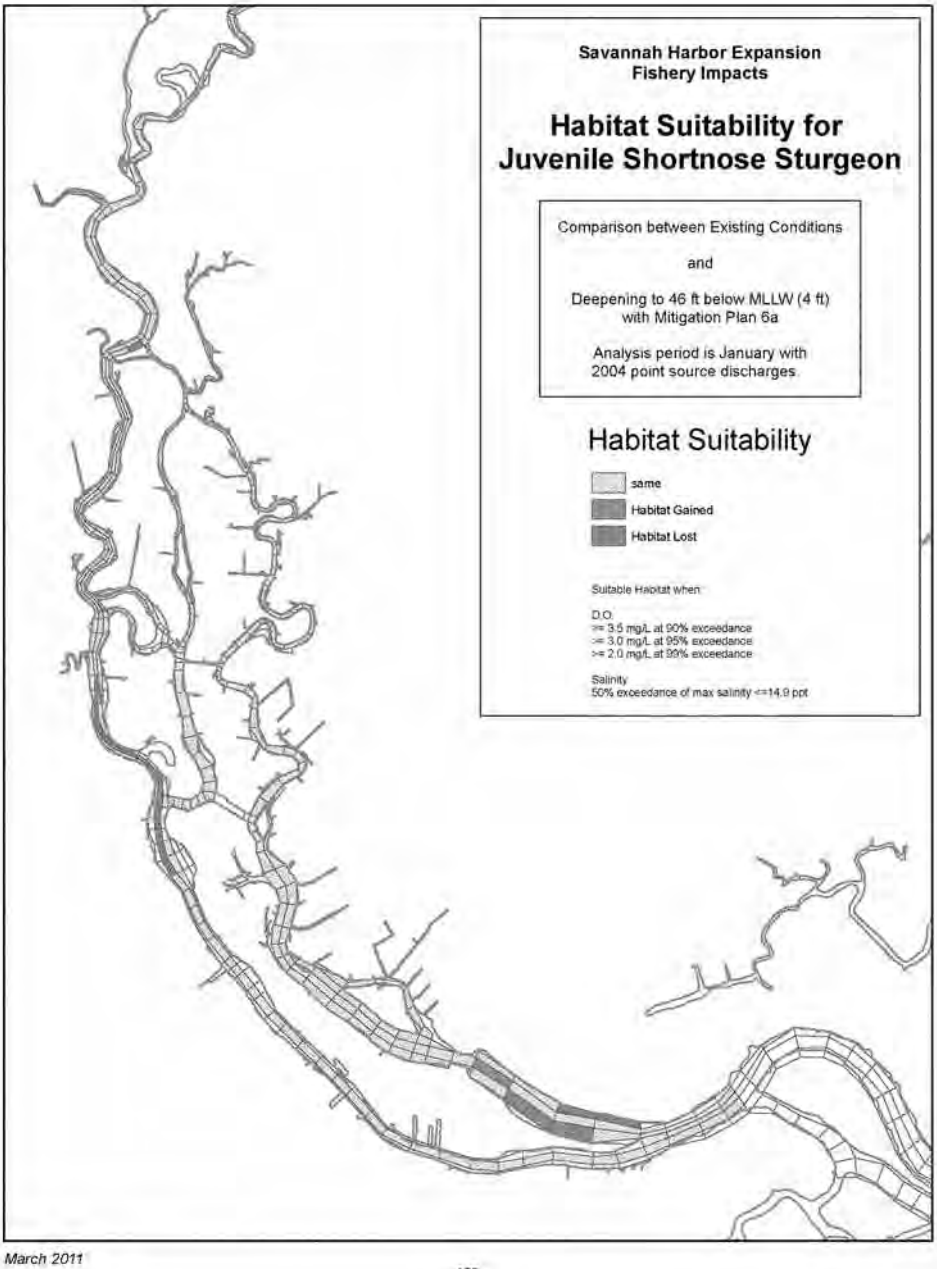
Species & Life Stage	Freshwater Flow Conditions	Simulation Period	Habitat Criteria
Shortnose Sturgeon (juvenile)	50%-tile of Long Term	January	Suitable habitat when DO >= 3.5 mg/l at 90% exceedance (10th percentile), >=3.0 at 95% (5th percentile), and >=2.0 at 99% (1 percentile) Suitable habitat when 50% exceedance of the Max Salinity is <= 14.9 ppt

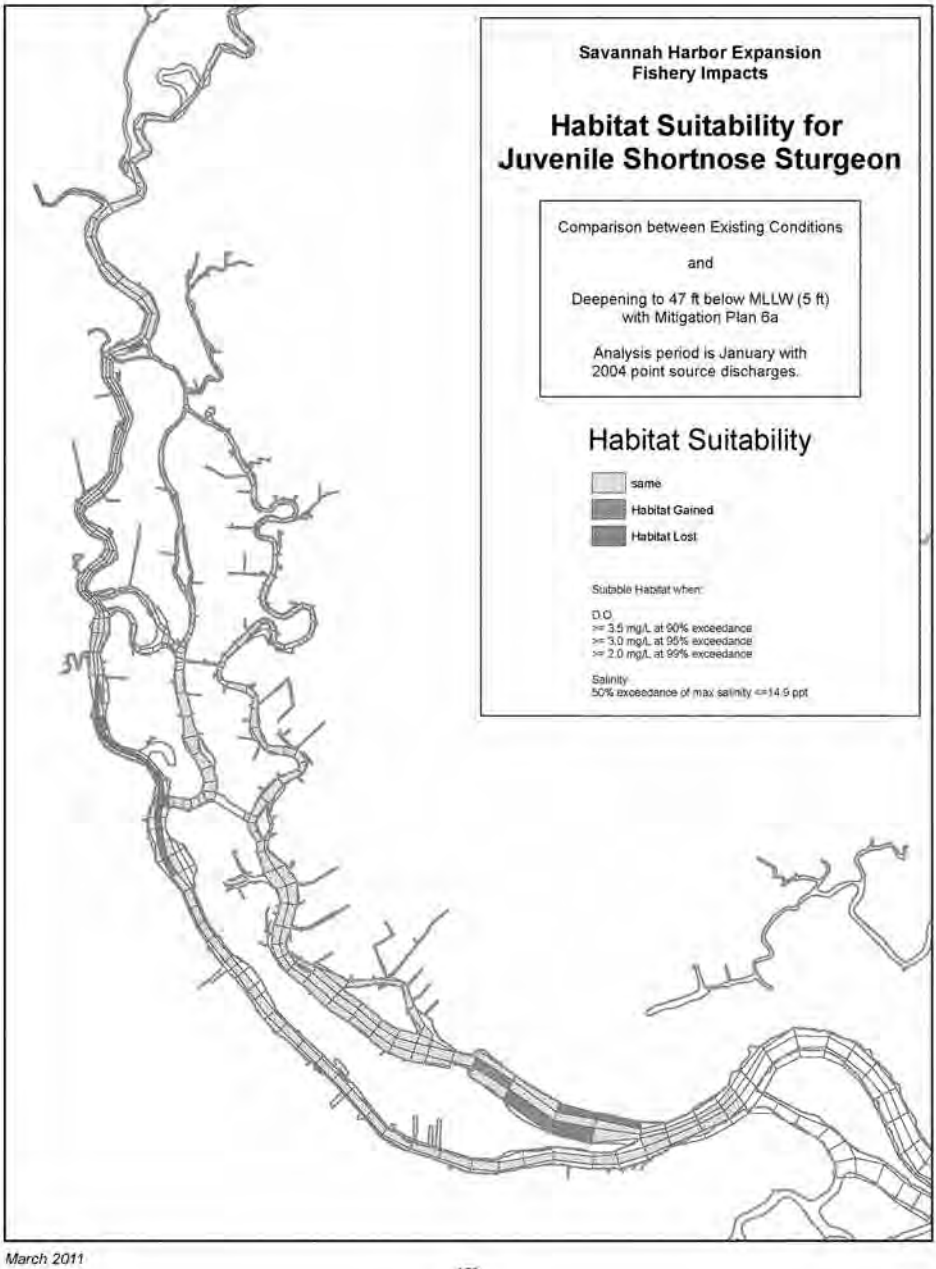
In addition to the flow conditions specified in the table above, the point source discharges from 2004 were also utilized for the three Shortnose sturgeon simulation periods (Adult January, Adult August, and Juvenile January). The point source discharge information was obtained from USEPA Region 4 and is based on the Discharge Monitoring Reports. The use of the 2004 loadings in the impact analysis is conservative in light of EPA's Revised Draft TMDL for D.O. in Savannah Harbor, which will require a reduction in loading from about 600,000 lbs/day to 130,000 lbs/day. For the August runs, the simulations were also run with and without the proposed D.O. injection loads that are a component of the proposed mitigation for impacts to habitat as outlined in Section 5 of the EIS. Reports detailing the revised Shortnose sturgeon model simulations and predicted impacts are included as supplemental materials to the Engineering Appendix of the GRR.

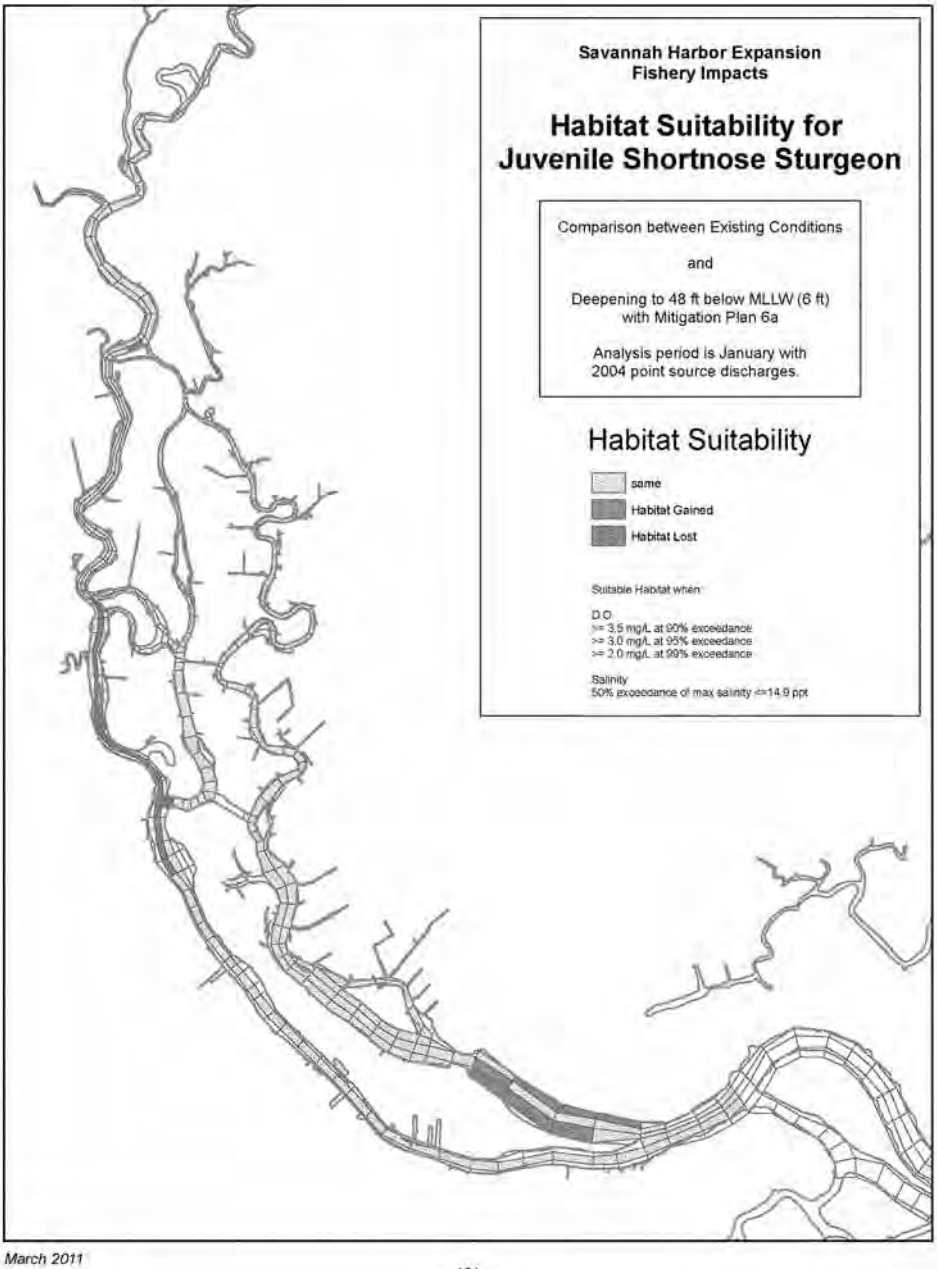

Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Juvenile Shortnose Sturgeon
Existing Conditions ONLY
NO Deepening
NO Mitigation
Analysis period is January with
2004 point source discharges.
Habitat Suitability
n/a
Unsuitable Habitat (Fail)
Suitable Habitat (Pass)
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
50% exceedance of max salinity <=14.9 ppt

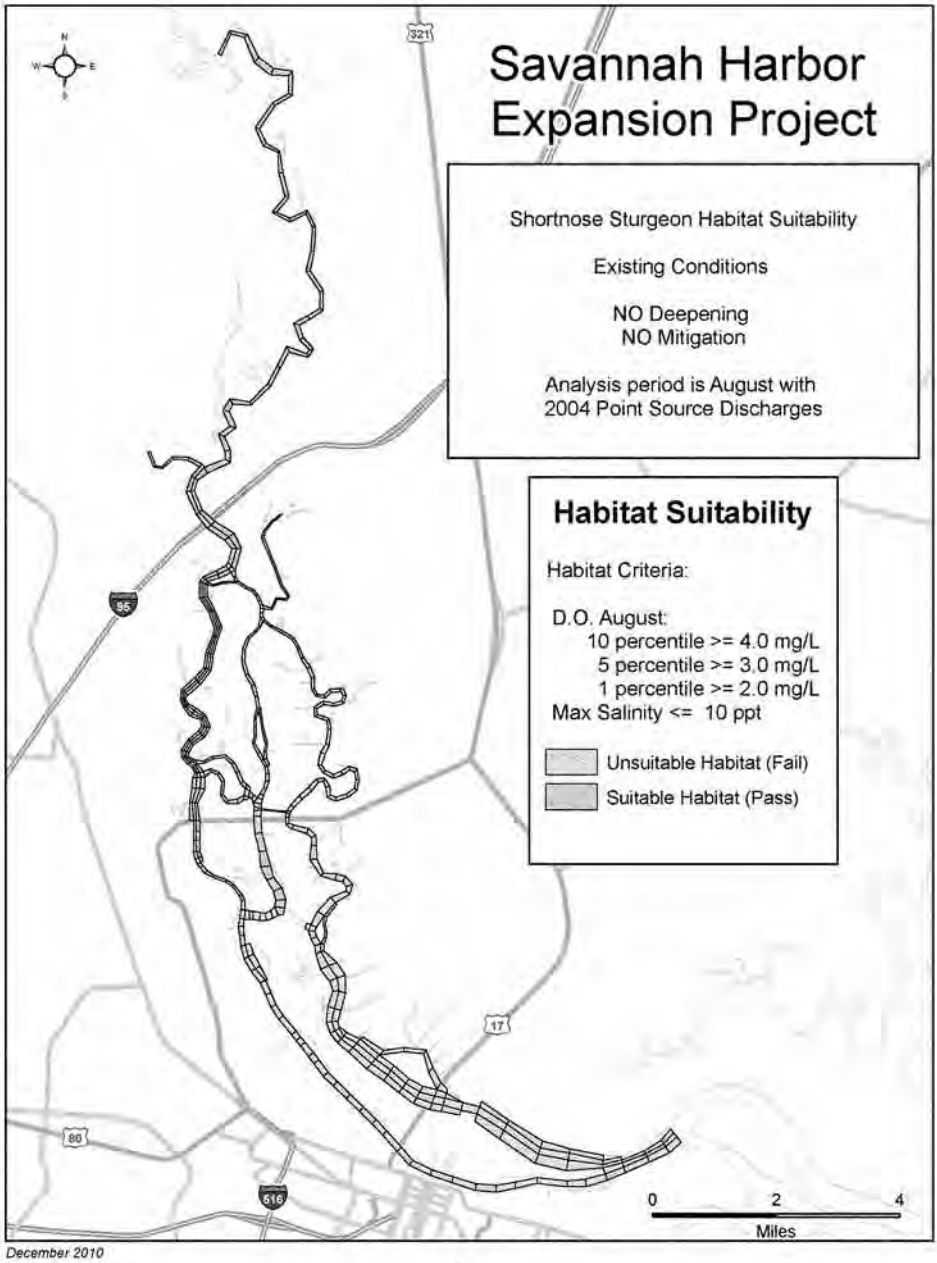

Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Juvenile Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 44 ft below MLLW (2 ft)
with Mitigation Plan 6b
Analysis period is January with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
50% exceedance of max salinity <=14.9 ppt


Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Juvenile Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 45 ft below MLLW (3 ft)
with Mitigation Plan 6a
Analysis period is January with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity:
50% exceedance of max salinity <=14.9 ppt

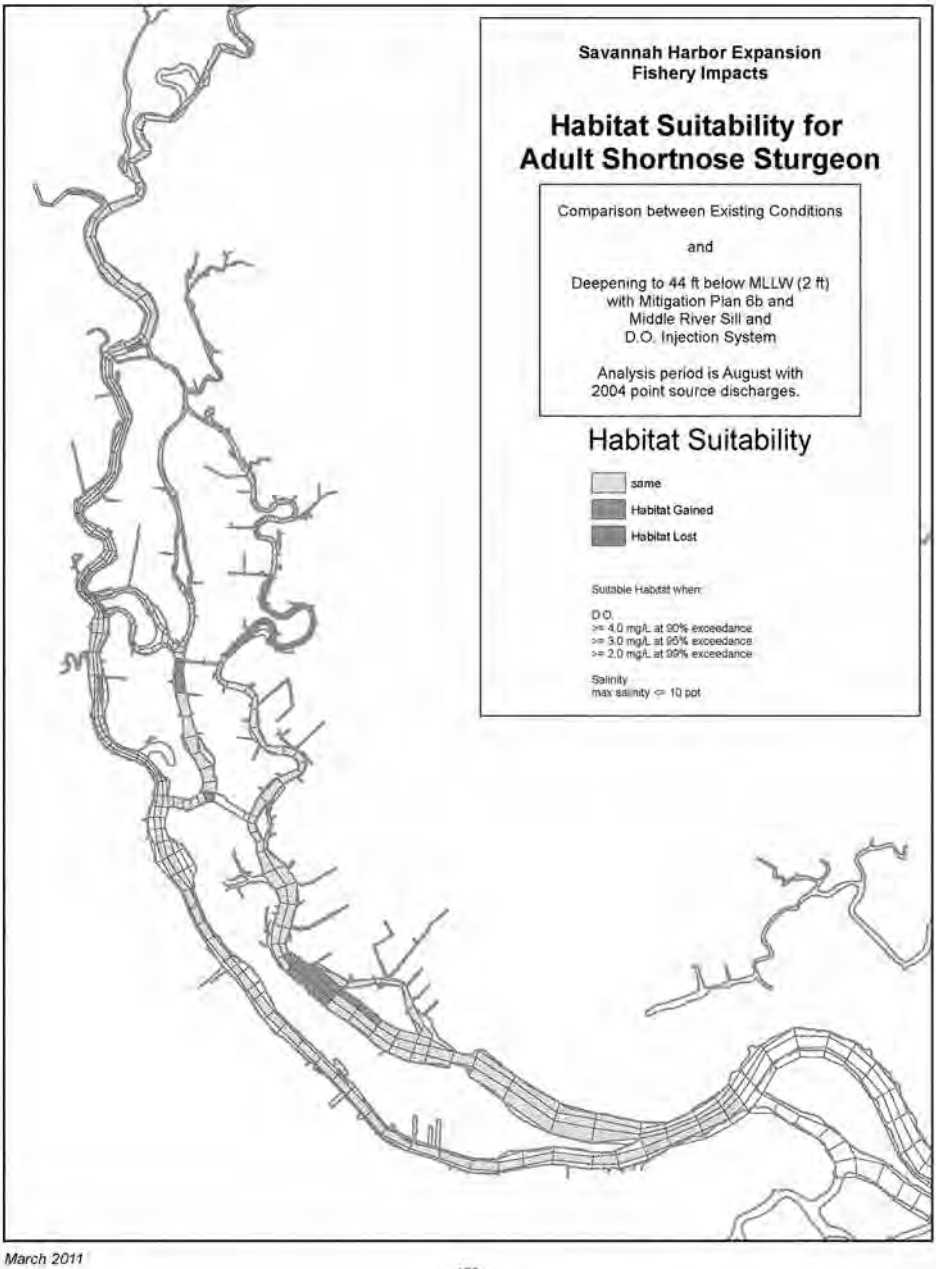

Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Juvenile Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 46 ft below MLLW (4 ft)
with Mitigation Plan 6a
Analysis period is January with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
50% exceedance of max salinity <=14.9 ppt

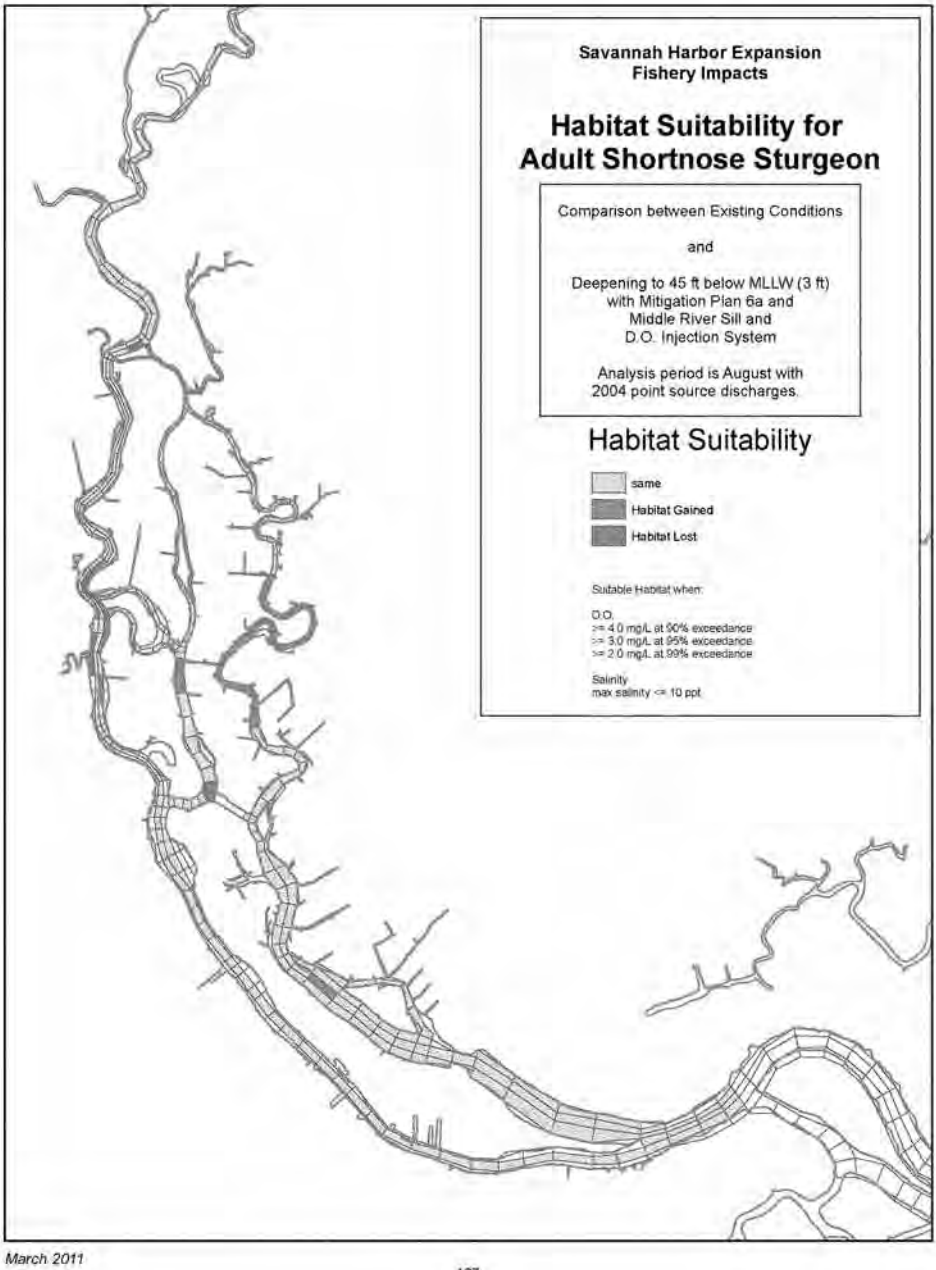

Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Juvenile Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 47 ft below MLLW (5 ft)
with Mitigation Plan 6a
Analysis period is January with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
50% exceedance of max salinity <=14.9 ppt

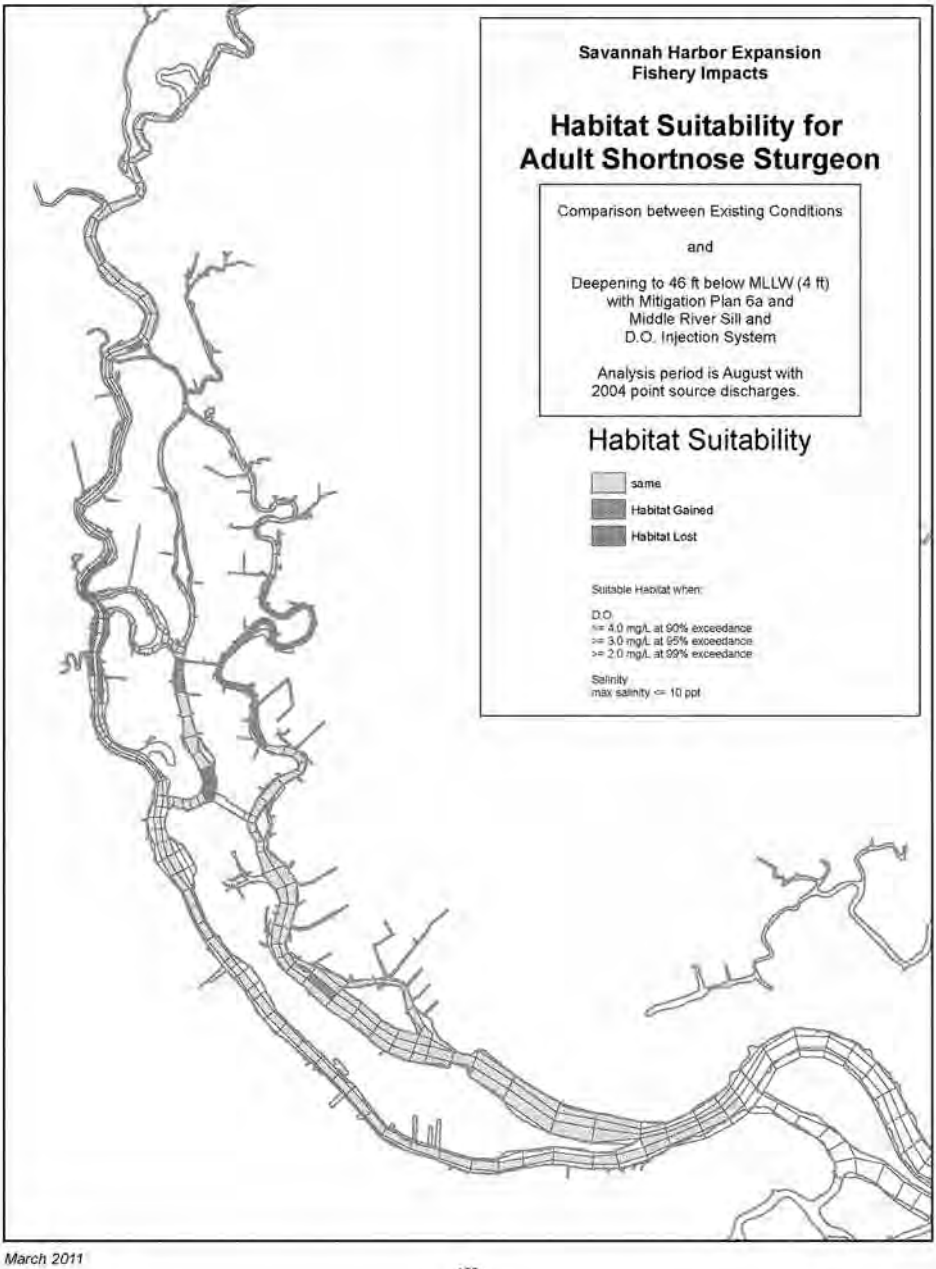

Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Juvenile Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 48 ft below MLLW (6 ft)
with Mitigation Plan 6a
Analysis period is January with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
50% exceedance of max salinity <=14.9 ppt

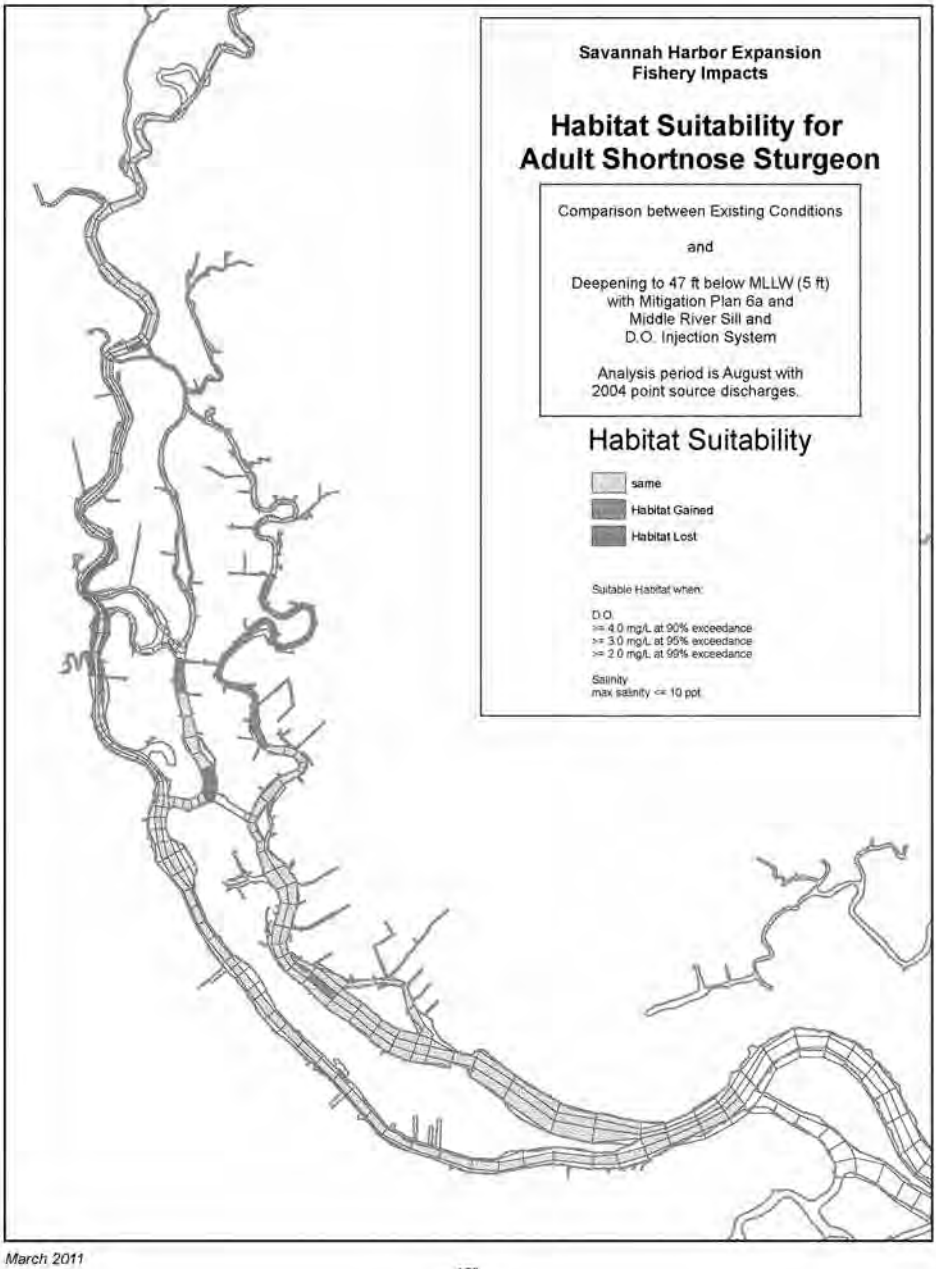


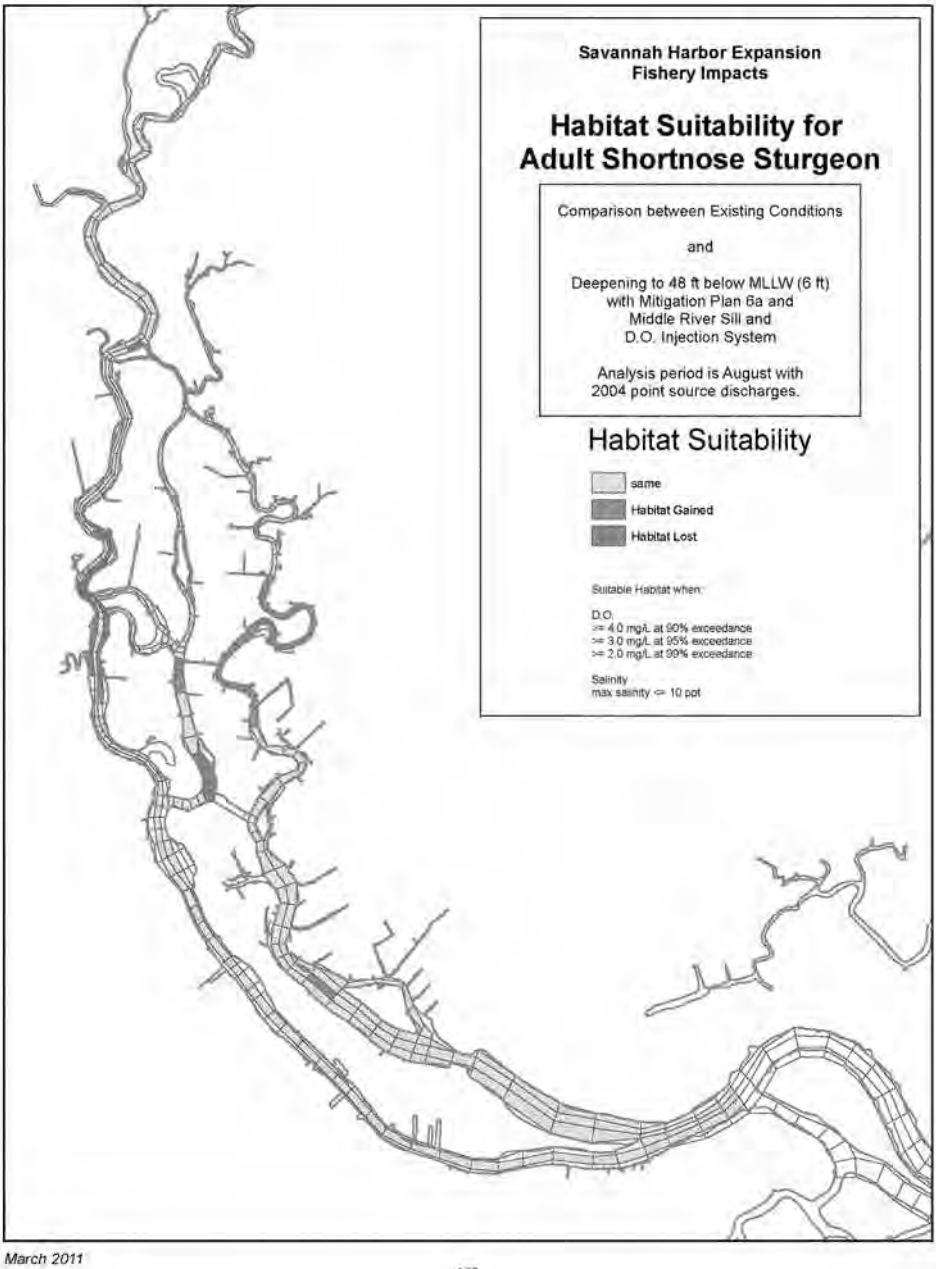
December 2010

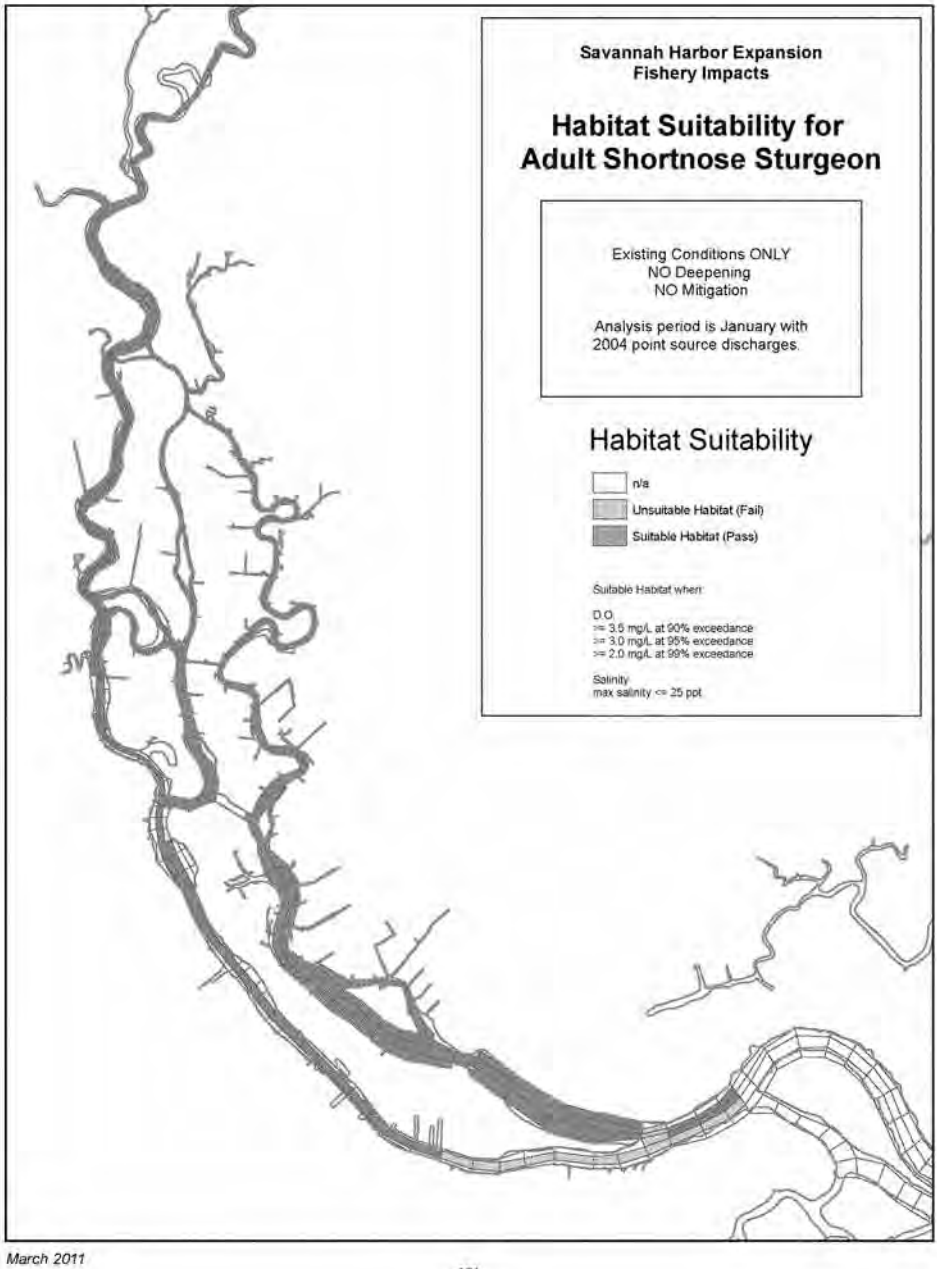

Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Adult Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 44 ft below MLLW (2 ft)
with Mitigation Plan 6b and
Middle River Sill and
D.O. Injection System
Analysis period is August with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 4.0 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
max salinity <= 10 ppt

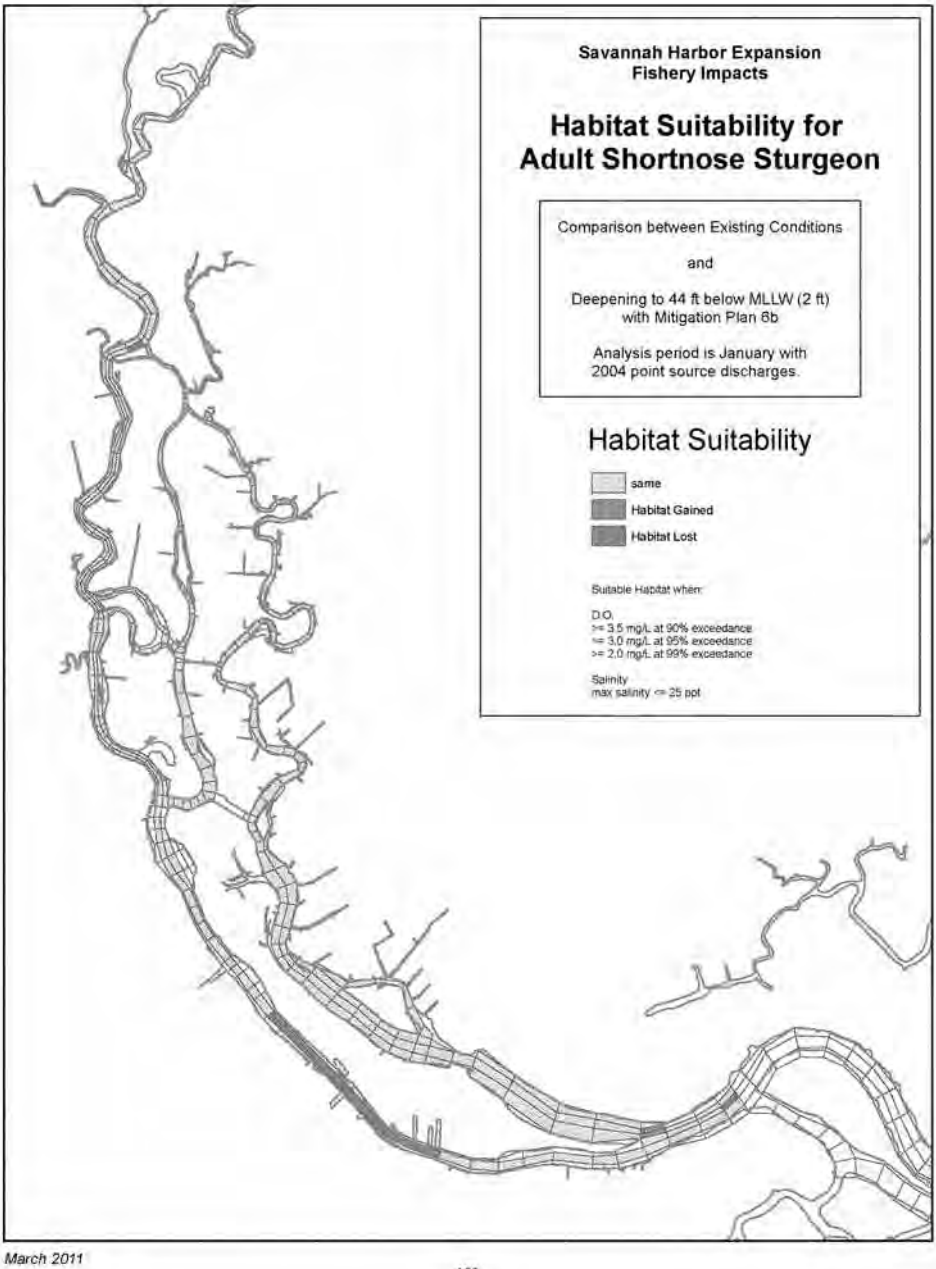

Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Adult Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 45 ft below MLLW (3 ft)
with Mitigation Plan 6a and
Middle River Sill and
D.O. Injection System
Analysis period is August with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 4.0 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
max salinity <= 10 ppt

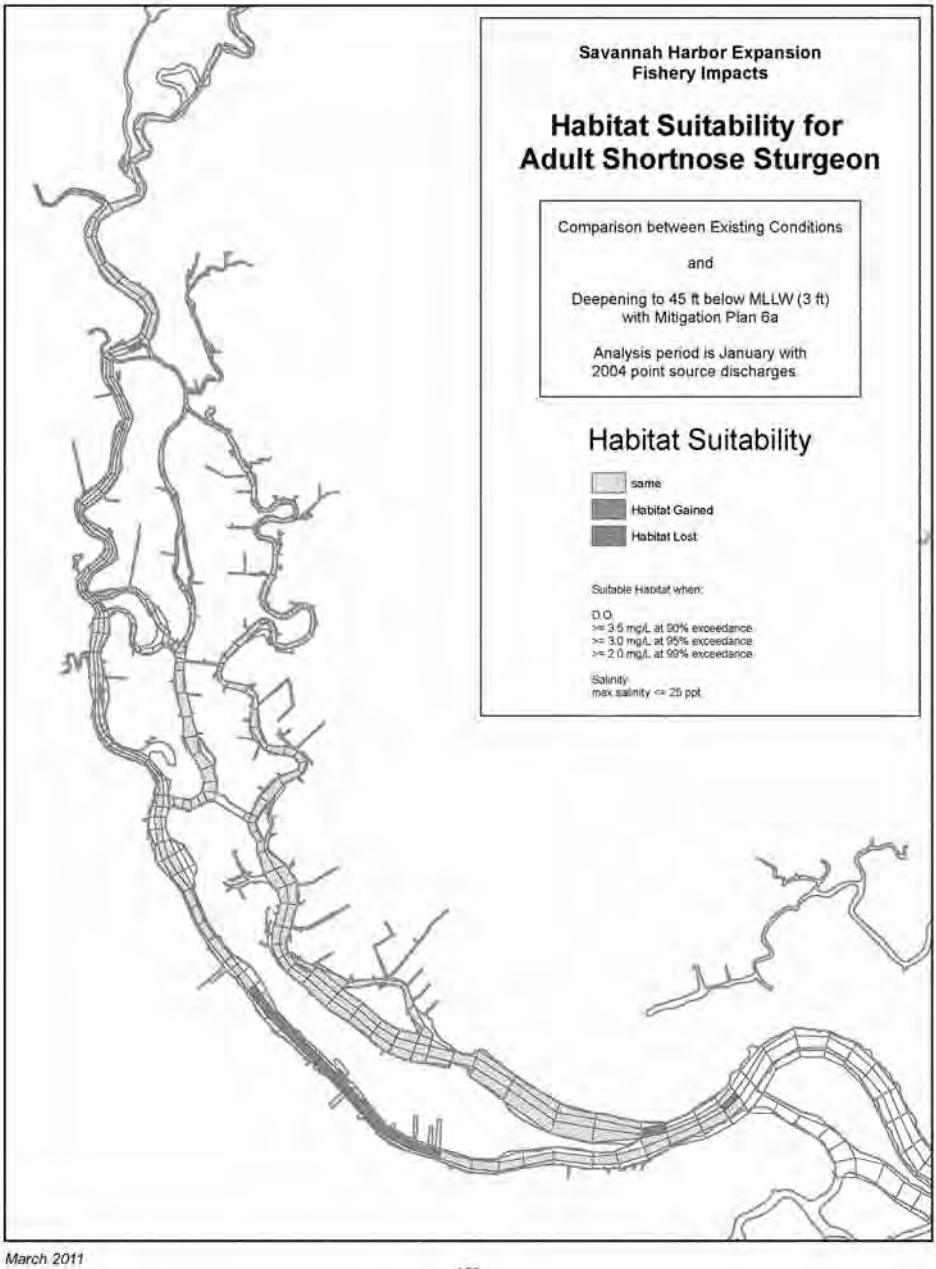

Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Adult Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 46 ft below MLLW (4 ft)
with Mitigation Plan 6a and
Middle River Sill and
D.O. Injection System
Analysis period is August with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 4.0 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
max salinity <= 10 ppt

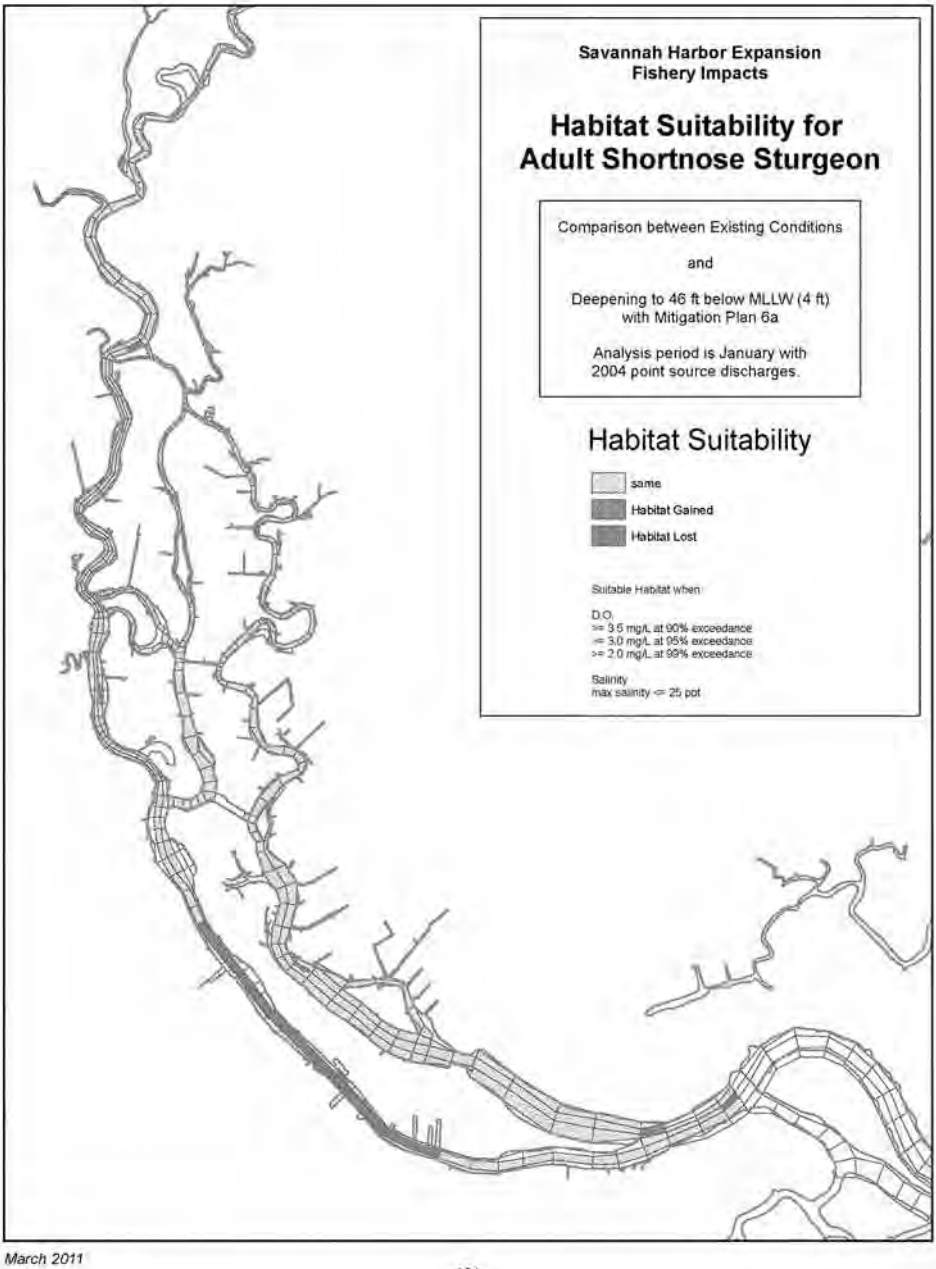

Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Adult Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 47 ft below MLLW (5 ft)
with Mitigation Plan 6a and
Middle River Sill and
D.O. Injection System
Analysis period is August with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 4.0 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
max salinity <= 10 ppt

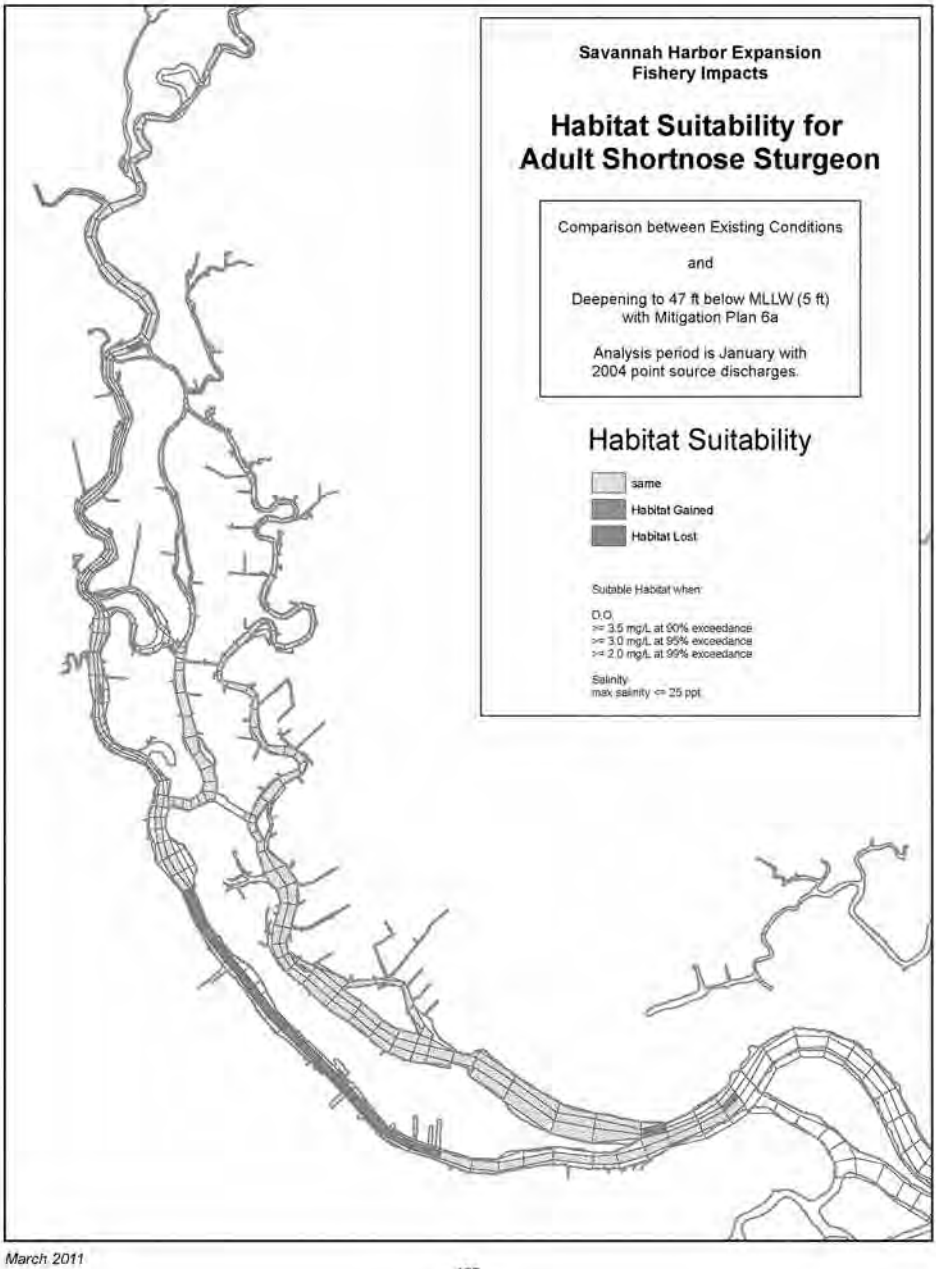

Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Adult Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 48 ft below MLLW (6 ft)
with Mitigation Plan 6a and
Middle River Sill and
D.O. Injection System
Analysis period is August with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 4.0 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
max salinity <= 10 ppt

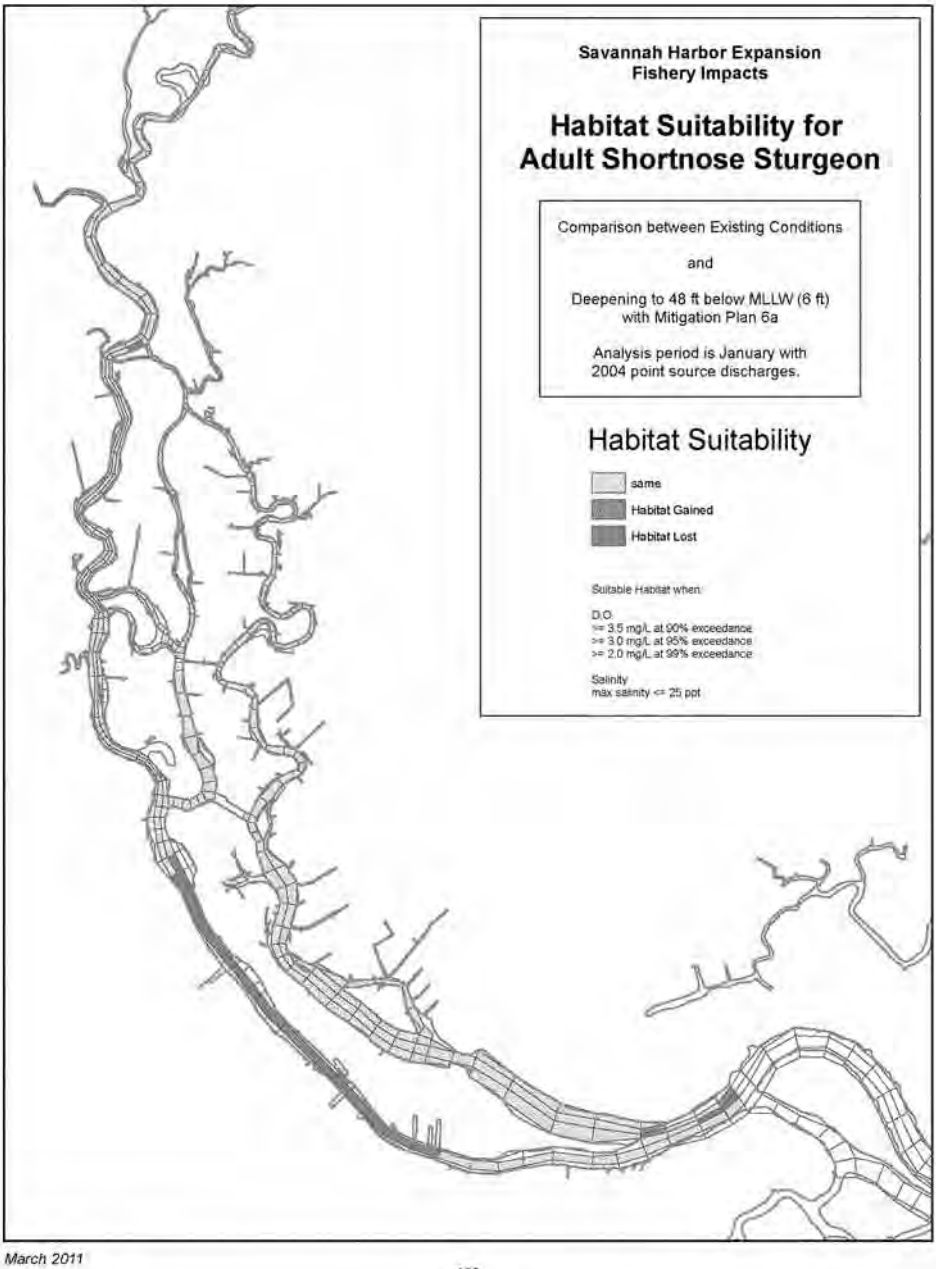

Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Adult Shortnose Sturgeon
Existing Conditions ONLY
NO Deepening
NO Mitigation
Analysis period is January with
2004 point source discharges.
Habitat Suitability
n/a
Unsuitable Habitat (Fail)
Suitable Habitat (Pass)
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
max salinity <= 25 ppt


Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Adult Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 44 ft below MLLW (2 ft)
with Mitigation Plan 6b
Analysis period is January with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
max salinity <= 25 ppt


Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Adult Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 45 ft below MLLW (3 ft)
with Mitigation Plan 6a
Analysis period is January with
2004 point source discharges
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
max salinity <= 25 ppt


Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Adult Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 46 ft below MLLW (4 ft)
with Mitigation Plan 6a
Analysis period is January with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
<= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
max salinity <= 25 ppt


Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Adult Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 47 ft below MLLW (5 ft)
with Mitigation Plan 6a
Analysis period is January with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
max salinity <= 25 ppt


Savannah Harbor Expansion
Fishery Impacts
Habitat Suitability for
Adult Shortnose Sturgeon
Comparison between Existing Conditions
and
Deepening to 48 ft below MLLW (6 ft)
with Mitigation Plan 6a
Analysis period is January with
2004 point source discharges.
Habitat Suitability
same
Habitat Gained
Habitat Lost
Suitable Habitat when:
D.O.
>= 3.5 mg/L at 90% exceedance
>= 3.0 mg/L at 95% exceedance
>= 2.0 mg/L at 99% exceedance
Salinity
max salinity <= 25 ppt

ENVIRONMENTAL IMPACT STATEMENT APPENDIX Q: Risk and Uncertainty in Environmental Evaluation Approach

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

US Army Corps
of Engineers
Savannah District
South Atlantic Division

Risk and Uncertainty Analysis

TABLE OF CONTENTS

Topic **Page**

1. Overview 1

2. Reducing Risk
   - A. Biological Field Studies 1
   - B. Development of Predictive Tools 2
   - C. Use of the Predictive Tools 3

3. Risk & Uncertainty in Salinity Predictions 5

4. Reliability of the Wetland Impact Predictions
   - A. Uncertainty in the Wetland Impact Predictions 7
   - B. Uncertainty in the Amount of Sea Level Rise 7
   - C. Risk with Wetland Impact Predictions 8

5. Reliability of the Dissolved Oxygen Impact Predictions
   - A. Uncertainty in Dissolved Oxygen Predictions 9
   - B. Risk with Dissolved Oxygen Predictions 10

6. Reliability of the Dissolved Oxygen Improvement Technique
   - A. Uncertainty in Dissolved Oxygen System Effectiveness 10
   - B. Risk with Dissolved Oxygen System Effectiveness 11

7. Biological Responses
   - A. Uncertainty in Biological Responses 12
   - B. Risk with Biological Responses 12

8. Air Quality Analysis
   - A. Uncertainty in Air Emission input data 13
   - B. Risk with Air Emission Analysis 14

9. Sediment Quality Evaluation
   - A. Uncertainty in Sediment Composition and Quality 14
   - B. Risk with Sediment Composition and Quality 15

Risk and Uncertainty Analysis

1. Overview

There are numerous uncertainties associated with the evaluation of expected environmental impacts from the proposed harbor deepening, the performance of the selected plan and the associated mitigation features. Savannah District considered the uncertainties identified during the initial scoping process and throughout the entire evaluation period. The Corps also considered uncertainties that would exist should the project proceed to implementation. In addition, the risks associated with the uncertainties were also considered.

This analysis will address only the uncertainties and risks associated with the environmental aspects of the proposed harbor deepening project.

Uncertainties occur when knowledge is incomplete. In a harbor deepening project there are many uncertainties. Over the course of the study, the Corps took many actions to reduce the uncertainties and the associated risk.

The Tier II Environmental Impact Statement was prepared partially in response to public and agency concerns about the uncertainties contained in the Tier I EIS. At the beginning of the Tier II efforts, the Corps and GPA held scoping meetings to identify issues that warranted further investigation. Federal and State natural resource agencies participated in the scoping. A Stakeholders Evaluation Group provided information about specific studies that should be conducted. Those studies were intended to reduce the uncertainties in information concerning potential environmental impacts from a harbor deepening.

2. Reducing Risk

A. Biological Field Studies

Biological field studies were conducted to obtain information on environmental conditions in the harbor, including the following:

- Migration of Juvenile American Shad, Hickory Shad, and Blueback Herring in the Savannah River
- Assessment of spawning sites and reproductive status of striped bass in the Savannah River estuary
- Shortnose sturgeon field study
- Spawning Aggregations of Sciaenid Species
- Temporal and Spatial Distribution Study – SC DNR
- Temporal and Spatial Distribution Study – GA Cooperative Fish and Wildlife Resources Unit
- Tidal Wetlands Resource Utilization Studies Report
- Tidal Marsh Studies Data Report

These studies removed uncertainties about what species reside in the harbor and their abundance, and provided information about their importance within the estuarine ecosystem.

In addition to existing information, an extensive monitoring study in the SE US is being funded by NOAA on the Atlantic and shortnose sturgeon. This effort began in the spring of 2011 and is scheduled to last for 5 years. The work in the Savannah River is being conducted by SC DNR (http://www.nmfs.noaa.gov/pr/conservation/states/funded.htm). As information becomes available, the Corps and NOAA Fisheries will consider it.

B. Development of Predictive Tools

Much effort was spent developing hydrodynamic and water quality models that could reliably replicate existing conditions. Being able to use such models reduces the uncertainty surrounding predictions of how the system would behave if physical modifications, such as deepening or closing a channel were implemented. Without such tools, decision-makers would be forced to rely entirely on professional judgment. In brief, the model developer (Tetra Tech) had an uncertainty analysis performed by a separate independent modeler to assess the models' performance. The Corps conducted an independent technical review of the models to determine if they were adequate. The Corps also obtained concurrence from the natural resource agencies that these models were acceptable to evaluate environmental impacts from this project. Those independent reviews and agency concurrences also reduced the risk that the models were inappropriate and/or inaccurate.

An interagency team oversaw development of the hydrodynamic and water quality models intended to be used on this project. As part of their work, the team developed a Draft Expectations Document that described (1) the resources of primary concern in the estuary, (2) the locations and conditions under which project impacts should be evaluated for those resources, (3) the modeling approach to be taken, (4) the statistical analyses to be performed to document the model's performance, and (5) the evaluation criteria upon which the acceptability of the model would be based. The goals included parameters such as salinity, dissolved oxygen, temperature, current velocity, and flow volumes. With those performance goals, the strengths and weaknesses of the models could be identified. The direction and guidance reduced uncertainty during the model development phase and provided benchmarks against which the agencies could evaluate the performance of the models that were produced. The extent to which the models met or did not meet the benchmarks is included in the TetraTech's, "2005 Model Development Report," which can be found in the Engineering Appendix to the GRR. The agencies used those benchmarks during their review of the model before they separately concluded that the models were acceptable for impact evaluation use on this project. The Expectations Document developed by the interagency team reduced uncertainty by providing a framework against which to judge the performance of the models.

C. Use of the Predictive Tools

The reliability of the hydrodynamic and water quality models is also dependent on how well they are applied. The Corps used Interagency Coordination Teams to define how the models should be used to predict physical changes from changes proposed in the harbor. The use of experts from several organizations reduces the risk of error from the limited perspective of just one or a few individuals. The Interagency Coordination Teams recommended that the models be applied over a range of conditions. Using the aforementioned approach reduces the risk of evaluating impacts based on just one set of conditions that may not be a good representation of conditions which are encountered in the future.

The Wetland Interagency Coordination Team recommended that analyses be conducted on average and drought river flows, and on two levels of potential sea level rise. Calculating environmental impacts using multiple input conditions allows identification of the sensitivity of the predictions to the input conditions. The team also identified the summer growing season as being when wetland vegetation is most stressed. This factor ensures the impact predictions are conducted during time periods that are critical to the survival of the vegetative communities.

The hydrodynamic modeling indicates that impacts to wetlands would vary not only with the channel depth selected, but also with river flows and sea level rise. The three sensitivity analyses that were conducted (in addition to the baseline evaluation) showed varying amounts of impacts, but the average river flow conditions with the existing sea level were the conditions which demonstrated the most adverse impacts from a harbor deepening. When compared to the baseline, the other conditions showed fewer acres impacted, primarily because the freshwater interface would have shifted further upstream under those other conditions and would not be as subject to additional impacts from a harbor deepening. So the baseline conditions (average river flow and present sea level) present the largest amount of impacts. The Wetland Interagency Coordination Team's recommendation to use those baseline conditions for mitigation determinations greatly reduces uncertainties that the predicted wetland impact values would be too low.

Corps engineering staff prepared the modeling report titled "Wetland/Marsh Impact Evaluation". That report documented the results of the impact and mitigation modeling for wetlands. The report explains that the model produces a range of salinity values for a given location over the duration of the model run. One must select which of those values to use as the salinity value for that cell for that model run. The Wetland Interagency Coordination Team requested the information be provided on salinity impacts at both the 10 and 50% exceedance levels. The report contains that information, and it shows that impacts are predicted to be higher if one uses the 50% exceedance salinity value for a given model cell. [Note – a 50% exceedance value would be close to the average value for a range of data points.] After reviewing the report, the Wetlands Interagency Coordination Team recommended we use the 50% exceedance values to determine impacts from the proposed project. The effect of that decision is to show higher impacts than would occur from more rare tidal, flow, or meteorological conditions (such as at the 10% exceedance level). The Team's selection of the 50% exceedance salinity values reduces uncertainty that the model's predicted level of impacts would be exceeded by other environmental conditions.

The Fisheries Interagency Coordination Team recommended that analyses be conducted over a range of river flows (20, 50 and 80 percent of historic frequencies) and a variety of seasons, to reflect the critical conditions for separate life stages of specific species. That team also recommended that the Corps evaluate impacts to several species of fish common in the estuary. This ensured that various fishery components of the estuarine ecosystem were considered. This broadening of the impact assessment to multiple species eliminates reliance on a narrow view of the ecosystem, thereby reducing the risk of not identifying a critical impact.

The Water Quality Interagency Coordination Team recommended that analyses be conducted using drought flows and over several months during the critical summer period. These analyses would ensure that the evaluation reflects critical flow and weather conditions and includes a wide range of tidal conditions. Using an expanded data set also reduces the uncertainties of the water quality predictions, which aggregate the values over that wide range of ecological conditions. As stated before, the use of multiple environmental input conditions allows identification of the sensitivity of the predictions to variations in those input conditions. Finally, the use of long modeling durations also reduces the risk of missing critical effects that may occur with a different combination of river flow or tidal conditions.

There is uncertainty regarding how biologic habitats are judged specific to the quality of fisheries. Although Federal and state resource agencies would like to easily differentiate between areas that provide good or poor habitat for a species, in practice it is often quite difficult to make those distinctions. There are and will be gradations in the quality of habitats. Some habitats will possess conditions that result in no stress to an individual fish. The other end of the spectrum includes habitats with conditions, which contribute to the stress of fish in that area. Ultimately, the fish species chooses not to stay in that location. Alternatively, the species stays and demonstrates decreased growth rates or a reduced response rates that lead to higher predation. (Of note: The previously described scenario does not consider variations between individual fish that comprise the population of a given fish species residing in the same general area.) After some discussion, the Fisheries Interagency Coordination Team recommended that fishery analyses be conducted using an "Acceptable" vs. "Unacceptable" criteria for fishery habitats. Such a procedure would allow easier use of the model results and help focus evaluation of the differences between the various depth alternatives. The Team subsequently determined the habitat conditions that would differentiate between these two categories (i.e., "Acceptable" vs. "Unacceptable". Modeling then identified the location and quantified the aerial extent of the two habitat categories. The criteria that the Team chose was on the conservative side, so that areas shown as acceptable habitat were identified as providing little to no stress to a particular fish community. The conservative nature of the values used to differentiate between "Acceptable" and "Unacceptable" habitats likely reduced the risk of overstating what portions of the estuary provide acceptable habitat to that species.

3. Risk & Uncertainty in Salinity Predictions

During the development process for the hydrodynamic and salinity models, the models were reviewed by the Federal and States natural resource agencies. The agencies regularly use those types of models and are familiar with their benefits and limitations (such as uncertainties in their predicted values). All the agencies agree that these models are more accurate when used to identify the differences between two scenarios than when used to identify values at a given location at a point in time in a given scenario.

The Corps funded the Kinetics Analysis Corporation (KAC) to perform an uncertainty analysis of the models in 2005. KAC performed that analysis toward the end of the model development process and evaluated the ability of those models to accurately predict the observed data. A model is typically developed and calibrated using field data, and validation of a model is determined based on the similarity of data output to observations recorded in the field. If the output and field observations are in agreement, then a model may be used as a predictive tool provided the associated precision and accuracy requirements are acceptable. A copy of KAC's analysis can be found in the Engineering Appendix. KAC evaluated the models' ability to duplicate the field data for salinity, dissolved oxygen, river discharge, and tidal phase. River discharge and tidal phase are useful in evaluating how a model is constructed but are not discussed here because they do not aid in evaluating the reliability of the impact predictions.

KAC discussed model errors at four locations – the I-95 Bridge, Lucknow Canal, the USFWS Dock, and at Houlihan Bridge. We believe that only two of those locations are pertinent to the present discussion of risk and uncertainty. In brief, salinity levels are too low at I-95 to be meaningful in this assessment. All values reported by KAC for that location are below those that would result in impacts to vegetation or fish habitat. The Lucknow Canal station is located very close and upstream of the USFWS Dock, so the USFWS Dock provides a better site at which to evaluate the model for salinity.

KAC found the models generally predict salinity levels too high at the Houlihan Bridge and the USFWS Dock. In general, KAC found the models to predict salinity high along the entire gradient from 1 to 15 ppt. KAC evaluated the model using two river flow periods, so they produced multiple evaluations of the model's reliability for the same location, depending on flow. At the Houlihan Bridge, the errors typically range from ½ to 1 ppt when the observed salinity measured 2 ppt (pages 39 and 45 of their report). At the USFWS Dock, the errors typically range from 0.25 to 0.6 ppt when the observed salinity measured 1 ppt (page 51 of their report) and from 1.1 to 1.6 ppt when the observed salinity measured 2 ppt (page 57 of their report).

KAC also developed error bounds for the model's salinity predictions. At the Houlihan Bridge, they found that for salinity levels around 1 ppt, the model had between a 70 and 85 percent chance of over-predicting salinity (pages 40 and 46 of their report). Similarly, at the USFWS Dock they found that for salinity levels around 0.5 ppt, the model had an 83 to 85 percent chance of over-predicting salinity (pages 51 and 58 of their report).

SC DHEC provided the following in their final assessment of the model development:

> "The EFDC hydrodynamic and salinity model continues to under-predict ebb flows on Back, Middle, and Little Back Rivers based on comparisons to discrete, short-term flow measurements. Improvement would likely require continuous, long-term flow data not currently available. The large amount of continuous water level and salinity data, and the overall agreement between this data and the model, appears to compensate for the limited flow data in demonstrating overall model performance. Thus, this issue is not considered significant for model calibration and for application to deepening impacts; however, application to mitigation scenarios that alter channel connections-and attempt to predict resulting changes to the flow regime and the effect on salinity-may require additional evaluation of model capability.
>
> The EFDC model continues to under-predict salinity on Middle River; however, we agree with Tetra Tech that the model achieves a reasonable balance between Middle River, Front River (where the model does well), and Little Back River (where the model tends to over-predict salinity). We also agree that the 7-year simulation results are evidence that the salinity model performs well over a wide range of conditions during 1997 through 2003. Notably, during the drought years 2000 through 2002 when salinity intrusion on Little Back River was greatest, model correlation to data increases and model percent error decreases as compared to the 1999 calibration and 1997 confirmation periods. Overall, the salinity model is performing well, and this issue is not considered significant."

The USFWS provided the following in their final assessment of the model development:

> "... we believe that salinity prediction performance is adequate to use in project planning. However, we must reiterate that there continues to be a limited understanding and modeling ability of the velocity and flow dynamics in the Middle River, Little Back River and Back River. This limitation will cause some uncertainty regarding salinity and water quality predictions for mitigation alternatives that involve channel modifications in the Savannah River system."

NOAA Fisheries did not provide specific comments on the model and stated that they would continue to follow the lead of the USFWS on the hydrodynamic modeling.

GA DNR-EPD did not provide specific comments on the model related to its uncertainties. They approved "the use of these models to assess the impacts and mitigation of the proposed Savannah Harbor deepening."

EPA Region 4 did not provide specific comments on the model related to its uncertainties. They stated that "The models are acceptable for continued use in the Savannah Harbor Expansion Project to identify the effects of potential changes the estuary water quality and hydrodynamics from proposed harbor activities."

Based on this information, the Corps recognizes that there are uncertainties in the salinity predictions of the hydrodynamic model, but believes that those uncertainties are reasonable and do not present any unacceptable risks.

4. Reliability of the Wetland Impact Predictions

There is uncertainty associated with any prediction of the future. There is also uncertainty in the ability of any model to accurately predict physical parameters as they would occur if the system were changed. Since the wetlands that could be adversely impacted by the proposed harbor deepening are highly valued by the USFWS and are part of a National Wildlife Refuge, there is substantial risk should the impact predictions be greatly inaccurate. In light of both the recognized uncertainties of predictive models and the risk of insufficiently identifying impacts, the Corps reviewed KAC's 2005 Uncertainty Analysis on the hydrodynamic, salinity, and water quality models. The following subsections discuss uncertainties of various components of the wetland impact predictions.

A. Uncertainty in the Wetland Impact Predictions

As discussed above, there is uncertainty in the salinity values used to predict impacts to wetland vegetation. It is the low levels of salinity (<5 ppt) that are of primary concern in the wetland impact assessment. In particular, the impact assessment in this project concentrated on the movement of the 0.5 ppt salinity contour. Although there is uncertainty surrounding the hydrodynamic model's predicted salinity values, since the model was found to generally over-predict at low salinity levels, this should lead to an over-prediction of impacts to wetlands.

There is also uncertainty related to the procedure used to quantify the wetland impacts. This process involved taking results from the hydrodynamic modeling and transferring them to a map of the estuary. With the map providing geographic reference points, wetland areas that would be affected by changes in the location of salinity thresholds could be determined and the change quantified. In brief, the procedure involves hand contouring salinity levels across a map. Uncertainty in the impact determination was reduced by using the same individual perform all of these analyses. To examine and quantify the uncertainty that a given individual may introduce into the analysis, the Corps conducted a test to examine how well it could repeat the impact numbers that were calculated. First, the individual who had originally performed the work re-contoured three randomly-selected maps and re-calculated the acres of impact. The Corps also used a second individual to contour the salinity data for those same three maps and calculate the affected acreage. Those tests show the calculated wetland impact acreages to be reliable within +/- 2 percent, and the Corps considers the acreages valid within +/- 50 acres.

B. Uncertainty in the Amount of Sea Level Rise

Since the project's impact predictions must consider other ongoing trends that affect the estuary, there is uncertainty concerning how those trends continue in the future. One trend related to wetlands that is uncertain is sea level rise. The extent to which the sea level rises at Savannah will determine the composition of the tidal wetlands that are available to be impacted by a harbor

deepening project. There has been extensive literature published concerning higher rates of sea level rise in various parts of the world. Much of that literature recognizes that the rate of future sea level rise will vary across the globe. Savannah District took several actions to address this uncertainty.

Early in the study process, the Wetlands Interagency Coordination Team recommended the District examine three levels of future sea level rise for Savannah – zero rise, 25 cm per 50-years and 50-cm per 50-years. The Corps conducted the wetland impact analyses for each of those scenarios. To comply with its own policies, the Corps also three other levels of future sea level rise – low, medium, and high. The impact analyses indicated that as sea level increases at Savannah, the amount of tidal freshwater wetlands will decrease. Since there have been continual records of sea level at Savannah for over 200 years, the District decided that it would rely heavily on that site-specific data in its prediction of future trends in sea level rise at this site. Examination of the historic information revealed that sea level has been rising relatively constantly at Savannah at an average 3 mm per year. The data indicate that the long term rate still apply to shorter, recent periods of time. Therefore, the District decided to use a continuation of the historic rate of sea level rise at Savannah (3 mm per year) in its predictions of future wetland distributions in the estuary. The historic rate would result in a rise in sea level of 0.3 feet in 25 years and 0.5 feet in 50-years. Those amounts of sea level rise are relatively minor in comparison to the 7-8 feet of daily tide range in Savannah and are within the accuracy of the wetland impacts for the proposed harbor deepening project.

Sea level rise would result in less project-induced impacts occurring in the future. A rise in the mean sea level would allow salty tidal waters to enter further into the estuary, adversely impacting the freshwater marshes. As this occurs, there would be fewer freshwater marshes remaining to be impacted by a harbor deepening project. The District calculated the effects of sea level rise on freshwater marsh impacts over the 50-year evaluation period (with the historic rate of sea level rise) using an average annual equivalent calculation methodology. The average annual equivalent freshwater marsh impact (285 acres for the 48-foot alternative) when compared to the base year prediction (337 acres for the 48-foot alternative) is within the degree of accuracy of the impact predictions. The proposed project would mitigate for wetland impacts that are predicted to occur once construction is complete (the base year). Impacts that would occur soon after the base year are those most likely to occur and least subject to uncertainty from more distant projections of future conditions. This approach also ensures the project fully mitigates for impacts that would occur over the entire period of analysis. Corps' guidance directs our designs to accommodate conditions expected to occur over the 50-year period of analysis, with the intention that the design be robust and reliable throughout the entire 50-year period. Mitigating based on the base year impacts ensures the project meets that intent and fully mitigates for wetland impacts that the project would produce.

C. Risk with Wetland Impact Predictions

As stated previously, the wetlands that could be adversely impacted by the proposed harbor deepening are highly valued by the USFWS and are part of a National Wildlife Refuge. Therefore, the risk of inaccurately predicting impacts to highly-valued resources would be that the impacts are not fully identified and appropriate amount of mitigation is not achieved.

As discussed above, the hydrodynamic model has roughly an 80 percent chance of over-predicting salinity levels at low salinity levels, thus leading to an over-prediction of salinity-induced impacts to wetlands. Therefore, the model is considered to present little risk for decision-makers evaluating salinity impacts to wetlands.

5. Reliability of the Dissolved Oxygen Impact Predictions

A. Uncertainty in Dissolved Oxygen Predictions

As with the hydrodynamic and salinity models, the Federal and States natural resource agencies reviewed the models during their development period and commented on their performance at the completion of that work.

In their final comments on the model development, EPA Region 4, NOAA Fisheries, and GA DNR-EPD did not provide specific comments on the model concerning uncertainties in the dissolved oxygen predictions.

SC DHEC provided the following in their final assessment of the model development:

> "Along the Front River, the model does not simulate the short-term fluctuations « 24 hours) and associated instantaneous minima shown in the DO data (Appendix P). The model does a better job on average as indicated by comparisons of measured and simulated 50th percentile DO, and it does a reasonable job of representing the spatial trends along Front River (Figures 9-1 and 9-2). Although DO data on the side channels are more limited, available data show the model over-predicts DO in these areas. Based on these characteristics, the model should do a reasonable job of predicting impacts in terms of relative change in DO. Impact evaluations involving predictions of absolute DO values would require consideration of, and accounting for, model bias."

The USFWS provided the following in their final assessment of the model development:

> "... with regard to dissolved oxygen, the model has limited ability to simulate the variability and trends in the data. However, we believe that the dissolved oxygen model is adequate for harbor deepening impact assessment, if these limitations are accounted for during project planning."

As with the hydrodynamic model, the Corps funded the Kinetics Analysis Corporation (KAC) to perform an uncertainty analysis of the models in 2005. KAC performed that analysis toward the end of the model development process and evaluated the ability of those models to accurately predict the observed data. KAC found the model to generally under-predict dissolved oxygen levels at the Houlihan Bridge and the USFWS Dock. Those two stations are the most downstream locations considered by KAC, and are therefore the closest to the area of the harbor which typically experiences DO problems in the summer. In general, KAC found the model to under-predict dissolved oxygen along the gradient of DO from 1 to 8 mg/L. At the Houlihan

Bridge, the errors typically range from 0.025 to 0.075 mg/L across that range depending on river flow (pages 17 and 25). At the USFWS Dock, the errors typically range from 0.01 to 0.02 when the observed DO measured less than 1.6 mg/L (upper extent of KAC's analysis on DO at this station). At the Lucknow Canal, KAC found the errors to range up to 0.01 when the observed DO measured less than 0.7 mg/L (pages 21 and 29 of their report). Those errors are quite small and within the general range of reliability of field and laboratory measurements.

B. Risk with Dissolved Oxygen Predictions

The fact that the model under-predicts dissolved oxygen by quite small amounts indicates that the model should be a good predictor of dissolved oxygen-related impacts. The model's errors in predicting dissolved oxygen levels present little risk for decision-makers. No adjustment to the predictions or mitigation procedure appears to be warranted in response to the risk of error in the models' predictions.

6. Reliability of the Dissolved Oxygen Improvement Technique

A. Uncertainty in Dissolved Oxygen System Effectiveness

Use of oxygen injection in an estuarine environment is relatively new. The technology has been used for years in industrial applications (single pipes) and in lakes. It has not been used before to treat the large volumes of water typically associated with tidal estuaries. Since this technology has not been applied before to this situation, there is substantial uncertainty about whether the system will be as effective as it is intended. Concerns were expressed by members of natural resource agencies and the public. The concerns were both general in nature (What would the system look like? How much noise would it make when operating?), and specific (Would high DO levels at the discharge kill fish?).

To address these concerns, the Georgia Ports Authority conducted a demonstration project in 2007 to show how oxygen injection could work in Savannah Harbor. The demonstration was conducted to increase understanding about the technology and to confirm that concerns/problems expressed by some individuals would not occur if the technology was used in the harbor. Additionally, the demonstration was conducted to reduce uncertainties expressed about the technology being proposed for use on the project.

Substantial monitoring was conducted during the demonstration to document the effects of adding oxygen to the river. Observations were also taken about issues that had been raised about those unfamiliar with the technology (size of equipment, noise, etc.).

The engineering firm of MACTEC produced a report in 2008 that described the demonstration project, observations they made during the operation, the data they collected during the 6-week operational period, and their assessment of the technology. The report was provided to natural resource agencies and made available to the general public.

At the request of the USFWS, a member of the USGS reviewed the report and issued a letter of their findings. The USGS stated that they did not believe that the report supported the conclusions of the writers. In light of that letter, the Corps convened a meeting of the Water Quality Interagency Coordination Team to listen to a presentation by MACTEC and discuss the issue. As a result of that meeting, GPA agreed to have engineering consultants perform additional analyses. Additionally, MACTEC agreed to analyze and review the 2007 data in accordance with recommendations by USGS. GPA engaged a firm to use the agency-approved hydrodynamic and water quality model to simulate conditions during the demonstration project, which would identify the extent the harbor's DO deficit would be improved with the addition of oxygen during a demonstration project. In brief, a 2009 supplemental report concluded DO deficits and spatial gradients were reduced during periodic slack-tide events, and this result was not observed before or after the demonstration project. Thus, conducting the study or demonstration project provided another means of reducing risks associated with implementation of a harbor deepening.

B. Risk with Dissolved Oxygen System Effectiveness

A reduction in D.O. levels in the harbor, which result from further deepening of the harbor, is a major issue when evaluating the economic feasibility and environmental acceptability of the proposed project. D.O. levels are already critical in the harbor in the summer months, and further reductions in D.O. could adversely affect fishery and benthic resources. Improving D.O. in a deep-draft harbor is a difficult task. The constantly-used channel precludes many methods of raising D.O. levels. Similarly, the relative shallowness of the harbor reduces the number of viable options when compared to the relatively deeper waters found in lake environments.

The Corps engaged a private engineering firm to review available techniques and technology that would raise D.O. levels in Savannah Harbor. The firm reviewed 24 methods/techniques of increasing D.O., assessed their strengths and weaknesses, and evaluated their cost effectiveness. They identified oxygen injection as the best method for the present situation in Savannah Harbor. It has been used for years in industrial applications and some environmental situations. This independent review reduced some of the risk of selecting a technology that may not work or provide the D.O. improvement that is needed to mitigate for project impacts.

The demonstration project that GPA conducted in 2007 illustrated what the operation of an oxygen injection system would look and sound like. The demonstration removed some risk that such a system could be operated satisfactorily in the harbor. In brief, a 2009 supplemental report concluded DO deficits and spatial gradients were reduced during periodic slack-tide events, and this result was not observed before or after the demonstration project. Thus, this study provides another means of reducing risks associated with project implementation.

Post-construction monitoring is proposed as part of this project. Water quality monitoring – including dissolved oxygen levels – would be a part of that monitoring. Such monitoring would confirm if the anticipated D.O. effects that are intended by the proposed mitigation feature (i.e., D.O. Improvement Systems) are occurring. This level of monitoring substantially reduces the risks associated with the effectiveness of the Dissolved Oxygen Improvement Systems.

7. Biological Responses

A. Uncertainty in Biological Responses

There is considerable uncertainty associated with the biological responses to changes in the physical environment. These changes are greatest at the individual organism level and are less at the species and ecosystem levels. With respect to the individual organisms, there are no known ways to establish the uncertainties, which are inherent to the impact predictions made during the evaluation of this project. Biologic responses typically vary around a norm, and the variation of an individual from that norm is not of primary concern in this evaluation. Instead, we are more concerned with the response of the biologic communities that reside in the harbor and depend on it to provide habitat for some portion of their life. The Interagency Coordination Teams developed procedures that capture the important biologic criteria for certain critical natural resources which could be affected by this project. The criteria are a matter of professional judgment and were intended to describe good habitat conditions for species of interest. However, field studies with specific evaluation criteria identified individual organisms residing in areas of the harbor that are considered outside the range of what would be considered good habitat. The level of observed variability indicates that some individuals are likely to find acceptable habitat, or be able to accept marginal habitat for short periods of time. However, for those individuals with a narrower range of acceptability as compared to the normal range, the harbor may provide less acceptable habitat than the calculations indicate. The effect of this range on individual behavior is unknown. However, it is not thought to be a concern since we are primarily interested in the response of the entire biologic community rather than individuals.

There is some uncertainty that the biologic parameters used to define acceptable habitat are incorrect. If the parameters are incorrect or incomplete and the values selected for those parameters are wrong, the extent of acceptable habitats would be in error. This possibility was reduced through interagency consultation when the parameters of interest were identified. In brief, the natural resource agencies provided representatives to the Interagency Coordination Teams based on an individual's experience and familiarity with similar constriction projects. The Interagency Teams first identified which species they believe to be most critical in the harbor or best represent important guilds or communities. Next, they identified those species most likely to be impacted by the changes expected from a harbor deepening. The teams then reviewed professional literature to identify parameters that were previously found to differentiate "acceptable" and "unacceptable" habitat for the species of interest. We believe that this collaborative and deliberate approach minimized the uncertainty in the species evaluated, the biologic parameters selected to define acceptable habitat, and the values selected for those parameters to differentiate between acceptable and unacceptable habitats.

B. Risk with Biological Responses

As previously described, there is uncertainty associated with the anticipated response of individual organisms to environmental changes that would occur as a result of the proposed project. While the risk to a given individual fish or plant may be high if it can't respond to environmental changes, the overall risk is considered low because the project is generally evaluated with respect to impacts at the community level. Thus, a specific individual plant may

not be able to accommodate a change in salinity, for example, but the community of similar plants is very likely to respond as that community has been observed to in the past.

Since biologic communities respond to the sum of the influences bearing upon them, there is uncertainty specific to the impacts of this project and the addition of other ecological factors that may stress the community. Assessing the project-related impacts required the analysis of several alternate conditions along with the basic set of conditions suggested by the resource agencies. These alternate conditions included such things as alternate river flows for fishery, wetland, and dissolved oxygen impacts, and two variations of sea level rise for wetland impacts. These alternate conditions were included as sensitivity tests in conjunction with the basic impact evaluation. The sensitivity tests provide information on how the project would function under environmental conditions that are outside the norm. Using this approach in the overall analysis substantially reduces the risk that the project would produce impacts that attain unacceptable levels, even under uncommon circumstances.

8. Air Quality Analysis

A. Uncertainty in air emission input data

There are numerous sources of uncertainty associated with the Air Quality Analysis. Because of the expected low level of impacts on air emissions from the proposed project, the Corps chose to conduct a mid-tier assessment of air emissions in the harbor. EPA identifies three possible approaches to conducting a harbor emissions inventory, and a mid-tier assessment is one of those accepted approaches. In brief, a mid-tier assessment allows one to use relationships identified at other locations and apply them to this site.

For instance, a detailed assessment was not conducted for the landside equipment used in Savannah by non-GPA terminals. Instead, the Corps identified the Ports of Tacoma and Seattle as being similar in size and composition to the Port of Savannah. Compared to all other ports with detailed air emission inventories, the aforementioned ports had the most similar cargo volume and fleet composition. Thus, the relationship between number of non-container vessels and emissions from landside equipment that service those ships was calculated in detail for those ports and used to calculate emissions for similar operations in Savannah.

A mid-tier assessment (as defined by EPA's guidance on air emission inventories) was deemed appropriate because the proposed harbor deepening project would be expected to affect only container vessels that call at GPA's Garden City Terminal. Other types of vessels that call at GPA's Ocean Terminal, and vessels that call at the other eighteen non-GPA terminals in the harbor, are not expected to be affected by the proposed project. Since their operations would not be affected, air emissions from those operations would also not be affected. Since the air emissions from those other terminal operations would not be affected, precise information about those emissions is not required. Instead, only a reasonable assessment of those emissions is required when evaluating the changes in emissions that could occur as a result of changes to GPA's Garden City container operations.

Alternatively, the District used site-specific, detailed information where changes could occur as a result of the proposed harbor deepening. Thus, detailed information was sought and obtained with respect to: (1) the movement of container vessels within the harbor; (2) operation of equipment on terminal grounds; (3) equipment associated with loading/unloading of ships; and (4) trucks and rail operations that move those containers from the terminal to the existing transportation system. With that previously described information, the Corps could more accurately identify potential changes to air emissions from the proposed deepening alternatives.

In summary, the Corps' approach to evaluating air quality allows for greater uncertainty in the levels of air emissions for portions of the harbor operations that would not be affected by the proposed project, while including more accurate information in those areas that could change as a result of the project.

B. Risk with Air Emission Analysis

As stated above, certain elements of the analysis have more uncertainty as a result of the methodology used to calculate air emissions. It should also be noted that those elements with greater uncertainty are not expected to change as a result of the proposed project. Thus, the risk of deriving an incorrect decision with respect to air impacts is low. With respect to air, a reviewer always has two benchmarks to consider – (1) the total emission volume reported by EPA for all of Chatham County, and (2) the threshold of Non-Attainment, where the total emission volume for the region would result in air quality being at levels determined by EPA to be unacceptable and harmful to humans. That said, impacts to air emission were evaluated for the proposed project and were judged by those two benchmarks. Neither benchmark would be violated by the proposed action, so the ultimate risk from expected changes in air emissions is low.

9. Sediment Quality Analysis

A. Uncertainty in Sediment Composition and Quality

As with any dredging project, there are concerns about the characteristics of the sediments that would be excavated. For example, rock requires special equipment that works slowly and has high operating costs. Likewise, toxic sediments may produce adverse environmental impacts if dredged. Because of these type concerns, investigations are typically conducted to determine the characteristics of dredged sediment prior to the physical act of dredging.

With respect to this project, the Corps conducted a geotechnical investigation to determine the physical characteristics of the sediment that would be excavated when deepening the harbor. Borings were taken and laboratory analyses were performed. These steps provided information which was useful in determining the type of equipment that would be needed to remove the sediments as well as the likely efficiency of that equipment. Such information reduced uncertainties about how the deepening could be accomplished and how long it would take to complete the work.

Samples were analyzed for their chemical properties. The sampling area covered the entire vicinity proposed for harbor deepening, which extended from deep water in the ocean to the Kings Island Turning Basin (Station 103+000). Chemical parameters that were evaluated include: metals, PCBs, PAHs, petroleum hydrocarbons, phenols, pesticides, dioxin congeners, cyanide, organotins, and nutrients. In brief, most of the sediments were considered safe for dredging and placement with no concern for contaminant-related impacts. However, three potential issues were identified.

One issue involved sediments near the old RACON Tower site, where high levels of PAHs where found. Subsequent sampling conducted in 2005 revealed that sediments at that location contained low levels of PAHs, so they do not pose potential contaminant-related environmental impacts.

The second issue pertained mostly to whether the sediment chemistry data for pesticides, polyaromatic hydrocarbons (PAHs) and phenols, and the associated detection limits, were adequate for comparison to screening criteria. This issue was addressed in 2005 when confirmatory sampling within the channel revealed there is no concern with respect to sediment contamination as it pertains to pesticides, PAHs, phenols, or metals other than cadmium.

The final issue involved elevated concentration and distribution of naturally occurring cadmium within the new work sediments. Sampling was conducted in 2005 to address this issue. Cadmium was found to occur naturally in unusually high levels within Miocene clays that would be excavated during the SHEP dredging. Evaluation of the laboratory results could not rule out the potential for adverse impacts from sediments with elevated cadmium levels in some reaches of the channel.

Additional sampling and detailed analyses were conducted in 2007, and the potential pathways by which cadmium might enter the environment were evaluated. Pathways of particular concern include the exposure of cadmium-containing clays in the channel with subsequent movement of cadmium into the river ecosystem and potential environmental impacts associated with placement of cadmium-containing sediments within the confined disposal facilities (CDFs).

About 7.1 MCY of dredged sediment contain higher levels of naturally-occurring cadmium (from Stations 6+375 to 45+000, 51+000 to 57+000, and 80+125 to 90+000). The Corps proposes to place and retain all of the cadmium laden sediment in existing confined disposal facilities (CDFs) 14A and 14B. Once disposal is complete, the site would be covered with about 2 -feet of clean dredged sediment taken from the Federal navigation channel. All new work dredged sediment within CDFs 14A and 14B will not be used for future dike raisings or used for borrow material.

B. Risk with Sediment Composition and Quality

Inaccurate cost estimates are the basic risk associated with incorrect assumptions or conclusions about the physical composition of the sediment. The sampling and analyses that the Corps performed reduced those risks to acceptable levels.

Unexpected, adverse environmental impacts are the risk associated with incorrect assumptions or conclusions about the chemical properties of the sediment. To ensure adequate testing protocols were achieved, the Savannah District utilized a tiered evaluation and decision process that reduced the risk of an incorrect decision. Three sets of sampling and laboratory analysis were performed for this project. The analyses became more specific and more technically complex with each iteration. The final (biological) tests were the most rigorous and were established by joint EPA/Corps protocols for sediment testing.

Prior to the start of sampling, the Corps had the natural resource agencies review the sediment testing and analysis scopes of work before they were conducted. This measure ensured that a general consensus was achieved concerning the sampling methodology, and the agencies agreed that correct tests would be performed and in the proper manner. Likewise, the same agencies reviewed the test results to determine whether additional steps would be needed. The District also employed an independent firm to collect the samples and perform the laboratory tests to increase the reliability of the results. The District provided its evaluation to the Corp's Engineering Research and Development Center (ERDC) (the Corps' national research arm) to ensure its technical conclusions were valid. This review reduced the risk that the District reached unsupported findings, which could lead to higher environmental impacts. The Corps provided their evaluation to the natural resource agencies prior to release of the Draft EIS to further reduce the risk of the EIS containing a sediment placement plan that would be unacceptable and lead to unacceptable environmental risk.

Improper information, and decisions based on a present understanding of sediment composition and quality, could lead to higher than expected construction costs and higher than expected environmental impacts. The risks associated with those two items were reduced to acceptable levels through the multiple sediment testing iterations, the review by natural resource agencies, and the review by the Corps' national experts in sediment evaluation (ERDC).

Post-construction monitoring is proposed as part of this project. Cadmium levels in the CDFs would be a part of that monitoring. Such monitoring would confirm if the cleaner sediments successfully covered the cadmium-laden sediments. The Corps has agreed to take further actions until it demonstrates that clean sediments cover the surface of those CDFs. This monitoring substantially reduces the risks associated with relocating the naturally-occurring cadmium sediments. The post-construction monitoring includes monitoring of cadmium levels in birds that use the CFS where cadmium-laden sediments have been deposited. Although no impacts are expected to birds, this biological monitoring would ensure the deposited sediments are not impacting birds that use the site(s).

ENVIRONMENTAL IMPACT STATEMENT APPENDIX R: ODMDS Placement Evaluation

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

US Army Corps
of Engineers
Savannah District
South Atlantic Division

ODMDS Placement Evaluation

TABLE OF CONTENTS

TOPIC	PAGE
1. INTRODUCTION	1
2. DREDGING AND DISPOSAL PROJECT INFORMATION	2
3. EXCLUSIONARY CRITERIA	8
4. NEED FOR TESTING	N/A
5. WATER COLUMN DETERMINATIONS	N/A
6. BENTHIC SCREENING	N/A
7. BENTHIC DETERMINATIONS	N/A
8. NON-TESTING RELATED REGULATORY ISSUES	19
9. MPRSA SECTION 103 CONDITIONS	23
10. REFERENCES	44

Attachment 1 – ODMDS Capacity Analysis

Savannah ODMDS Placement Evaluation

1. Introduction

This evaluation addresses transport and disposal in the Savannah Ocean Dredged Material Disposal Site (ODMDS) of new work construction in the Savannah Harbor entrance channel conducted by the Savannah Harbor Expansion Project (SHEP) from Stations +4+000 to -97+680B. New work sediments from these channel reaches would be placed into the Savannah ODMDS.

Savannah District prepared a Section 103 Evaluation for Operation and Maintenance of the Savannah Harbor from Stations 0+000 to -60+000B in December 2010 as a separate action (Savannah O&M Section 103 Evaluation). After the project completes the ongoing biological testing and evaluation of the entrance channel sediments, the District will submit a request to modify the Savannah O&M Section 103 Evaluation to include future transport and disposal in the Savannah ODMDS of entrance channel new work and O&M materials from Stations +4+000 to -97+680B.

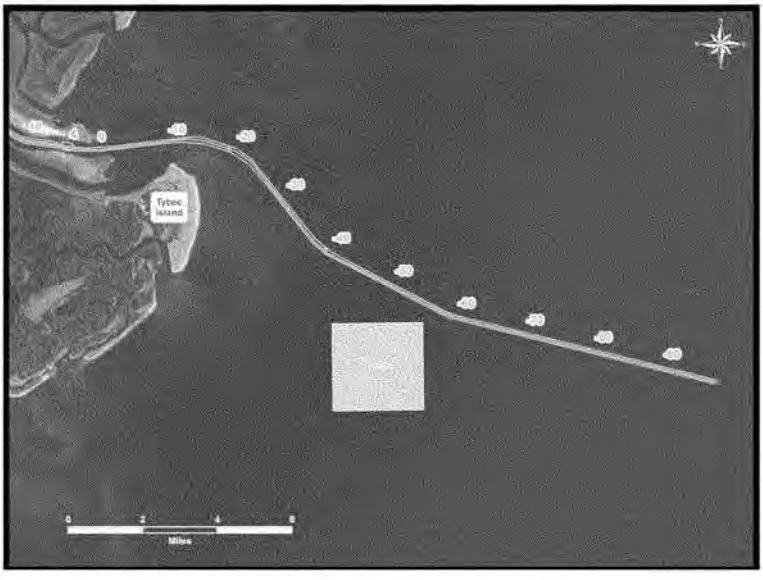
The District believes the proposed new work material meets the Exclusionary Criteria set forth in 40 CFR §227.13(b). Specifically, the material is substantially the same as the substrate at the disposal site and the dredging site is far removed from sources of pollution, so as to provide a reasonable assurance that such material has not been contaminated by pollution. Grain size and chemistry data are provided to demonstrate the similarity between the proposed dredging site and the Savannah ODMDS.

This evaluation was conducted using Appendix C of the Southeast Regional Implementation Manual (SERIM) as a guide.

2. Dredging and Disposal Project Information

a. A map showing dredging locations/boundaries and delineating dredging units. Shall include range stations to adequately delineate project limits.

The Savannah Harbor Expansion Project Bar Channel and ODMDS are shown in the following figures. The maps show the locations and boundaries of the proposed dredging.



b. Core boring logs (if available) and other historical and current sampling stations keyed to the map.

The sampling stations are described in the Sediment Quality Evaluation Savannah Harbor Expansion Project, June 2011, Appendix M of the SHEP Final EIS.

c. Volume of material to be dredged by dredging unit.

The following shows the dredging units proposed for deepening of the entrance channel during SHEP:

Dredging Unit	Placement Site	Dredge Type	Dredging Reach	Sediment Volume
1	ODMDS or Jones/Oysterbed Island CDF	Pipeline or Hopper	+4+000 to 0+000	305,674
2	ODMDS or Jones/Oysterbed Island CDF	Pipeline or Hopper	0+000 to -10+000B	917,064
3	ODMDS or Jones/Oysterbed Island CDF	Pipeline or Hopper	-10+000B to -20+000B	1,311,222
4	ODMDS	Pipeline or Hopper	-20+000B to -30+000B	1,352,115
5	ODMDS	Pipeline or Hopper	-30+000B to -40+000B	1,305,921
6	ODMDS	Pipeline or Hopper	-40+000B to -53+500B	1,632,346
7	ODMDS	Pipeline or Hopper	-53+500B to -57+000B	**391,437**
8	ODMDS	Pipeline or Hopper	-57+000B to -97+680	3,736,308
Total				10, 952,087

The following shows a comparison of proposed placement site estimated volumes:

Placement Site	Dredge Type	Volume CY
ODMDS or Jones/Oysterbed Island CDF	Pipeline or Hopper	2,533,960
ODMDS	Pipeline or Hopper	8,418,127
Total		10,952,087

d. Percentage of fine-, medium-, and coarse-grained material by dredging unit.

ew Work Sediment Grain Size (2005 Sampling). Since the dredging work proposed for placement in the Savannah ODMDS would be conducted by both hopper dredge and cutterhead dredge, some disturbance below -51 feet MLLW may occur, depending on the equipment used. Coarse-grained material dominates the new work material, as shown in the following table.

Stations	Top of Layer	Bottom of Layer	Volume (cubic yds)	% Sand	% Silt
0 to 4+000(upriver)					
		46	21,594	79.1	20.9
	46	48	101,482	76.8	23.3
	48	50	134,144	79.2	20.8
	50	51	70,048	79.2	20.8
			327,268	78.4*1	
0 to 10+000B					
		46	438,715	N/A	N/A
	46	48	346,997	88.7	11.3
	48	50	376,397	90.4	9.6
	50	51	193,670	77.9	22.1
			1,355,779	87.1*2	
10+000B to 20+000B					
		46	328,512	N/A	N/A
	46	48	473,047	N/A	N/A
	48	50	555,352	73.8	26.2
	50	51	282,823	80.5	19.5
			1,639,734	76.1*2	
20+000B to 30+000B					
		46	365,322	N/A	N/A
	46	48	529,910	77.3	22.7
	48	50	546,728	80.9	19.1
	50	51	275,477	79.8	20.2
			1,717,437	79.3*2	
30+000B to 40+000B					
		46	1,118,617	66.7	33.3
	46	48	505,693	70.9	29.1
	48	50	532,927	68.6	31.4
	50	51	267,301	70.8	29.2
			2,424,538	68.4*1	
40+000B to 53+500B					
		46	524,569	94.3	5.7
	46	48	646,976	87.3	12.8
	48	50	657,409	91.3	8.8

	50	51	327,961	57.4	42.6
			2,156,915	85.6*1	
Stations	**Top of Layer**	**Bottom of Layer**	**Volume (cubic yards)**	**% Sand**	**% Silt**
53+500B to 57+000B					
		46	88,669	94.6	5.4
	46	48	78,504	90.7	9.3
	48	50	156,310	92.4	7.7
	50	51	77,815	65.1	34.9
			401,298	87.2*1	
57+000B to 98+600B					
		46	102,927	N/A	N/A
	46	48	1,667,123	N/A	N/A
	48	50	1,258,309	N/A	N/A
	50	51	810,876	N/A	N/A
			3,839,235	N/A	

N/A data not available because project core did not encounter sediment within the subject layer or no project cores were taken
*1 Average is weighted by volumes
*2 Average is weighted by volumes but is based only on available data

The locations of the recent (2005) sampling stations are described in the Sediment Quality Evaluation Savannah Harbor Expansion Project, June 2011, Appendix M of the SHEP Final EIS.

This sampling indicates that the volume weighted average of the new work sediments is 80 percent sand. Some fines would be lost during the dredging (overflow process) and sediment placement operations (suspension in water column with down-current migration). Those two actions would effectively increase the percent sands of sediments that deposit on the floor of the ODMDS.

This can be compared to the information below that shows the composition of maintenance sediments that are presently excavated on a yearly basis and deposited in the Savannah ODMDS.

Composition of Maintenance Sediments in Entrance Channel

Stations	Percent Sand	Percent Silt
0+000 to -10+000B	86	14
-10+000B to -20+000B	81	19
-20+000B to -30+000B	79	21
-30+000B to -40+000B	77	23
-40+000B to -50+000B	74	26
-50+000B to -60+000B	93	7

This information shows that O&M sediments on the entrance channel average about 82 percent sand. On a bulk composition basis, the SHEP new sediments are not substantially different from the O&M sediments that have already been approved and are regularly deposited in the ODMDS.

e. Bathymetric information for the channel to be dredged with the project dredging depth contour highlighted.

The portion of the project proposed for hopper dredging and placement of sediment in the ODMDS is currently maintained to a depth of -46 feet MLLW. Dredging with the deeper harbor would be performed to -51 feet MLLW (with 47-foot depth alternative).

f. Design depth (including overdredge depth or advance maintenance) and width for each dredging unit or project reach.

Currently Authorized Channel

Reach	Width (Feet)	Authorized Depth (Feet MLW)	Advance Maintenance (Feet)	Allowable Overdredge (Feet)	Total Dredging Depth (Feet MLW)
+4+000 to -14+000B	500	-42	2	2	-46
-14+000B to -60+000B	600	-44	0	2	-46

Proposed Channel

Reach	Width (Feet)	Authorized Depth (Feet MLW)	Advance Maintenance (Feet)	Allowable Overdredge (Feet)	Total Dredging Depth (Feet MLW)
+4+000 to -14+000B	500	-47	2	2	-51
-14+000B to -97+680B	600	-49	0	2	-51

The proposed work from Stations -14+000B to -97+680B would be box cut 600-feet wide to a depth of approximately -51 feet MLLW.

g. Expected method(s) of dredging, transport, and disposal of material.

The dredging, transport, and disposal of project material are expected to be performed by both pipeline and hopper dredge, depending on the season.

h. Expected start, duration and end of dredging, transport, and disposal of material.

The work proposed for placement in the ODMDS is estimated to require a total of about 48 months to complete; however, the work may be performed intermittently. At present, a pipeline dredge is expected to be used for a 6-month period in 2013/2014. Hopper dredges may be used for four winter seasons as follows: December – March 2013, December – March 2014, and December – March 2015, and December – March 2016.

i. Proposed disposal location (or zone) within the ODMDS.

It is expected that deposition will take place within the northern 1/3 of the site

j. Historical compliance with ODMDS site designation and Site Management and Monitoring Plan (SMMP) conditions.

The District is not aware of any more than minimal non-compliance issues regarding past use of the Savannah ODMDS.

Recent monitoring of the ODMDS was completed on the following dates.

Date	Survey Type
19-Jun-92	Bathymetry
13-Jun-94	Bathymetry
12-Aug-97	Bathymetry
4-Mar-98	Bathymetry
12-Aug-98	Bathymetry
14-Apr-99	Bathymetry
25-Sep-99	Bathymetry
17-Apr-00	Bathymetry
21-Dec-00	Bathymetry
20-Apr-01	Bathymetry
18-Apr-02	Bathymetry
12-Feb-03	Bathymetry
6-Jun-03	Bathymetry
20-Feb-04	Bathymetry
9-Dec-04	Bathymetry
24-Mar-05	Bathymetry
21-Oct-05	Bathymetry
1-Dec-05	Bathymetry
19-Jul-06	Side scan
9-Feb-07	Bathymetry
7-Oct-07	Bathymetry
19-Feb-08	Bathymetry
27-Mar-08	Bathymetry
8-Sep-10	Bathymetry

3. Exclusionary Criteria - 40CFR §227.13(b) [Tier I]

a. Rationale for meeting the exclusionary criteria: The material proposed for dumping is substantially the same as the substrate at the proposed disposal site and 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 a reasonable assurance that such material has not been contaminated by such pollution.

Sediment testing indicates that the new work sediments for the entrance channel are 80 percent sand. This compares favorably to the 82 percent sand composition of the O&M sediments on the entrance channel that EPA previously approved and are deposited each year in the ODMDS.

At EPA's request, the Corps initiated biological testing of the new work entrance channel sediments. Savannah District and EPA Region 4 jointly developed a Sampling and Analysis Plan and a Quality Assurance Project Plan and the sampling and laboratory analyses have been completed. The data is undergoing analysis along with required modeling, following guidelines given in the joint EPA/USACE Southeast Regional Implementation Manual. Once Savannah District has made a determination of compliance with the Ocean Dumping Regulations, the completed MPRSA Section 103 Evaluation and Sediment Report will be forwarded to EPA Region 4 along with a request for concurrence with the Corps' determination of compliance. The District believes the proposed dredged material will meet the above exclusionary criteria § 227.13(b)(3) based, in part, on the following.

(1) Grain sizes of the dredged material (from 2d above).

As shown in 2d above, average grain size samples from cores to project depth in the proposed dredging units averages from 68 to 87 percent sand. The volume weighted average of the new work sediments is 80.3 percent sands, which is very similar to that of the O&M sediments (82 percent) which have previously been found suitable for deposition in the ODMDS.

(2) Grain sizes of the material at the disposal site

On 16 December 1998, six sediment grab samples were taken at the Savannah ODMDS at the following locations (Scott et al., 1999).

Sample #	Latitude	Longitude	State Plane E	State Plane W
DA-14	31 57.429	80 46.209	1089286	714623
DA-15	31 56.448	80 46.19	1089461	708676
DA-16	31 55.437	80 46.21	1089437	702544
DA-17	31 57.43	80 44.901	1096048	714717
DA-18	31 56.451	80 44.905	1096105	708780
DA-19	31 55.445	80 44.917	1096123	702680

The collected sediments had the following characteristics:

Sample #	% Gravel	% Sand	% Silt	% Clay	% Fines
DA-14	0.1	60.7	38.9	0.3	39.2
DA-15	0.4	97.1	0.0	2.5	2.5
DA-16	0.8	95.4	0.6	3.2	3.8
DA-17	0.0	97.2	0.0	2.8	2.8
DA-18	0.1	96.0	0.0	3.9	3.9
DA-19	0.0	97.2	0.0	2.8	2.8

Note: DA-14 is in the northwest section of the ODMDS, and is an area that is regularly used for placement of O&M sediments.

Using those samples, the surface sediments presently in the ODMDS average 90.6 percent sand. Although the surficial sediment presently in the ODMDS is not an exact match with the SHEP sediments proposed for deposition, both are predominantly sand and the 10 percent difference would be much less if measured when the sediment reaches the ODMDS floor (after the fines are lost during the dredging (overflow process) and sediment placement operations (suspension in water column with down-current migration)).

(3) Locations (keyed to map), quantities, and types of pollutants discharged upstream of the dredging area (see Section 3.1.1 of the RIM for data sources)

(a) Information on toxic releases and NPDES permit holders within the project area from the EPA Envirofacts website are listed below. These dischargers are all approximately 20.5 to 9.5 miles upstream of the uppermost extent of proposed dredging for placement in the ODMDS (Station +4+000). Because of the mixing that occurs in the river prior to reaching the proposed dredging location, the precise location of the dischargers is not relevant to this determination and therefore map locations of the dischargers is not provided. These data show that various contaminants are discharged in various amounts into the Savannah River. However, because of the high river flow volumes and mixing, these discharges would not be expected to have more than minimal impact to sediments in the area of proposed dredging.

Facility	NPDES Permit	Surface Water Discharges Reported 2008
ARIZONA CHEMICAL 1201 WEST LATHROP AVENUE SAVANNAH, GA 31415	**TRI Facility ID: 31402NNCMPWESTL**	
Acetaldehyde		2,300
Barium compounds		10,700
Catechol		4,320
Formaldehyde		200
Lead compounds		180
Manganese compounds		33,900
Polycylic aromatic compounds		13
Vanadium compounds		760
Zinc compounds		3,270

Facility	NPDES Permit	Surface Water Discharges Reported 2008
ATLANTIC WOOD INDUSTRIES INCORPORATED SUGAR REFINERY ROAD PORT WENTWORTH, GA 31407	**GA0047783**	
BASF CATALYSTS LLC - SAVANNAH OPERATIONS 1800 E PRESIDENT ST SAVANNAH, GA 31404		
Nitrate Compounds		760,000
CITGO ASPHALT REFINING CO OWNER AS OF 12/31/07 7 FOUNDATION DRIVE SAVANNAH, GA 31408	**GA0004332**	
BOD, COD, pH, suspended solids, oil & grease, ammonia nitrogen, sulfide, hexavalent chromium, chromium, phenolitic compounds		
COLONIAL OIL INDUSTRIES, INC 101 NORTH LATHROP AVENUE SAVANNAH, GA 31402	**GA0037923**	
CONOCO PHILLIPS 110 FORBES ROAD SAVANNAH, GA 31404		
Zinc compounds		503
CONSOLIDATED UTILITES, INC, 221 YORK STREET, SAVANNAH, GA 31401		
Sewerage system	GA0034819 exp 05	
EMD CHEMICALS INCORPORATED 110 EMD BOULEVARD SAVANNAH, GA 31407	**GA0034355**	
Nitrate Compounds		511,173
BOD, pH, total suspended solids, ammonia nitrogen, chromium		

Facility	NPDES Permit	Surface Water Discharges Reported 2008
FUJI VEGETABLE OIL INCORPORATED 120 BRAMPTON ROAD SAVANNAH, GA 31408	**GAU050241**	
Nickel compounds		5
Sewerage System: BOD, pH, total suspended solids, oil & grease		
GAF MATERIALS CORP 1 BRAMPTON ROAD SAVANNAH, GA 31408-2109	**GA0003841**	
Conductivity, COD, pH, total suspended solids, oil & grease		
GEORGIA-PACIFIC CHEMICALS LLC 130 CROSSGATE ROAD PORT WENTWORTH, GA 31407	**GA0047007**	
Formaldehyde		2
COD, pH, suspended solids		
HERTY FOUNDATION SAVANNAH P.O. BOX 7798 SAVANNAH, GA 31418	**GA0002402**	
BOD, pH		
GARDEN CITY WATER POLLUTION CONTROL PLANT BUD BROWN DRIVE GARDEN CITY, GA 31408	**GA0031038**	
DO, BOD, pH, total suspended solids, ammonia nitrogen, phosphorus, chlorine, fecal coliforms		
GULFSTREAM AEROSPACE CORPORATION 500 GULFSTREAM ROAD (CORPORATE HDQRS.) SAVANNAH, GA 31407	**GA0003255**	
Conductivity, pH		

Facility	NPDES Permit	Surface Water Discharges Reported 2008
IMPERIAL SUGAR COMPANY 2 BRYAN STREET PORT WENTWORTH, GA 31407	**GA0003611**	
BOD, pH		
INTERCAT-SAVANNAH, INC. 115 ELI WHITNEY BLVD SAVANNAH, GA 31408		
Vanadium Compounds		44
INTERMARINE USA 301 NORTH LATHROP AVENUE SAVANNAH, GA 31415	**Ga0003671**	
BOD, pH, suspended solids, oil & grease		
INTERNATIONAL PAPER CO - SAVANNAH COMPLEX 1201 W LATHROP AVE SAVANNAH, GA 31415		
Acetaldehyde		2,300
Barium compounds		10,700
Catechol		4,320
Formaldehyde		200
INTERNATIONAL PAPER CO - SAVANNAH COMPLEX 1201 W LATHROP AVE SAVANNAH, GA 31415 (CONT.)		
Lead compounds		180
Manganese compounds		33,900
Polycylic aromatic compounds		13
Vanadium compounds		760
Zinc compounds		3,270
KRAFT STEAM ELECTRIC GENERATING PLANT 110 CROSSGATE RD AT SAVANNAH RIVER PORT WENTWORTH, GA 31407		
Barium compounds		120
Lead compounds		3
Manganese compounds		17

Facility	NPDES Permit	Surface Water Discharges Reported 2008
NEW NGC INC D/B/A NATIONAL GYPSUM CO 2 BRAMPTON ROAD GARDEN CITY, GA 31408	**TRI Facility ID: 31418GLDBNBRAMP**	
Lead compounds		0.2
QUALA SYSTEMS INC 6061 COMMERCE COURT GARDEN CITY, GA 31408	**GAU050124**	
pH, oil & grease, cyanide, arsenic, cadmium, chromium, copper, lead, nickel, silver, zinc, mercury		
SAVANNAH – PRESIDENT STREET WPCP 1400 PRESIDENT STREET SAVANNAH, GA 31404	**GA0020427**	
Sewerage Systems		
TRONOX PIGMENTS (SAVANNAH) INC 1 KERR-MCGEE ROAD SAVANNAH, GA 31401	**GA0003646**	
Chromium compounds		200
Dioxin & like compounds		0.0203
Lead compounds		2
Manganese compounds		229,000
Vanadium compounds		600
WESTWOOD HEIGHTS & MILL CREEK, SAVANNAH, GA 31401	**GAU020234**	
Sewerage Systems		

Facility	NPDES Permit	Surface Water Discharges Reported 2008
WEYERHAEUSER NR PORT WENTWORTH 1 BONNYBRIDGE RD PORT WENTWORTH, GA 31407		
Acetaldehyde		2,737
Barium compounds		3,704
Catechol		24
Formaldehyde		1,774
Formic acid		3,682
Lead compounds		54
Manganese compounds		25,995
Methanol		7,422
Nitrate compounds		7,716
Polycyclic compounds		7

(b) The US Coast Guard records on spills in the Savannah Harbor since the last Section 103 are listed below. None of these spills would be expected to impact the sediments proposed for dredging under this evaluation.

Year	Date	Substance	Amount
2004	9-Nov-04	DIESEL	7 Gallons
	2-Jul-04	DIESEL	1.5 Gallons
	29-Jul-04	OIL LIKE	30 Gallons
	19-May-04	OIL LIKE	5 Gallons
	21-Dec-04	OIL LIKE	0.1 Gallons
	16-Nov-04	# 6 OIL	6,839 Gallons
2005	24-Mar-05	DIESEL	1 Gallon
	19-Apr-05	DIESEL	5 Gallons
	12-May-05	LUBE OIL	5 Gallons
	21-Jun-05	DIESEL	10 Gallons
	12-Aug-05	DIESEL	1 Gallon
	10-Oct-05	DIESEL	10 Gallons
2006	19-Jun-06	DIESEL	2 Gallons
	15-Jul-06	OIL LIKE	3 Gallons
	17-Jul-06	# 6 OIL	22,000 Gallons
	5-Jul-06	DIESEL	20 Gallons
	9-Aug-06	DIESEL	15 Gallons
	11-Aug-06	TALL OIL	1,209 Gallons
	28-Sep-06	DIESEL	0.3 Gallons
	25-Oct-06	DIESEL	40 Gallons
	1-Oct-06	DIESEL	2 Gallons
	7-Nov-06	OIL LIKE	1 Gallon
	13-Nov-06	DIESEL	10 Gallons
	13-Nov-06	DIESEL	710 Gallons
	14-Nov-06	DIESEL	10 Gallons
	14-Nov-06	DIESEL	10 Gallons
	13-Dec-06	OIL LIKE	1 Gallon
	12-Dec-06	OIL LIKE	2 Gallons
	24-Dec-06	HYDROGEN FLUORIDE	50 Gallons
	31-Dec-06	OIL LIKE	0.5 Gallons
2007	5-Jan-07	OIL	10 Gallons
	14-Jan-07	DIESEL	10 Gallons
	2-Mar-07	DIESEL	25 Gallons
	17-Mar-07	DIESEL	5 Gallons
	21-Mar-07	OIL-LIKE	0.5 Gallons
	30-Mar-07	OIL LIKE	0.5 Gallons
	30-Apr-07	DIESEL	5 Gallons
	14-May-07	DIESEL	5 Gallons
	16-May-07	DIESEL	25 Gallons
	26-May-07	OILY-LIKE	5 Gallons
	25-Jun-07	DIESEL	10 Gallons
	4-Jul-07	MYSTERY SHEEN	UNKNOWN
	5-Jul-07	DIESEL	30 Gallons
	12-Jul-07	OIL LIKE	25 Gallons
	16-Jul-07	HYDRAULIC FLUID	25 Gallons
	20-Jul-07	HYDRAULIC FLUID	1 Gallon
	27-Jul-07	HYDRAULIC FLUID	20 Gallons
	27-Aug-07	DIESEL	1 Gallon
	30-Aug-07	OIL	25 Gallons

Year	Date	Substance	Amount
	2-Sep-07	BUNKER OIL	1 Gallon
	4-Sep-07	LUBE OIL	25 Gallons
	6-Sep-07	BUNKER OIL	10 Gallons
	24-Sep-07	DIESEL	1 Gallon
	27-Sep-07	OIL-LIKE	1 Gallon
	26-Nov-07	HYDRAULIC OIL	3 Gallons
2008	7-Jan-08	OIL-LIKE	1 Gallon
	18-Jan-08	OIL-LIKE	5 Gallons
	20-Feb-08	DIESEL	5 Gallons
	26-Mar-08	LUBE OIL	5 Gallons
	7-Apr-08	DIESEL	10 Gallons
	28-Apr-08	DIESEL	1 Gallon
	30-Apr-08	LUBE OIL	3 Gallons
	15-May-08	DIESEL	20 Gallons
	28-May-08	OIL-LIKE	1 Gallon
	4-Jun-08	# 6 OIL	5 Gallons
	20-Jun-08	DIESEL	5 Gallons
	25-Jun-08	DIESEL	1 Gallons
	26-Jun-08	OIL-LIKE	5 Gallons
	11-Jul-08	LUBE OIL	2 Gallons
	5-Aug-08	HYDRAULIC OIL	10 Gallons
	22-Sep-08	DIESEL	1 Gallon
2009	26-Feb-09	OIL-LIKE	7 Gallons
	2-Mar-09	HYDRAULIC OIL	5 Gallons
	12-Mar-09	DIESEL	1 Gallon
	27-Mar-09	DIESEL	12 Gallons
	18-Apr-09	OIL-LIKE	1 Gallon
	10-Jun-09	# 6 OIL	5 Gallons
	3-Jul-09	SODIUM HYDROXIDE	1,200 Gallons
	17-Jul-09	DIESEL	2 Gallons
	24-Sep-09	DIESEL	25 Gallons
	26-Oct-09	LUBE OIL	0.5 Gallons
	3-Nov-09	# 6 OIL	2 Gallons
2010	21-Jan-10	DIESEL	20 Gallons
	21-Mar-10	DIESEL	7,000 Gallons
	29-Mar-10	OIL-LIKE Mixture	<1 Gallon
	17-May-10	Diesel Oil	150 Gallons
	21-Jun-10	Mystery Sheen	Unknown
	31-Aug-10	Toluene	2676 Gallons
	11-Dec-10	Hydraulic Oil	1 Gallon
	11-Apr-11	Diesel Oil	30 Gallons
	7-Jun-11	Lube Oil	3.5 Gallons
	8-Jul-11	Diesel Oil	<1 Gallon
	1-Sep-11	Gasoline	12 Gallons
	16-Sep-11	Diesel Oil	4 Gallons
	1-Oct-11	Fuel Oil	1000 Gallons
	22-Oct-11	Palm Kernel Oil	100 liters
	5-Dec-11	Mystery Sheen	Unknown
	16-Dec-11	Mystery Sheen	Unknown

(4) Results of previous testing in the area demonstrating lack of contamination

The results of new work sampling are discussed in detail in the Sediment Quality Evaluation SHEP, December 2011, Appendix M of the SHEP EIS. Organics were, for the most part, non-detect. Metal results for the bar channel samples are shown below. The only result of potential concern was cadmium found at Station -75+000B. This sample was taken near the old RACON tower site and is thought to have been influenced by contamination around the tower. Re-sampling in the vicinity of this station found no elevated cadmium. See Appendix M of the SHEP EIS for additional details.

Metal Concentrations in the Bar Channel (ATM, 1998, and Table 4 Appendix M).

Sample No.	**005NW**	**015NW**	**W01NW**	**W02NW**	**035NW**	**075NW**	**TEL****
Stations*	-5	-15	-19	-39.5	-35	-75	
Aluminum	2510	2780	11300	1200	3020	3830	
Iron	2600	2840	18100	2910	4600	3650	
Antimony	<2.7	<2.7	<3.1	<2.5	<2.7	<2.6	
Arsenic	3.3	3.4	*8.7*	3.6	6.4	12	7.2
Beryllium	<0.67	<0.68	<0.78	<0.62	<0.68	<0.64	
Cadmium	0.68	*1.5*	<0.5	<0.4	<0.4	**24.3**	**0.68**
Chromium	20.2	39.4	20	7.1	9.2	35.9	52.3
Copper	3.9	5.6	8.1	<3.1	<3.4	5.5	18.7
Lead	1.3	1.7	11.3	1.8	2.9	2.3	30.2
Manganese	25.2	13.9	436	33.6	63	38.4	
Mercury(7471)	<0.013	<0.014	0.04	<0.012	<0.014	0.04	
Nickel	6.8	8.9	5.9	1.9	3.1	9	15.9
Selenium	<1.3	<1.4	<1.6	<1.2	<1.4	<1.3	
Silver	<0.27	<0.27	<0.31	<0.25	<0.27	<0.26	0.73
Thallium(7841)	<0.27	<0.27	<0.31	<0.25	<0.27	<0.27	
Zinc	12.2	16.3	26.3	8	10.1	51.4	124

* Stations in 1000's feet above Station 0+000.
** Buchman, 1999.

2005 Sampling/Testing Sediment Cadmium Concentration (mg/kg dry wt)

STATION	AVG Cd CONC (mg/kg) to -54 ft	AVG Cd CONC (mg/kg) to -51 ft
+2+750	1.03	0.86
+0+250	1.07	1.01
-7+000	0.86	0.69
-17+000	1.89	1.73
-27+000	0.65	0.83
-34+500	0.38	0.41
-36+500	0.34	0.32
-37+500	0.84	0.82
-45+000	0.31	0.31
-50+000	0.66	0.45
-54+500	0.69	0.52
-56+500	0.48	0.39
-57+000	0.50	0.43
-63+000	0.31	

For comparison purposes, the following table shows the results of grab sample metals analyses at the Savannah ODMDS in 1998 as dry weight.

Sample #	DA-14	DA-15	DA-16	DA-17	DA-18	DA-19
Al %	0.127	<0.0903	<0.0873	0.105	0.162	<0.0777
As ug/g	3.23	3.95	1.54	4.14	2.2	0.906
Cd ug/g	<0.0329	<0.0355	<0.0343	<0.0346	0.0373	<0.0305
Cr ug/g	4.56	2.35	1.98	4.09	4.93	2.02
Cu ug/g	0.38	<0.307	0.296	0.299	0.504	0.352
Fe %	0.21	0.144	0.0895	0.168	0.195	0.0795
Pb ug/g	1.32	1.14	<0.160	0.528	0.584	0.589
Mn ug/g	41.4	28	21.8	44.3	30.3	12.8
Ni ug/g	<1.80	<1.94	<1.88	<1.89	<1.91	<1.67
Se ug/g	0.0598	<0.0343	<0.0331	<0.0334	0.291	0.0581
Ag ug/g	<0.0194	<0.0209	<0.0202	<0.0203	<0.0205	<0.0179
Sn ug/g	0.817	1.02	<0.771	<0.777	<0.785	<0.686
Zn ug/g	5.13	3.07	2.67	4.09	4.73	3.08

b. If one of the exclusionary criteria is met, items 3 through 6 below need not be addressed.

Based on the foregoing analysis, the Savannah District believes that the new work dredged material proposed for placement in the Savannah ODMDS is substantially the same as the substrate at the ODMDS. Furthermore, the new work dredged material is far removed from known existing and historical sources of pollution. Therefore, there is reasonable assurance that such material has not been contaminated by such pollution. Since Savannah District believes the proposed dredged material

meets the exclusionary criteria and in accordance with guidance in Appendix C of the Regional Implementation Manual (RIM), items 3 through 6 (Need for Testing, Water Column Determinations, Benthic Screen, Benthic Determinations) are not addressed here.

Although Savannah District has provided information indicating that the exclusionary criteria at 40 CFR § 227.13(b)(3) have been met, Savannah District is performing further detailed analyses (sampling, physical characterization, and sediment bioassays) of the new work sediments to support the determination that the exclusionary criteria have been met and the new work sediments are suitable for placement in the Savannah ODMDS. EPA Region 4 reviewed the Sediment Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) prior to the work being initiated. The District will provide the test results and analysis to EPA for their approval prior to initiating dredging on the entrance channel.

8. Non-Testing Related Regulatory Issues: Subparts B, C, D and E of 40CFR§227

a. Subpart B - Environmental Impact

i. §227.4 Criteria for Evaluating Environmental Impact

The District believes the proposed work will result in: (a) No unacceptable adverse effects on human health and no significant damage to the resources of the marine environment; (b) No unacceptable adverse effect on the marine ecosystem; (c) No unacceptable adverse persistent or permanent effects due to the dumping of the particular volumes or concentrations of these materials; and (d) No unacceptable adverse effect on the ocean for other uses as a result of direct environmental impact.

ii (a). §227.5 Prohibited Materials

The proposed work is not expected to contain any prohibited materials listed at 40 CFR § 227.5. The proposed sediments are new work sediments from the open ocean and are not expected to contain such materials.

ii (b). §227.6 Constituents Prohibited as other than Trace Contaminants.

The proposed work is not expected to contain any constituents prohibited as other than trace contaminants. The proposed sediments are new work sediments from the open ocean and are not expected to contain such materials. Sediment sampling from 2005 has shown that sediments with elevated cadmium levels do not occur in the bar channel. Sampling results from 2005 indicate that average cadmium levels of 0.86 to 1.73 mg/kg should be expected in the sediments proposed for placement in the ODMDS. At 40 CFR § 227.6(f), it is stated that the prohibitions and limitations do not apply when the applicant can demonstrate that such constituents are non-toxic to marine life and non-bioaccumulative in the marine environment. These observed sediment cadmium levels are below the published Probable Effects Level (PEL) for marine sediments of 4.2 mg/kg cadmium, as published in Buchman, 1999. Furthermore, discussions and evaluations in Appendix M show there is little environmental concern for either toxicity or bioaccumulation of cadmium in sediments containing less than 4 mg/kg cadmium.

iii. §227.7 Limits established for specific wastes or waste constituents - address presence of pathogens, biological pests, non-indigenous species.

The proposed sediments are not expected to contain liquid waste constituents immiscible with or slightly soluble in seawater or radioactive materials. Because the proposed sediments are new work sediments and would be placed in an area close to the dredging site, the work should not extend the range of biological pests, viruses, pathogenic microorganisms or other agents capable of infesting, infecting or extensively and permanently altering the normal populations of organisms; the work should not degrade uninfected areas or introduce viable species not indigenous to an area. The proposed sediments are not expected to be highly acidic or alkaline and should not change the acidity or alkalinity of water at the ODMDS. The sediments are also not expected to contain significant amounts of biodegradable constituents that would depress dissolved oxygen by more than 25 percent below the normally anticipated ambient conditions in the disposal area at the time of dumping. Appendix M also discusses the low potential for effects from radioactive substances.

iv. §227.8 Limitations on the Disposal Rates of Toxic Wastes;
v. §227.9 Limitations on Quantities of Waste Materials
vi. §227.10 Hazards to Fishing, Navigation, Shorelines, or Beaches

The proposed work does not include disposal of toxic wastes, containerized wastes, or -insoluble wastes. The proposed work will not present a serious obstacle to fishing or navigation; therefore, the proposed work will not cause unacceptable interference with fishing or navigation. Proposed placement of dredged material in the Savannah ODMDS is not expected to present hazards to fishing, navigation, shorelines, or beaches.

b. Subpart C - Need for Ocean Dumping

i. For federal projects, provide authorization and reference Feasibility Study or other NEPA document providing assessment of disposal alternatives.

The proposed new work dredging, transport, and placement in the Savannah ODMDS is covered in the SHEP EIS, in which this evaluation is contained as Appendix R. The EIS contains a discussion of disposal alternatives.

(a) In accordance with at 40 CFR § 227.15
(1) No useful or feasible treatment is required for this material prior to dumping.
(2) The concept of raw materials and manufacturing or other processes resulting in the waste is not applicable to the proposed dredged material.
(3) The proposed work has been evaluated with respect to the relative environmental risks, impact and cost for ocean dumping as opposed to other potential alternatives including but not limited to: land fill, well injection, incineration, spread of material over open ground, recycling of material for reuse, and additional biological, chemical, or physical treatment of intermediate or final waste streams, and storage. None of these alternatives were determined to be feasible. Placement of a portion of the inner reaches of the proposed work in the Jones/Oysterbed dredged material containment area may be feasible and undertaken depending on conditions present at the time of construction.

(4) Irreversible or irretrievable consequences of the use of alternatives to ocean disposal have been identified for all proposed alternatives to ocean disposal.

(b) In accordance with at 40 CFR § 227.16. The District has demonstrated a need for ocean dumping by conducting a thorough evaluation of the factors listed in § 227.15 and determining that the following conditions exist where applicable:

(1) There are no practicable improvements which can be made in process technology or in overall waste treatment to reduce the adverse impacts of the waste on the total environment;

(2) There are no practicable alternative locations and methods of disposal or recycling available, including without limitation, storage until treatment facilities are completed, which have less adverse environmental impact or potential risk to other parts of the environment than ocean dumping.

ii. For non-federal projects, the alternative disposal alternatives should be summarized and assessed. The final determination is made in the USACE Statement of Findings on whether or not to grant the permit.

Not applicable.

c. Subpart D - Impact of the Proposed Dumping on Aesthetic, Recreational, and Economic Values

i. Reference appropriate section(s) of the site designation EIS/EA to address potential impacts of disposal at the site on recreational fisheries, commercial fisheries, shore recreation, and cultural resources with regard to disposal of dredged material at the site.

According to the Final EIS for Savannah, GA, Charleston, SC, and Wilmington, NC, Ocean Dredged Material Disposal Site Designation, EPA Criteria and Standards Division (WH-585), Washington, DC, page 2-7, "The existing Savannah ODMDS is seaward of valuable fishing grounds and is not adjacent to hard-bottom or artificial reef areas. Furthermore, no known cultural or economic resources occur within the vicinity of the site…Disposal has occurred at this site since 1964 and only minor, temporary increases in turbidity, smothering of benthic infauna, and sediment accumulation have been detected." Potential impacts from the proposed work are expected to be similar.

ii. Address visible characteristics.

As stated above, only minor, temporary increases in turbidity, smothering of benthic infauna, and sediment accumulation are expected from the proposed work. Because sediments proposed for placement in the Savannah ODMDS are expected to be similar to those currently at the site, overall changes in visible characteristics of the site should be minimal.

iii. Address presence of toxics and bioaccumulative chemicals (reference 6 above).

Because the proposed new work sediments and overlying maintenance materials are expected to be predominantly sands and occur along the entrance channel, the presence of toxics and bioaccumulative chemicals is not expected and would be highly unlikely. The results of chemical analysis of the new work sampling are discussed in detail in the Sediment Quality Evaluation SHEP, December 2011, Appendix M of the SHEP EIS. Organics were, for the most part, non-detect. Metal results for the bar channel samples were shown previously on pages 14 and 15. The only result of potential concern was

cadmium found at Station -75+000B. This sample was taken near the old RACON tower site and is thought to have been influenced by contamination around the tower. Resampling in the vicinity of this station found no elevated cadmium.

iv. Address pathogens (reference 7.a.iii above).

The majority of the proposed work is new work sediments with a minor O&M component. These sediments occur along the entrance channel to Savannah Harbor. Both the entrance channel and the ODMDS are in adjacent open ocean environments. If pathogens existed in the area, their occurrence is just as likely in both the dredging and placement sites. The proposed action is not expected to spread any pathogens beyond their current range.

d. Subpart E - Impact of the Proposed Dumping on other Uses of the Ocean - reference appropriate section(s) of the site designation EIS/EA.

The site designation EIS identified no other uses of the ocean that would be impacted by the continued use of the Savannah ODMDS for dredged material placement.

i. § 227.20. Basis for determination.
   (a) Based on current state-of-the-art, the District has not identified any long-range impact the proposed work would have on other uses of the ocean.
   (b) The District has conducted an evaluation of the effect of the proposed dumping of SHEP construction materials on uses of the ocean for purposes other than material disposal. The factors considered in this evaluation are the factors listed at Subpart D. This evaluation is based on the impact of the proposed dumping on specific uses of the ocean rather than on overall esthetic, recreational and economic values.

ii. § 227.21. Uses considered in the evaluation include those listed at § 227.2.

iii. § 227.22. Assessment of impact. In conducting the assessment of impact on other uses of the ocean, the District considered both temporary and long-range effects within the state-of-the-art, but placed particular emphasis on any irreversible or irretrievable commitment of resources that would result from the proposed dumping. The District believes that temporary and long-range effects of the proposed dumping would be minimal and that no irreversible or irretrievable commitment of resources would occur.

9. MPRSA Section 103 Conditions

a. Requirements (management options) to meet the Ocean Disposal Criteria

i. Disposal zones or minimum distances from the disposal site boundaries

All placement actions will be at least 100 meters (330 feet) inside the boundary of the ODMDS.

ii. Ambient disposal conditions (e.g., current or tidal conditions)

The District believes that no disposal restriction is warranted, taking into account ambient conditions at the ODMDS.

iii. Limits on disposal vessel size or discharge rates

The District believes that no restrictions on vessel size or discharge rates are warranted. The ongoing modeling will provide additional information on this issue. The results of the modeling will be included in the Section 103 Evaluation.

b. Requirements necessary to meet site designation conditions

There are no applicable requirements in the site designation conditions.

i. Grain size limitations

There are no grain size limitations for use of the Savannah ODMDS. The proposed new work dredged material is expected to consist predominantly of sands. Savannah District will provide the results from the ongoing tests and analyses to EPA for their approval prior to initiating dredging on the entrance channel.

ii. See 40 CFR Section 228.15(h). According to 40 CFR § 228.15(h), the disposal of dredged material into the ODMDS is restricted to dredged material from the Savannah Harbor area. The proposed new work sediments would be from the Savannah Harbor Navigation Project; therefore, 40 CFR § 228.15(h) does not impose any additional conditions.

c. Requirements necessary to meet the requirements of the disposal site SMMP.

The Savannah ODMDS SMMP is currently under review. The following information reflects the District's current understanding, but is subject to change prior to finalization of the SMMP. The USACE will ensure that final conditions in the new Savannah SMMP are made a part of dredging contracts for the Savannah Harbor Expansion Project and the O&M Navigation Project.

i. Disposal zones

In the past, there have been no disposal zones for the Savannah ODMDS. However, for this deepening project, dredged sediment shall be disposed in the southern two-thirds of the site

ii. Limits on oceanographic conditions for disposal

Disposal shall occur no less than 100 meters (330 feet) inside the site boundaries to comply with 40 CFR §227.28.

The District will prevent mounded dredged material from becoming an unacceptable navigation hazard. Dredged material shall be placed so that at no point will depths be less than -25 feet Mean Lower Low Water (MLLW) (i.e., a clearance will be maintained 25 feet above the bottom), where a depth of -30 feet MLLW is the warning threshold for monitoring and management purposes. If -30 feet is reached, then management decisions will be made on future sediment placement to avoid exceeding the -25 foot MLLW threshold.

The physical removal or leveling of material deposited above -25 feet MLLW is a management alternative should mound heights occur that are higher than those elevations. This would most likely be accomplished by physically moving the materials by bed-leveler or other mechanical means to adjacent spots within the ODMDS.

Disposal shall be limited within the disposal release zone and shall be completed (doors closed) prior to departing the ODMDS.

iii. Disposal monitoring requirements

For all disposal activities, an electronic tracking system (ETS) must be used. The ETS will provide surveillance of the transportation and disposal of dredged material. The ETS will be maintained and operated to continuously track in real-time the horizontal location and draft condition (nearest 0.5 foot) of the disposal vessel (i.e. hopper dredge or disposal scow) from the point of dredging to the disposal site, and return to the point of dredging. Data shall be collected at least every 500 feet during travel to and from the ODMDS and every minute or every 200 feet of travel, whichever is smaller, while approaching within 1,000 feet of the boundary of the ODMDS. The following information shall be electronically recorded for each disposal cycle:

a. Contractor Name
b. Load Number
c. Disposal Vessel Name and Type (e.g. scow)
d. Tow or Trawler Vessel Name (if applicable)
e. Captain of Disposal or Tow/Trawler Vessel
f. Estimated Volume of Load
g. Description of Material Disposed
h. Source of Dredged Material
i. Date, Time and Location at Initiation and Completion of Disposal Event

It is expected that disposal monitoring will be conducted using the National Dredging Quality Management (DQM) Program for Civil Works projects [see http://dqm.usace.army.mil/Specifications/Index.aspx], although other systems may be deemed acceptable upon mutual agreement between the District and EPA. Disposal monitoring and ETS data are expected to be reported to EPA Region 4 on a weekly basis using the eXtensible Markup Language (XML) specification and protocol per Section 3.5. EPA Region 4 and the USACE District shall be notified within 24 hours if disposal occurs outside of the ODMDS or specified disposal zone or if excessive leakage occurs. Excessive leakage is any change in draft exceeding 1.5 feet from the point of departure from the dredging site to the disposal site.

Post-Discharge Monitoring. The USACE will conduct a bathymetric survey within 60 days after disposal project completion. [Surveys will not be required for projects less than 50,000 cubic yards.] Surveys will conform to the minimum performance standards for Corps of Engineers Hydrographic Surveys for "Other General Surveys & Studies" as described in the USACE Engineering Manual, EM1110-2-1003, *Hydrographic Surveying*, dated January 1, 2002 [http://140.194.76.129/publications/eng-manuals/em1110-2-1003/toc.htm]. The number and length of transects required will be sufficient to encompass the ODMDS and a 500-foot wide area around the site. The survey area may be reduced on a case-by-case basis if disposal zones are specified and adhered to. The surveys will be taken along lines spaced at 500-foot intervals or less. The minimum performance standards from Table 3-1 in *Hydrographic Surveying* shall be followed. Horizontal location of the survey lines and depth sounding points will be determined by an automated positioning system using either a microwave line of site system or differential global positioning system. The vertical datum will be referenced to prescribed NOAA Mean Lower Low Water (MLLW) datum, 1983-2001 epoch, as shown on the Tidal Benchmark sheet for St. Simons Island, GA (Station ID: 8677344). MLLW is 3.23 feet below NGVD 1929. The horizontal datum will be Georgia State Plane (zone 1001 GA East, NAD 1983). Bathymetric surveys will be used to monitor the disposal mound to ensure a navigation hazard is not produced, and to assist in verification of material placement, to monitor bathymetric changes and trends, to aid in environmental effects monitoring, and to ensure that the site capacity is not exceeded, i.e., the mound does not exceed the site boundaries. Copies of these surveys shall be provided to EPA, Region 4 when completed.

The interagency team will meet to review the results of the bathymetric surveys and determine the need for additional information. This need will be based on observance of any anomalies or potential adverse impacts associated with a specific event. If the results of the bathymetric surveys do not indicate any anomalies or adverse impacts, no additional monitoring will be required for the disposal event. Reassessment of the site may be undertaken, possibly every 10 years. This reassessment may include benthic macrofaunal and sediment chemistry surveys. Additional surveys for water quality, sediment mapping, or the use of remote sensing equipment may also be required.

iv. Reporting requirements

Disposal monitoring data are expected to be provided to EPA Region 4 electronically on a weekly basis. Data shall be provided per the EPA Region 4 XML format (USEPA, Region 4, 2007) and delivered as an attachment to an email to DisposalData.R4@epa.gov. The XML format is available from EPA Region 4.

Disposal summary reports shall be provided to EPA within 90 days after project completion. These reports should include: dates of disposal; dredging project; volume disposed, number of loads completed, type of material disposed; contractor conducting the work, permit and/or contract number; identification of any misplaced material; and dates of bathymetric surveys of the ODMDS. The disposal summary reports should be accompanied by the bathymetry survey results (paper plot and X, Y, Z ASCII data file), track plots for each disposal trip, a scatter plot of all dump locations, and a summary table of the information required by Section 3.2. If all data are provided in the required XML format, track plots, scatter plots and summary tables will not be necessary.

The Corps contractor will prepare USACE daily reports of operations and a monthly report of operations for each month or partial month's work. The Corps contractor will also be required to notify USACE and EPA within 24 hours (or next business day) if a violation of the permit and/or contract conditions occur during disposal operations.

d. All conditions must be implemented through permit conditions or contract specifications for federal projects. The draft permit conditions/contract specification must be included as part of the MPRSA Ocean Disposal Evaluation Documentation. These are typically available from the SMMP.

The District plans to incorporate contract specifications that are prescribed in the final SMMP into the dredging contract(s) for the proposed work. Final contract specifications for the proposed new work will be written once final designs have been completed. Those specifications currently do not exist. The following pages are applicable portions of the contract specifications for O&M work conducted in the entrance channel in FY11 (selected portions of the dredging section and the entire DQM Section). The new work specifications are expected to be similar.

SECTION 35 20 23
DREDGING
04/06
PART 1 GENERAL
1.1 SUBMITTALS
1.1.1 National Dredging Quality Management Program
Documentation verifying the National Dredging Quality Management Program (DQM), formerly known as Silent Inspector (SI) system has been certified by the Engineer Research and Development Center (ERDC) within the last year shall be provided within the Contractor Quality Control (CQC) Plan. The DQM system shall be in operation throughout dredging and disposal operations.
1.2 WORK COVERED BY THIS CONTRACT
The Contract price includes mobilization and demobilization, dredging and disposal of materials, and disposal area operations as directed by the Contracting Officer. The work covered by this section consists of furnishing plant, labor, and materials as necessary to complete the work as indicated by the Contract and as directed by the Contracting Officer (CO).
1.3 WORK COVERED BY THIS SECTION
Operations consist of the dredging and disposal of material indicated in the specifications and drawings. Do not use drag beams, bed levelers or other such devices. Move dredge plant as necessary to facilitate proper dredge operations. Remove material above the required depth shown on the Contract Drawings and additional shoaling which may have occurred by the time of the Before Dredging Surveys within the construction limits at the unit price for Items 0002 - 0007. The Contracting Officer may waive the requirement to remove material above the required depth if the Government does not consider it a hazard to navigation. Properly dispose of dredged material properly and monitor the Ocean Dredged Material Disposal Sites (ODMDS) in accordance with this Contract.
1.3.2 Savannah Harbor
Dredging shall commence no earlier than 15 December 2011 and shall be completed by 31 March 2012. The dredging for this Contract is between Stations 0+000 and -60+000B. Channel dimensions to be provided are shown on the Contract drawings. The required depth for material removal is -44.0 ft. MLLW.
1.4 ORDER OF WORK
After the initial harbor maintenance dredging has been completed, the dredge shall proceed to the other harbor and dredge there. Simultaneous dredging in both harbors is allowed within the stated environmental windows. In each harbor, the order of work shall be as follows or as directed by the CO or the Contracting Officer's Representative (COR), based on conditions shown on the Before Dredging Survey. Dredging shall begin at the furthermost point from the ocean disposal site and progress successively toward the nearest point. The order of work for dredging shall be directed insofar as practicable to provide for efficient operation of the dredging equipment. Dredging for navigation needs shall be given priority and the Contractor will be directed to dredge in areas that are, in the opinion of the CO, more advantageous to the Government. Orders to the Contractor's representative at the site will be in writing based on acceptance sections as shown on the Contract drawings.
1.5 PLAN AND SCHEDULE OF WORK
Submit a dredging plan within 5 days after Notice to Proceed, to be approved by the CO prior to dredging. The dredging plan shall include the dredging plant the Contractor intends to use on each acceptance section and the schedule indicating starting and completion dates for dredging each section. The Contractor's dredging and disposal plan and schedule shall ensure the following:
a. Dredge size and production rates
b. Performance of work is in strict accordance with the Contract
c. Completion of the work is within the time allowed by the Contract
1.5.1 Dredging Plan
The dredging plan shall include, but is not limited to, the following:
a. A description and schedule of the operations performed in connection with the removal and transport of material. The operations shall be described in the sequence in which they are performed.
b. A description of the plant (including names of dredges) and

equipment utilized in connection with the removal and transport of material.
c. Plant to be used in each acceptance section.
1.8.2 Savannah Harbor
The Savannah ODMDS is currently authorized for disposal of dredged material. Placement is allowed only within the ODMDS. Bin loads are restricted to 12,000 cubic yards. The navigation channel is not an authorized disposal area, and the use of bed leveling or similar devices is not permitted. The maximum distance that the material is transported shall not exceed 11 miles. Bids received will be based on utilizing only the area described above.
Material shall not be placed in the ERDC nearshore disposal area.
1.8.3 Use of Other Disposal Areas
Material deposited elsewhere than in places designated or approved by the Contracting Officer will not be paid for and the Contractor may be required to remove such misplaced material and deposit it where directed by the Contracting Officer at the Contractor's expense. The use of hopper, mechanical, and/or pipeline dredges to dispose of dredged material is permitted.
1.8.4 Navigational Devices
a. To ensure that material is being deposited within the limits of the designated ocean disposal area, each vessel used for the transportation of dredged material from the work site to the ocean disposal area shall be equipped with two navigational recording devices for use during transit to and from the ocean disposal area and during dumping operations. One of these shall be either a chart or map recorder with a scaled grid that shows the beginning and ending location of each dump, either latitude/longitude or Georgia State plane coordinates. The other recording device shall be a computer to generate reports containing the information described in Paragraph Dump Logs, below. The use of a loran navigation device is not suitable for use as the primary vessel positioning system.
b. Both navigation recording devices shall be used simultaneously throughout the project. If 1 of the recording devices stops functioning, repair or replace it immediately upon return to the work site and continue to use the second device. If both recording devices stop functioning, outfit at least 1 recording device on the vessel upon return to the work site.
c. No vessel shall leave for the dump site without at least one operational navigation recording device. Under extreme emergency conditions as determined by the CO and when no recording device is operational, the vessel may be allowed to complete one loading and dump cycle. During this one loading and dump cycle, the Contractor shall manually record the vessel position at 2-minute intervals by either listing the vessel coordinates or graphically plotting the vessel position on a map. After dumping, the vessel shall not be allowed to resume dredging until both navigational recording devices are operational.
1.8.5 Dump Logs
The daily dump logs shall show the following for each dump:
a. The dump number
b. Date
c. Time dump began
d. The location in the entrance channel from which the dredged material came (give from/to dredging stations)
e. The beginning and ending coordinates for which dredging was conducted for the load
f. The beginning (hopper opened) and end (hopper closed) coordinates for each dump
g. The name of the site in which the load was placed
h. The number of cubic yards in each dump
i. Brief description of the material in each dump (e.g., clean, coarse sand; sand and shell; sand mixed with clay and shell; dark organic silt sand; debris; etc.)
At the end of the Contract, prepare a computer-generated report on a disc for the entrance channel which encompasses the required information listed above. These data shall be provided in an ASCII, delimited format, capable of being imported into a spreadsheet, such as an Excel spreadsheet.
SECTION 35 20 23 Page 8

Entrance Channel Maintenance Dredging 11B01
1.8.6 Track Plot
When disposal operations are complete, provide to the COR 2 scatter plots on a disc using small dots showing where each load was deposited (beginning of each dump). One plot shall be on a scale of 1 inch equals 1500 feet (to fit an 8-1/2 x 11-inch paper), and the other plot shall be to a scale of 1 inch equals 500 feet (to fit a full-size blue line drawing). The plots shall also show the boundaries of the ODMDS. Each plot line shall indicate the load number associated with the plot. Provide this information on disc only, not hard copy.
1.8.7 Release of Load
Loads shall be released at least 110 yards inside the ODMDS boundary.
Savannah Harbor:
0002 0+000B to -30+000B* -44.0 81,000 150,000 231,000
0003 -30+000B to -40+000B* -44.0 100,000 198,000 298,000
0004 -40+000 to -60+000B* -44.0 100,000 178,000 278,000
1.11.1 Savannah Harbor
Acceptance Section Stations
1 0+000 to -10+000B
2 -10+000B to -20+000B
3 -20+000B to -30+000B
4 -30+000B to -45+000B
5 -45+000B to -60+000B
1.12 MEASUREMENT AND PAYMENT
For purposes of acceptance, dredge in accordance with the COR's written orders to the Contractor.
1.12.1 Measurement
a. Material removed and paid for under the Contract shall be measured by the cubic yard in situ by computing the volume within the required dredging prism between the bottom surfaces shown by soundings of the last survey made before dredging and the bottom surface shown by the soundings of a survey made as soon as practicable after the work has been completed, less deductions that may be required for excessive dredging, as described in Paragraph OVERDEPTH AND SIDE SLOPES, above, and misplaced material, as described in Paragraph DISPOSAL OF EXCAVATED MATERIAL, below. After dredging surveys will be made upon written request by the Contractor. The bin and scow measurement method (see Paragraph Records and Verification of Hopper Dredge Load meter System, below) will only be used to determine monthly partial payment when weather prevents the use of hydrographic surveying equipment.
b. The maps and drawings already prepared (see Contract Clause "CONTRACT DRAWINGS, MAPS, AND SPECIFICATIONS (DFARS 52.236-7001)") are believed to accurately represent conditions existing at the time surveyed, but the depths shown thereon will be verified and corrected by soundings taken within 14 days before dredging. Determination of quantities removed and the deductions made therefrom to determine quantities by place measurement to be paid for in the area specified, after having once been made, will not be reopened, except on evidence of collusion, fraud, or obvious error.
1.12.2 In-Place (Survey) Method of Measurement
1.12.3 Records and Verification of Hopper Dredge Loadmeter System
a. During the first full day of dredging, the Contractor shall furnish sufficient documentation to enable the CO to determine the quantity of material dredged. This documentation shall include the time, place dredged, and quantity of each load hauled and, for hopper dredges, the loadmeter chart. In addition, the Contractor shall demonstrate the accuracy of its bin measurement system to the COR, using displacement curves and hopper capacity tables. These documents are acceptable to the Government if prepared by the vessel's builder or a qualified engineering firm (other than the Contractor) and notarized.
b. If the Contractor cannot demonstrate the accuracy of its loadmeter to the satisfaction of the COR by completion of the first full day of dredging, the Contractor shall hire a registered marine architect or engineer to certify the accuracy of the loadmeter and ullage table and to provide the results to the COR by the completion of the first week of dredging.
1.12.4 Loadmeter Calibration
1.12.4.1 Hopper Dredges

a. The bin measure system senses changes in draft due to loading and displays the draft changes in the form of displacement changes (weight). Displacement changes are mathematically adjusted to determine the number of cubic yards of in-place density material hauled. This adjustment requires the average in-place density of the material to be dredged. For this Contract, an in-place density of 1,800 grams per liter shall be used. Hopper dredges shall be equipped with a loadmeter which displays the loading process as a function of time on a permanent record.
b. Lightship calculations shall be performed prior to commencement of dredging and subsequent calculations shall be made each time there is an appreciable change in the weight of the vessel (prior to and after taking on fuel, water, heavy equipment, etc.). The COR will be present when the lightship readings are taken and when the calculations are made. Provide a copy of the calculations to the COR immediately after lightship is determined. Daily adjustments of lightship shall be made using fuel and water soundings to determine the weight change. The change shall be documented on the Contractor's daily report and appropriate calculations shall be shown. Appreciable change in weight does not include the loading and unloading of dredge material. Draft markings (port bow, port stern, starboard bow, and starboard stern) shall be legible and adequate to perform an accurate lightship determination. Wetship calculations shall not be used as an alternate method to determine lightship.
1.12.4.2 Scows
The bin measurement for scows shall be determined by averaging a minimum of 4 draft mark readings to determine the mean depth of load, and from it, the volume of the load. The use of loadmeters on scows is optional.
as appropriate. Dredges shall also be equipped with a cellular telephone on the bridge for Corps of Engineers communication with the dredge and inspectors. Final acceptance of the plant will not be made until the radio-telephone is installed and in good working order.
2.2 DISPOSAL EQUIPMENT
The use of self-load bottom dump barges and hopper dredges to dispose of dredged material will be permitted.

SECTION 35 20 23.23
NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM HOPPER DREDGE
04/2011
PART 1 GENERAL
1.1 DESCRIPTION
1.2 SUBMITTALS
1.3 PAYMENT
1.4 NATIONAL DQM PROGRAM CERTIFICATION
1.5 DREDGE PLANT INSTRUMENTATION PLAN (DPIP)
PART 2 PRODUCTS
PART 3 EXECUTION
3.1 REQUIREMENTS FOR REPORTED DATA
3.1.1 Date and Time
3.1.2 Load Number
3.1.3 Vessel Horizontal Positioning
3.1.4 Draghead Horizontal Positioning
3.1.5 Hull status
3.1.6 Dredge Course
3.1.7 Dredge Speed
3.1.8 Dredge Heading
3.1.9 Tide
3.1.10 Draft
3.1.11 Hopper Ullage
3.1.12 Hopper Volume
3.1.13 Displacement
3.1.14 Empty Displacement
3.1.15 Draghead depths
3.1.16 Slurry Densities of Dragarms
3.1.17 Slurry Velocities of Dragarms
3.1.18 Pump RPM
3.1.19 Dragarm Production Criteria
3.1.19.1 Minimum Pumping Effort
3.1.19.2 Pumping Water

3.1.19.3 Material Recovery
3.1.20 Pumpout
3.2 NATIONAL DQM PROGRAM SYSTEM REQUIREMENTS
3.2.1 Computer Requirements
3.2.2 Software
3.2.3 Network Hub
3.2.4 UPS
3.2.5 Printer
3.2.6 Internet Access
3.2.7 Data Routing Requirements
3.2.8 Data Measurement Frequency
3.2.9 Data Format
3.2.10 Data Reporting
SECTION 3520 23.23 Page 1
Entrance Channel Maintenance Dredging 11B01
3.2.11 Contractor Data Backup
3.3 PERFORMANCE REQUIREMENTS
3.4 COMPLIANCE INSPECTION AND QUALITY ASSURANCE CHECKS
3.4.1 Displacement (Draft) Check
3.4.2 Draghead Depth Check
3.4.3 Hopper Dredge Ullage Check
3.4.4 Position Check
3.4.5 Water Load Test
3.5 CONTRACTOR QUALITY CONTROL
3.6 LIST OF ITEMS TO BE PROVIDED BY THE CONTRACTOR
-- End of Section Table of Contents --
SECTION 35 20 23.23
NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM HOPPER DREDGE
04/2011
PART 1 GENERAL
1.1 DESCRIPTION
The work under this Contract requires use of the National Dredging Quality Management Program (DQM), formerly known as Silent Inspector (SI), to monitor the dredge's status during the Contract, and to track load number, time-position history, instrument readings, vessel state, compute tons dry solids, report data, and manage data history.
This performance-based Section identifies the minimum required output and precision and instrumentation requirements. The requirements may be satisfied using equipment and technical procedures selected by the Contractor. For purposes of this document, Contracting Officer's Representative (COR) will include the DQM Support Team personnel when on site.
1.2 SUBMITTALS
Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office responsible for review of the submittal for the Government. "SAM" Indicates the Mobile District, Operations Division; "SAS" indicates the Savannah District. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
SD-01 Preconstruction Submittals
Dredge Plant Instrumentation Plan; G, SAM
Plan Addenda And Modifications; G, SAM
Contractor Quality Control Plan; G, SAS
SD-06 Test Reports
Data Appropriately Archived e-mail; G, SAS
SD-07 Certificates
National DQM Program Certification; G, SAS
1.3 PAYMENT
No separate payment shall be made for installation, operation, and maintenance of the DQM certified system as specified herein for the duration of the dredging operations; costs in connection therewith shall be considered a subsidiary obligation of the Contractor and covered under the Contract unit prices for dredging in the bidding schedule.
SECTION 35Entrance Channel Maintenance Dredging 11B01
1.4 NATIONAL DQM PROGRAM CERTIFICATION
The Contractor is required to have a current certification from the

National DQM Program for the hopper dredge instrumentation system to be used under this Contract. Criteria for certification shall be based on the most recent specification posted on the National DQM Program website (http://dqm.usace.army.mil/Specifications/Index.aspx). Compliance with these criteria shall be verified by on-site plant inspections conducted by DQM Support Center Inspection Team personnel, and by periodic review of the transmitted data. A National DQM Program Certification is valid for one year from the date of the annual inspection. Certification is contingent upon the system's ability to continuously meet the performance requirements as outlined in Paragraphs PERFORMANCE REQUIREMENTS and CONTRACTOR QUALITY CONTROL. If issues with data quality are not corrected within 48 hours, the system certification shall be revoked and recertification may be necessary.
Annual inspection shall include:
- A series of quality assurance checks as described in Paragraph COMPLIANCE INSPECTION AND QUALITY ASSURANCE CHECKS
- Verification of data acquisition and transfer (paragraph PERFORMANCE REQUIREMENTS)
- Review of the Dredge Plant Instrumentation Plan (DPIP) as described in paragraph DREDGE PLANT INSTRUMENTATION PLAN (DPIP)
Engage personnel who are familiar with the system instrumentation and who have the ability to recalibrate the sensors on site during the inspection. Provide transportation from the shore to the platforms with a DQM certified system for the COR in a timely manner. As a general rule, inspection teams will come with PPE consisting of hardhats, steel toe boots, and life jackets. If additional safety equipment is needed, such as eye protection, safety harnesses, work gloves or personal location beacons, provide these items to the team while on site.
The owner or operator of the dredge shall contact the DQM Support Center Inspection Team at dqmins@usace.army.mil on an annual basis, or at least 3 weeks prior to the proposed beginning of dredging, to schedule an inspection. This notification is meant to make the inspection team aware of a target date. At least 1 week prior to start of dredging, contact the inspection team and verbally coordinate a specific inspection date and location. Follow-up this conversation with a written e-mail confirmation. The owner-operator shall coordinate the inspection with local authorities, including but not limited to, the Contracting Officer.
Re-inspection is required for yard work which produces modification to displacement (i.e. change in dredge lines, repositioning or repainting hull marks), modification to bin volume (change in bin dimensions or addition or subtraction of structure) or changes in sensor type or location; these changes shall be reported in the sensor log section of the DPIP. A system does not have to be transmitting data between jobs, however it may not be turned off, disconnected or removed from the dredge in order to retain its certification during this period.
1.5 DREDGE PLANT INSTRUMENTATION PLAN (DPIP)
File a digital copy of the DPIP with the National DQM Support Center. Maintain a copy of the DPIP, easily accessible to Government personnel, on the dredge. This document shall describe how sensor data is collected, how quality control on the data is performed, and how sensors/data reporting equipment are calibrated and repaired if they fail, including a description of computed dredge-specific data, and how the sensor data will be transmitted to the DQM Database. Submit plan addenda and modifications to the DQM Support Center, subsequent to its original submission, prior to start of work.
The DPIP shall include the following as a minimum:
(DPIP Table Of Contents shall be in the following order)
1. Dredging Company
a. Dredge Point of Contact
b. Telephone Number
c. Email address
2. Dredge Monitoring System Provider
a. Dredge Monitoring System Point of Contact
b. Telephone Number
c. Email address
3. Dredge Name
4. Sensor data collection method
a. Any averaging

b. Route from sensor to DQM computer
5. DQM Computer Hardware & Components
a. Brand names and specifications
b. User guides and owner manuals
6. Sensor repair, replacement, installation, modification or calibration methods
7. Dimensioned Drawings of the Dredge
a. A typical plan and profile view of the dredge showing:
i. Hopper dredge cross section
ii. Locations of required sensors referenced to:
(1) Fore and aft perpendicular
(2) Hopper dredge length, depth, width, zero reference
(3) External hull draft markings (latitudinal, longitudinal, keel)
(4) Each other
iii. Overall dredge dimensions
iv. Dimensions of draghead
(1) Length
(2) Pipe inside diameter at sensor locations
(3) Offset to positioning system antenna
8. Criteria and method used to increment load number
9. Description of how the UTC date/time stamp is collected
10. Positioning system
a. Brand name and specifications
b. Dredge heading instrumentation brand name and specifications
c. Instrument used to calculate COG
d. Calculations done external to the instrumentation
e. Certificates of calibration and/or manufacturer certificates of compliance
f. Description of how dredge speed is determined
11. Tide
a. Description of how tidal information is entered into the data string.
12. Hull status
a. Instrumentation brand name and specifications
b. Certificates of calibration and/or manufacturer certificates of compliance
c. Calculations done external to the instrumentation
13. Drafts:
a. Instrumentation brand name and specifications
b. Certificates of calibration and/or manufacturer certificates of compliance
c. Calculations done external to the instrumentation
14. Displacement:
a. Method used by Contractor to calculate displacement based on fore and aft draft
b. Method used by Contractor to calculate lightship displacement
c. Hydrostatic curves
d. Tables listing (fresh and salt water) displacement as a function of draft certified by a licensed marine surveyor/ naval architect independent of the Contractor (feet and tenths of feet)
e. These methods and tables shall be an accurate reflection of the current configuration and displacement
15. Hopper Ullage:
a. Sensor brand name and specifications
b. Certificates of calibration and/or manufacturer certificates of compliance
c. Calculations done external to the instrumentation
16. Hopper Volume:
a. Method used by Contractor to calculate hopper dredge volume based on fore and aft hopper dredge ullage
b. Table listing the hopper dredge volume as a function of hopper dredge ullage, certified by a licensed marine surveyor/ naval architect independent of the Contractor (feet and tenths of feet).
c. These methods and tables shall be an accurate reflection of the current configuration and volume
17. Draghead

a. Draghead Depth
i. Sensor brand name and specifications
ii. Certificates of calibration and/or manufacturer certificates of compliance
iii. Calculations done external to the instrumentation
b. Draghead Depth Check
i. Method used
ii. If applicable sensor brand name and specifications
iii. If applicable certificates of calibration and/or manufacturer certificates of compliance
iv. If applicable, calculations done external to the instrumentation
c. Drag Head Position
i. Sensor brand name and specifications
ii. Calculations done external to the instrumentation
iii. Certificates of calibration and/or manufacturer certificates of compliance
18. Slurry Density and Velocity Sensors:
a. Sensor brand name and specifications
b. Calculations done external to the instrumentation
c. Certificates of calibration and/or manufacturer certificates of compliance
19. Pump RPM
a. Sensor brand name and specifications
b. Calculations done external to the instrumentation
c. Certificates of calibration and/or manufacturer certificates of compliance
d. Description of the pump for which the RPM is reported
20. Criteria used to determine
a. Minimum pump effort
b. Pumping water
c. Material recovery
d. Pumpout
21. Refractometer:
a. Brand
b. Resolution and accuracy
c. Method of calibration
22. Criteria used to determine open/closed status of hopper dredge
23. Documentation of:
SECTION 35 20 23.23 Page 7
Entrance Channel Maintenance Dredging 11B01
a. Test methods used by the Contractor to provide quality control of data
b. Verification that the reported values are applicable for the sensor and application
24. Remote log in information
a. Static IP address (Host)
b. Incoming and outgoing port settings (Host)
c. Username and password (Host)
25. Log of sensor performance and modifications
26. Log of Contractor data backup per Paragraph "Contractor Data Backup".
27. Quality Control Plan as per Paragraph "Contractor Quality Control":
a. Name of Quality Control Systems Manager
b. Procedures for checking collected data against know values
c. Procedures for verifying telemetry is functioning
d. Procedures for verifying DQM computer is on
e. Procedures for verifying DQMOBS is running
Changes to the computation methods shall be approved by the National DQM Program Support Center prior to their implementation.
PART 2 PRODUCTS
Not used.
PART 3 EXECUTION
3.1 REQUIREMENTS FOR REPORTED DATA
Provide, operate, and maintain the hardware and software to meet these specifications. Replace, repair, and calibrate sensors and other necessary

data acquisition equipment needed to supply the required data. Repairs shall be completed within 48 hours of sensor failure. Upon completion of a repair, replacement, installation, modification, or calibration, notify the COR, who may request re-calibration of sensors or other hardware components during the Contract as the COR deems necessary. Keep a log of sensor repair, replacement, installation, modification and calibration in the dredge's onboard copy of the DPIP. The log shall contain a three-year history of sensor maintenance to include: the time of sensor failures (and subsequent repairs), the time and results of sensor calibrations, the time of sensor replacements, and the time that backup sensor systems are initiated to provide required data. It shall also contain the name of the person responsible for the sensor work.

3.1.1 Date and Time

The date and time shall be reported to the nearest second and referenced to UTC time based on a 24 hour format; mm/dd/yyyy hh:mm:ss

3.1.2 Load Number

A load number shall document the end of a disposal event. Load numbering will begin at number 1 at the start of the Contract, and will be incremented by 1 at the completion of each disposal event or emptying of the hopper. Whenever possible, the load number shall be calculated off of the sensors aboard the dredge, and shall be a mathematically repeatable routine. Efforts shall be made to include logic that avoids false load number increments while also not allowing the routine to miss disposal events. If manual incrementing of the load number is in place, extra attention shall be paid to this value in the Contractor's quality control process (Paragraph "Contractor Quality Control").

3.1.3 Vessel Horizontal Positioning

Horizontal positioning of the antenna location shall be obtained using a Positioning System operating with a minimum accuracy level of 1 to 3 meters horizontal Circular Error Probable (CEP). Positions shall be reported as Latitude/Longitude WGS 84 in decimal degrees. West Longitude and South Latitude values are reported as negative.

3.1.4 Draghead Horizontal Positioning

Horizontal positioning of the dragheads shall be obtained using a Positioning System operating with a minimum accuracy level of 1 to 3 meters horizontal Circular Error Probable (CEP). Positions shall be reported as Latitude/Longitude WGS 84 in decimal degrees. West Longitude and South Latitude values are reported as negative.

3.1.5 Hull status

Open/closed status of the hopper dredge, corresponding to the split/non-split condition of a split hull hopper dredge shall be monitored. For dredges with hopper doors, the status of a single door that is the first opened during normal disposal operations may be monitored. An "OPEN" value shall indicate the hopper door is open, or in the case of split hull dredges, the hull is split. A "CLOSED" value indicates the hopper doors are closed, or in the case of split hull dredges, the hull is not split. For this Contract, hull status shall register closed prior to leaving the disposal area.

3.1.6 Dredge Course

Dredge course-over-ground (COG) shall be provided using industry standard equipment. Provide dredge course over ground to the nearest whole degree with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

3.1.7 Dredge Speed

Dredge speed-over-ground shall be provided in knots using industry standard equipment with a minimum accuracy of 1 knot and resolution to the nearest 0.1 knot.

3.1.8 Dredge Heading

Dredge heading shall be provided using industry standard equipment. The dredge heading shall be accurate to within 5 degrees and reported to the nearest whole degree, with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

3.1.9 Tide

Tide data shall be obtained using appropriate equipment to give the water level with an accuracy of +/- 0.1 feet and a resolution of 0.01 feet. Tide values above project datum described in the dredging specification shall be entered with a positive sign, those below with a negative sign.

3.1.10 Draft
Draft measurements shall be made in feet with an accuracy of +/- 0.1 foot, and reported with a resolution to the nearest 0.01 foot relative to the fore and aft draft marks. Industry standard pressure sensors, or an equivalent system, may be used. Two draft sensors, one fore and one aft, are required. At the discretion of the DQM Support Center, a system may use other means of measuring drafts if accuracies and resolution are maintained relative to the draft marks.
3.1.11 Hopper Ullage
Fore and aft hopper ullage values shall be measured to the nearest 0.01 foot with a minimum accuracy of +/- 0.1 foot relative to the hopper dredge's zero reference elevation. If only 2 sensors are used, they shall be mounted in locations as near as possible to the hopper dredge centerline, and away from discharge flume turbulence, foam, and structures that could produce sidelobe errors. If 1 sensor is offset to port or starboard, the other sensor shall be offset to the opposite side of the hopper dredge. If more than 1 fore or one aft sensor is used, they shall be placed near the corners of the hopper dredge and the average value of the fore sensors and the average value of the aft sensors shall be reported.
3.1.12 Hopper Volume
Hopper dredge volume shall be reported in cubic yards, based on the most accurate method available for the dredge. The minimum standard of accuracy for hopper dredge volume is interpolation from the certified ullage table, based on the average fore and aft ullage readings.
3.1.13 Displacement
Dredge displacement shall be reported in long tons, based on the most accurate method available for the dredge. The minimum standard of accuracy for displacement is interpolation from the displacement table, based on the average draft. For this Contract, the density of water used to calculate displacement shall be 1027 kg/cubic meter and shall be used for an additional interpolation between the fresh and salt water tables.
3.1.14 Empty Displacement
Empty displacement shall be reported in long tons, and shall be the lightship value of the dredge, or the weight of the dredge with no material in the hopper, adjusted for fuel and water consumption.
3.1.15 Draghead depths
Draghead depths shall be reported with an accuracy of +/- 0.5 feet and a resolution to the nearest 0.1 feet as measured from the surface of the water with no tidal adjustments. Minimum accuracies are conditional to relatively calm water.
3.1.16 Slurry Densities of Dragarms
A density metering device, calibrated according to the manufacturer's specifications, shall be used to record the slurry density of each dragarm to the nearest 0.0001 g/cc with an accuracy of +/- 0.001g/cc. If the manufacture does not specify a frequency of re-calibration, calibration shall be conducted prior to commencement of work.
3.1.17 Slurry Velocities of Dragarms
A flow metering device, calibrated according to the manufacturer's specifications, shall be used to record the slurry velocity of each dragarm to the nearest 0.0001 fps with an accuracy of +/- 0.001 fps. If the manufacture does not specify a frequency of re-calibration, calibration shall be conducted prior to commencement of work. The slurry velocity shall be measured in the same pipeline inside diameter as that used for the slurry density measurement.
3.1.18 Pump RPM
Pump RPM shall be measured with the highest level of accuracy that is standard on the vessel operational displays, either at the bridge, at the drag tenders controls, or in the engine room. Dredges with multiple pumps per side shall report RPM for the pump that best describes the dredging process (typically the outboard pump). If requirements of Paragraph "Dragarm Production Criteria" are determined based on pump RPM, then that value shall be reported.
3.1.19 Dragarm Production Criteria
For the purposes of DQM, a dragarm pump can only operate one of 3 ways and each shall be mutually exclusive of the other 2.
3.1.19.1 Minimum Pumping Effort
For Minimum Pumping Effort a "TRUE" value shall mean the hopper dredge

pumps are idling (assuring minimum dragarm intake velocity) or off. The logic can be triggered either with Pump revolutions per minute below a certain idle threshold or dragarm slurry velocity at or below the idle speed threshold (depending on the particular dredge plant and project). The only permissible values are "TRUE" and "FALSE". The criteria for minimum pump effort may be unique to each dredge.

3.1.19.2 Pumping Water

For Pumping Water a "TRUE" value shall indicate the dredge is not digging material but is pumping water (or very low-density material) through the dredge pump(s). For example, when the slurry density is less than 1.05 grams per cubic centimeter, the dredge is considered to be pumping water. Other parameters such as pump vacuum may be used to satisfy the pumping water requirement. These criteria may be unique to each dredge. The only permissible values are "TRUE" and "FALSE".

3.1.19.3 Material Recovery

For material recovery, a "TRUE" value shall indicate the dredge is digging material. The only permissible values are "TRUE" and "FALSE". Example: when the slurry velocity is greater than 10 feet per second and the density is greater than 1.05 grams per cubic centimeter, material recovery is "TRUE". These criteria may be unique to each dredge.

3.1.20 Pumpout

When the hopper dredge is being pumped out, a "True" value shall be reported; when it is not, a "False" value shall be reported. The only permissible values are "TRUE" and "FALSE".

3.2 NATIONAL DQM PROGRAM SYSTEM REQUIREMENTS

The Dredge shall be equipped with a DQM computer system consisting of a computer, monitor, keyboard, mouse, printer, data modem, UPS, and network hub. The computer system shall be a stand alone system, exclusive to the DQM monitoring system, and will have USACE DQM software installed on it. If a hardware problem occurs, or if a part of the system is physically damaged, repair it within 48 hours of determination of the condition.

3.2.1 Computer Requirements

Provide a dedicated on-board computer for use by the DQM system. This computer shall run the Corps' software and receive data from the Contractor's data reporting interface. This computer shall meet or exceed the following performance specifications:

CPU: Intel or AMD processor with a (non-overclocked) clock speed of at least 3 gigahertz (GHz)

Hard drive: 250 gigabytes (GB); internal

RAM: 2 gigabytes

Ethernet adapter: 10 or 100 megabit (Mbit) internal network card with an RJ-45 connector

Video adapter: Shall support resolution of 1024x768 at 16 bit color depth

Keyboard: Standard 101-key

Mouse: Standard 2-button mouse

Monitor: 17 inch viewable display; shall support 1024x768 resolution at 16 bit color depth

CD-ROM drive: 16X read speed/8X write speed

Ports: 2 free Serial ports with standard 9-pin connectors; 1 free USB port

Other hardware: Category 5 (Cat-5) cable with standard RJ-45 plugs connecting the network adapter to the network hub; 1 spare cable

Contractor shall provide a fully-licensed copy of Windows XP Professional on the computer specified above and the necessary manufacturer-provided drivers for the installed hardware.

This computer shall be located and oriented to allow data entry and data viewing, as well as to provide access to data ports for connection of external hardware. Location and orientation shall be subject to the COR's approval.

3.2.2 Software

The DQM computer's primary function is to transmit data to the DQM shore side database. No other software which conflicts with this function shall be installed on this computer. A copy of Symantec pcAnywhere™ 12.5 (Remote and Host) or newer shall be available on the dredge and installed on the DQM computer (host) and available for installation on the inspection

computer (remote). Information required to log-in on the DQM computer (host) shall be in included in the DPIP. This shall include the DQM computers (host) static IP address, data port and status port information, and associated login names and passwords. The DQM personnel will provide the DQMOBS (Dredge Quality Management Onboard Software) on the computer.

3.2.3 Network Hub

The DQM computer shall communicate via IEEE 802.3 Ethernet and the TCP/IP networking protocol. Provide a network hub to allow the temporary addition of the COR's portable computer to the computer network. The hub shall provide a minimum of four RJ-45 ports that support Category 5 (Cat-5) cable with standard RJ-45 plugs connecting the network adapter to the network hub; one spare cable shall be available on site to plug into the network hub.

3.2.4 UPS

Supply an Uninterruptible Power Supply (UPS) for the computer and networking equipment. The UPS shall provide backup power at 1kVA for a minimum of 10 minutes. The UPS shall interface to the DQM computer to communicate UPS status. Ensure that sufficient power outlets are available to run the specified equipment.

3.2.5 Printer

Supply a printer and driver software (when necessary) for use with the DQM computer. The printer shall support the Universal Serial Bus interface (cable provided by the Contractor), and shall have a minimum resolution of 300 dots per inch and have a rated print speed of 6 pages per minute (black and white) or higher and support color. Additionally, the printer shall have minimum paper capacity of 50 pages of 8.5 X 11 inch paper. Maintain a supply of printer paper and other consumables such as printer cartridges. Printer usage will not exceed 500 pages per month.

3.2.6 Internet Access

Provide an internet connection to the DQM computer with connectivity in the area where they are working. The internet shall be always available to the DQM computer with connectivity at least 12 out of 24 hours. Provide the necessary hardware and software to make this Internet connection available to the DQM on-board computer.

3.2.7 Data Routing Requirements

Onboard sensors shall continually monitor dredge conditions, operations and efficiency and route this information into the shipboard dredge-specific system computer (DSS) to assist in guiding dredge operations. Portions of this Contractor-collected information shall be routed to the DQM computer on a real-time basis for archival data storage and compilation into summary reports of dredging operations. Standard sensor data shall be sent to the DQM computer via an RS 232 19200-baud serial interface. The serial interface shall be configured as 8 bits no parity and no flow control.

3.2.8 Data Measurement Frequency

Disposal activities shall be logged with high temporal and spatial resolution. Data shall be logged as a series of events. Each set of measurements (i.e. time, position, etc.) will be considered an event. The required information in Paragraph REQUIREMENTS FOR REPORTED DATA shall be collected within one second of the reported time. A data string for an event shall be sent to the DQM computer every 10 seconds or less; but never more frequently than once per every 5 seconds.

3.2.9 Data Format

Data shall be reported as an eXtensible Markup Language (W3C standard XML 1.0) document as indicated below. Line breaks and spaces are added in the example for readability, but in the actual file, the carriage return, line feed character combination is only added to delineate records. Each data record is a single line including its data parameters with appropriate xml tags(i.e. the carriage return shall only occur after the xml tag (HOPPER DREDGE_DREDGING_DATA). Each data record is distinguishable by the beginning tag (?xml version="1.0"?) and the ending tag (HOPPER_DREDGING_DATA), with a carriage return after this tag.

```
(?xml version="1.0"?)
(HOPPER_DREDGING_DATA version = "2.0")
(DREDGE_NAME) string32 (/DREDGE_NAME)
(HOPPER_DATA_RECORD)
(DATE_TIME) time date string (/DATE_TIME)
(LOAD_NUMBER) integer string (/LOAD_NUMBER)
```

```
{VESSEL_X coord_type = "LL"} floating point string {/VESSEL_X}
{VESSEL_Y coord_type = "LL"} floating point string {/VESSEL_Y}
{PORT_DRAG_X coord_type = "LL"} floating point
string{/PORT_DRAG_X}
{PORT_DRAG_Y coord_type = "LL"} floating point
string{/PORT_DRAG_Y}
{STBD_DRAG_X coord_type = "LL"} floating point
string{/STBD_DRAG_X}
{STBD_DRAG_Y coord_type = "LL"} floating point
string{/STBD_DRAG_Y}
{HULL_STATUS} OPEN/CLOSED string {/HULL_STATUS}
{VESSEL_COURSE} floating point string {VESSEL_COURSE}
{VESSEL_SPEED} floating point string {/VESSEL_SPEED}
{VESSEL_HEADING} floating point string {/VESSEL_HEADING}
{TIDE} floating point string {/TIDE}
{DRAFT_FORE} floating point string {/DRAFT_FORE}
{DRAFT_AFT} floating point string {/DRAFT_AFT}
{ULLAGE_FORE} floating point string {/ULLAGE_FORE}
{ULLAGE_AFT} floating point string {/ULLAGE_AFT}
{HOPPER_VOLUME} floating point string {/HOPPER_VOLUME}
{DISPLACEMENT} floating point string {/DISPLACEMENT}
{EMPTY_DISPLACEMENT} floating point string {/EMPTY_DISPLACEMENT}
{DRAGHEAD_DEPTH_PORT} floating point string
{/DRAGHEAD_DEPTH_PORT}
{DRAGHEAD_DEPTH_STBD} floating point string
{/DRAGHEAD_DEPTH_STBD}
{PORT_DENSITY} floating point string {/PORT_DENSITY}
{STBD_DENSITY} floating point string {/STBD_DENSITY}
{PORT_VELOCITY} floating point string {/PORT_VELOCITY}
{STBD_VELOCITY} floating point string {/STBD_VELOCITY}
{PUMP_RPM_PORT} floating point string {/PUMP_RPM_PORT}
{PUMP_RPM_STBD} floating point string {/PUMP_RPM_STBD}
{MIN_PUMP_EFFORT_PORT} true/false/unknown string
{/MIN_PUMP_EFFORT_PORT}
{MIN_PUMP_EFFORT_STBD} true/false/unknown string
{/MIN_PUMP_EFFORT_STBD}
{PUMP_WATER_PORT} true/false/unknown string {/PUMP_WATER_PORT}
{PUMP_WATER_STBD} true/false/unknown string {/PUMP_WATER_STBD}
{PUMP_MATERIAL_PORT} true/false/unknown
string{/PUMP_MATERIAL_PORT}
{PUMP_MATERIAL_STBD} true/false/unknown string
{/PUMP_MATERIAL_STBD}
{PUMP_OUT_ON} true/false/unknown string {/PUMP_OUT_ON}
{/HOPPER_DATA_RECORD}
{/HOPPER_DREDGING_DATA}
Carriage return - ASCII value 13
Line Feed - ASCII value 10
Example
{?xml version="1.0"?}
{HOPPER_DREDGING_DATA version = "2.0"}
{DREDGE_NAME}Essayons{/DREDGE_NAME}
{HOPPER_DATA_RECORD}
{DATE_TIME}04/11/2002 13:12:05{/DATE_TIME}
{LOAD_NUMBER}102{/LOAD_NUMBER}
{VESSEL_X coord_type = "LL"}-80.123333{/VESSEL_X}
{VESSEL_Y coord_type = "LL"}10.123345{/VESSEL_Y}
{PORT_DRAG_X coord_type = "LL"}-80.1233371{/PORT_DRAG_X}
{PORT_DRAG_Y coord_type = "LL"}10.12335{/PORT_DRAG_Y}
{STBD_DRAG_X coord_type = "LL"}-80.123339{/STBD_DRAG_X}
{STBD_DRAG_Y coord_type = "LL"}10.123347{/STBD_DRAG_Y}
{HULL_STATUS}CLOSED{/HULL_STATUS}
{VESSEL_COURSE}258{/VESSEL_COURSE}
{VESSEL_SPEED}3.4{/VESSEL_SPEED}
{VESSEL_HEADING}302{/VESSEL_HEADING}
{TIDE}-0.1{/TIDE}
{DRAFT_FORE}10.05{/DRAFT_FORE}
{DRAFT_AFT}15.13{/DRAFT_AFT}
```

{ULLAGE_FORE}10.11{/ULLAGE_FORE}
{ULLAGE_AFT}10.22{/ULLAGE_AFT}
{HOPPER_VOLUME}2555.2{/HOPPER_VOLUME}
{DISPLACEMENT}4444.1{/DISPLACEMENT}
{EMPTY_DISPLACEMENT}2345.0{/EMPTY_DISPLACEMENT}
{DRAGHEAD_DEPTH_PORT}55.10{/DRAGHEAD_DEPTH_PORT}
{DRAGHEAD_DEPTH_STBD}53.21{/DRAGHEAD_DEPTH_STBD
{PORT_DENSITY}1.02{/PORT_DENSITY}
{STBD_DENSITY}1.03{/STBD_DENSITY}
{PORT_VELOCITY}22.1{/PORT_VELOCITY}
{STBD_VELOCITY}23.3{/STBD_VELOCITY}
{MIN_PUMP_EFFORT_PORT}false{/MIN_PUMP_EFFORT_PORT}
{MIN_PUMP_EFFORT_STBD}false{/MIN_PUMP_EFFORT_STBD}
{PUMP_WATER_PORT}true{/PUMP_WATER_PORT}
{PUMP_WATER_STBD}true{/PUMP_WATER_STBD}
{PUMP_MATERIAL_PORT}false{/PUMP_MATERIAL_PORT}
{PUMP_MATERIAL_STBD}false{/PUMP_MATERIAL_STBD}
{PUMP_OUT_ON}false{/PUMP_OUT_ON}
{/HOPPER_DATA_RECORD}
{/HOPPER_DREDGING_DATA}
{cr}
{lf}
{DREDGE_NAME}Essayons{/DREDGE_NAME}
{HOPPER_DATA_RECORD}
{DATE_TIME}04/11/2002 13:12:10{/DATE_TIME}
{LOAD_NUMBER}102{/LOAD_NUMBER}
{VESSEL_X coord_type = "LL"}-80.123334{/VESSEL_X}
{VESSEL_Y coord_type = "LL"}10.123346{/VESSEL_Y}
{PORT_DRAG_X coord_type = "LL"}-80.1233372{/PORT_DRAG_X}
{PORT_DRAG_Y coord_type = "LL"}10.12336{/PORT_DRAG_Y}
{STBD_DRAG_X coord_type = "LL"}-80.123340{/STBD_DRAG_X}
{STBD_DRAG_Y coord_type = "LL"}10.123348{/STBD_DRAG_Y}
{HULL_STATUS}CLOSED{/HULL_STATUS}
{VESSEL_COURSE}259{/VESSEL_COURSE}
{VESSEL_SPEED}3.5{/VESSEL_SPEED}
{VESSEL_HEADING}300{/VESSEL_HEADING}
{TIDE}-0.1{/TIDE}
{DRAFT_FORE}10.00{/DRAFT_FORE}
{DRAFT_AFT}15.15{/DRAFT_AFT}
{ULLAGE_FORE}10.15{/ULLAGE_FORE}
{ULLAGE_AFT}10.20{/ULLAGE_AFT}
{HOPPER_VOLUME}2555.5{/HOPPER_VOLUME}
{DISPLACEMENT}4444.0{/DISPLACEMENT}
{EMPTY_DISPLACEMENT}2345.0{/EMPTY_DISPLACEMENT}
{DRAGHEAD_DEPTH_PORT}55.15{/DRAGHEAD_DEPTH_PORT}
{DRAGHEAD_DEPTH_STBD}53.19{/DRAGHEAD_DEPTH_STBD
{PORT_DENSITY}1.00{/PORT_DENSITY}
{STBD_DENSITY}1.01{/STBD_DENSITY}
{PORT_VELOCITY}22.5{/PORT_VELOCITY}
{STBD_VELOCITY}23.3{/STBD_VELOCITY}
{MIN_PUMP_EFFORT_PORT}false{/MIN_PUMP_EFFORT_PORT}
{MIN_PUMP_EFFORT_STBD}false{/MIN_PUMP_EFFORT_STBD}
{PUMP_WATER_PORT}true{/PUMP_WATER_PORT}
{PUMP_WATER_STBD}true{/PUMP_WATER_STBD}
{PUMP_MATERIAL_PORT}false{/PUMP_MATERIAL_PORT}
{PUMP_MATERIAL_STBD}false{/PUMP_MATERIAL_STBD}
{PUMP_OUT_ON}false{/PUMP_OUT_ON}
{/HOPPER_DATA_RECORD}
{/HOPPER_DREDGING_DATA}
{cr}
{lf}

3.2.10 Data Reporting

The system shall transmit correctly formatted event data XML strings to the DQM Database continuously from mobilization until the last USACE post-dredging survey has been accepted. If the internet connection is non-operable, either because of hardware failure or poor local operating conditions, the system is not in compliance with the Specifications and

manual backups shall be performed for each day the device is inoperable and submitted to the DQM center within 48 hours. Instructions on how to backup DQM data, perform DQM data transfer (Contractor), and the downloadable executable for Send Data can be found at http://dqm.usace.army.mil/Dredging_Plants/hopper.aspx. If a sensor is not functional, maintain a manually recorded disposal log, consisting of a series of events. These events are start of dredging, end of dredging, pre-disposal, and post-disposal events. Each event shall include time stamp (GMT), position (latitude and longitude WGS84), draft, ullage, volume, and displacement. Submit disposal logs on a daily basis to the COR during the time when the system is not operational.

3.2.11 Contractor Data Backup

Maintain an archive of the data collected for transmittal to the DQM computer during the dredging Contract. The COR may require, at no increase in the Contract price, the Contractor to provide a copy of these data covering specified time periods. The data shall be provided within an ascii text file (*.txt) containing the XML data strings which would have been transmitted to the DQM computer (Paragraph "Data Format"). Each data record within the text file shall be stored on a single line, including the data parameters with appropriate xml tags (i.e. the carriage return shall only occur after the xml tag (HOPPER_DREDGING_DATA). Each data record is distinguishable by the beginning tag (?xml version="1.0"?) and the ending tag (HOPPER_DREDGING_DATA) with a carriage return after this tag. As per Paragraph "Data Format", there shall be no line breaks between parameters; each record shall be a separate line. Naming convention for the files shall be (dredgename)_(StartYYYYMMddhhmmss)_(EndYYYYMMddhhmmss).txt. Data submission shall be via storage medium acceptable to the COR.

At the end of the Contact, contact the National DQM Support Center prior to discarding the data to ensure it has been appropriately archived. Record, in a separate section at the end of the dredge's on-board copy of the DPIP, the following information:

a. Person who made the call

b. The date of the call

c. The DQM representative who gave permission to discard

The same day of the phone call and prior to discarding the data, submit a "Data Appropriately Archived e-mail" to the COR with the above information, and Cc: the DQM Support Center representative providing permission; dqm-support@usace.army.mil. In addition to the above information, also include in the e-mail:

d. Project name and Contract number

e. Dredge start and end dates

f. Name of hopper dredge

3.3 PERFORMANCE REQUIREMENTS

The Contractor's DQM system shall be fully operational at the start of dredging operations and fully certified prior to moving dredge material on the Contract (see Paragraph NATIONAL DQM PROGRAM CERTIFICATION). To meet Contract requirements for operability, in addition to certification, the Contractor's system shall provide a minimum 95 percent data return and be compliant with DPIP requirements (Paragraph DREDGE PLANT INSTRUMENTATION PLAN (DPIP)) as determined by DQM support team. Data return percentage is defined as the total number of quality data strings sent by the DSS system to the DQM computer divided by the total possible number of records that could be sent by a system in good working order. Quality data strings are considered to be those providing accurate values for at least 34 of the 35 parameters reported. If repairs necessary to restore 95 percent data return are not made within 48 hours or if the Contractor fails to report required data within the specified time window for dredge measurements (see Paragraphs "Data Measurement Frequency" and "Data Reporting"), the system will be declared not fully operational, and the Contractor will be assessed liquidated damages equivalent to the additional oversight hours that would be required for Corps personnel to be on site from the first full day after the system is deemed not operational through to the time when the system is returned to fully operational status. For this purpose, the liquidated damages shall be $2413 per day, regardless of and in addition to other liquidated damages that the Government may assess against the Contractor.

3.4 COMPLIANCE INSPECTION AND QUALITY ASSURANCE CHECKS

For inspections and compliance monitoring, the COR will include, but not be

limited to, DQM support center personnel. Provide the COR transportation from the shore to platforms with a DQM certified system. Transportation to the DQM equipment shall be provided in a timely manner.
Quality assurance checks are required prior to the commencement of dredging, and at the discretion of a COR periodically throughout the duration of the Contract. Detailed instructions for performing these checks and a spreadsheet for recording the results are available at http://sj.usace.army.mil/downloads.asp. Incoming data shall be periodically reviewed to assure compliance with performance requirements outlined in Paragraph PERFORMANCE REQUIREMENTS.
3.4.1 Displacement (Draft) Check
The COR will periodically verify the accuracy of the fore and aft draft sensors by comparing the vessel hull draft marks to the corresponding sensor readings indicated on the DQM screen. The vessel's hull draft reading will be viewed from a Contractor-supplied auxiliary vessel circling the dredge. The COR will review the difference between averaged drafts recorded by the instruments and those estimated from the draft marks to insure that the system is operating within the acceptable accuracy of approximately ± 0.1 foot in calm seas conditions, and shall direct the Contractor to re-calibrate or repair system components as necessary. This check may be performed separately or as a part of the Water Load Test.
3.4.2 Draghead Depth Check
The COR may require periodic calibration checks of the reported draghead depth using manual means such as tape measures or sounding lines to directly measure draghead depth. Furnish a steel tape, chain, or wire with clearly visible flags/tags placed at 1 foot increments within the operational range of the dragarm. These devices shall be capable of measuring the depth below the water surface to the lowest fixed point of each draghead (often the heel) with sufficient length to measure 5 feet more than the maximum project depth. Pressure sensors may be used to verify calibration of the draghead sensors only in areas where current flow past the vessel/dragarm cannot be reduced sufficiently to allow safe handling of manual measuring devices. Pressure sensors, used for this purpose shall be vented pressure gages and shall be subjected to an annual manufacturer's calibration. Prior to the dragarm depth check, the sensor shall be checked at a known depth, and may be required to be zeroed at this point according to manufacturer's specifications. Care shall be taken not to kink the cable or restrict the vent during deployment.
The COR will review the draghead depth data to insure that the system is operating within acceptable accuracy, and may direct the Contractor to re-calibrate or repair system components as necessary. If a bubbler type system is used, weekly calibration of the draghead sensors is recommended, as they are sensitive to environmental conditions.
3.4.3 Hopper Dredge Ullage Check
The COR will periodically check the reported hopper dredge ullage using a tape measure or other distance measuring device. Furnish a clearly readable weighted tape, marked in tenths of a foot, capable of measuring throughout the full range of hopper dredge depth. The weight for this tape shall be a 6-inch diameter disk weighing between 2 and 3 pounds. The COR will review the hopper dredge ullage data to insure that the system is operating within acceptable accuracy (0.1 feet), and may direct the Contractor to re-calibrate or repair system components as necessary. This check may be performed separately or as a part of the Water Load Test.
3.4.4 Position Check
During inspection the reported position of the dredge shall be verified by comparison with readings from a handheld GPS receiver. Throughout the Contract, the COR will periodically take readings from an independent GPS to verify locations.
3.4.5 Water Load Test
Water Tests shall consist of pumping the hopper dredge out to its lowest level and then filling it to capacity with water, taking ullage and draft measurements at both levels to determine hopper dredge volume and displacement. The objective of the water test is to validate the dredge's reported displacement and hopper volumes. If the results of the water test indicate that the system is not operating within acceptable accuracy, correct the deficiencies causing the error, and repeat the water test until the results are acceptable.

Provide a handheld refractometer with automatic temperature compensation to measure the hopper dredge water specific gravity during water tests. The refractometer shall be capable of measuring the hopper dredge water specific gravity with a resolution of 0.001 and minimum accuracy of +/- 0.001. Also provide a water-sampling device to retrieve a sufficient volume of water from various depths in the hopper dredge to accurately determine specific gravity with the refractometer, and a sufficient volume of deionized water for calibration of the device.

3.5 CONTRACTOR QUALITY CONTROL

Designate a quality control systems manager (QCSM), who shall develop and maintain daily procedures to ensure quality control (QC) of the DQM system. These methods shall include a procedure by which data being collected is checked against known values, telemetry is verified to be functioning, and the DQM computer is verified to be on and the DQMOBS is running. These procedures shall be outlined in the DPIP and submitted prior to the start of the Contract. In the event a Contractor Quality Control (CQC) Report is required, daily annotations shall be made in the Daily CQC Report documenting the actions taken on each day of work including deficiencies found and corrective actions taken.

3.6 LIST OF ITEMS TO BE PROVIDED BY THE CONTRACTOR

DPIP Paragraph DREDGE PLANT INSTRUMENTATION
PLAN
DQM SYSTEM
Sensor Instrumentation Paragraph REQUIREMENTS FOR REPORTED DATA
DQM Computer Paragraph NATIONAL DQM SYSTEM
REQUIREMENTS
DREDGE DATA
Event documentation Paragraph "Data Reporting"
Dredge Data Backups Paragraph "Contractor Data Backups"
QA EQUIPMENT ON DREDGE
Ullage tape Paragraph "Hopper dredge Ullage Check"
Dragarm depth chain Paragraph "Draghead Depth Check"
Refractometer* Paragraph "Water Load Test"
Water sampling device Paragraph "Water Load Test"
*Measuring in grams/cubic centimeter with a resolution of 0.001 and a minimum accuracy of +/- 0.001 with calibration water

-- End of Section --

10. References

Buchman, 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle WA, Buchman, M.F., Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pages.

Scott et al., 1999. Savannah Harbor O&M Sediment Testing, Sampled December 1998. Submitted to U.S. Army Corps of Engineers, Savannah District, in Response to MIPR W33SJG83416218, by Dr. Dan Bearden and Dr. Geoff Scott, U.S. National Oceanic and Atmospheric Administration National Ocean Service, Mr. J. Edward Buxton, General Engineering Laboratories, Inc., and Dr. Walter J. Sexton, Athena Technologies, Inc., June 1, 1999.

Attachment 1

SAVANNAH HARBOR EXPANSION
ODMDS CAPACITY ANALYSIS
December 2011
Updated March 2012

Two approaches were taken to determine future capacity of the ODMDS (**Figure 1**) after placement of materials from the Savannah Harbor Expansion offshore dredging.

- The first analysis assumed that dredged material would primarily consist of sands (with no bulking factor) and that all deposited material would remain in the ODMDS area after placement.

- The alternative approach was to examine the last period of time when the ODMDS was used consistently and compare the dredged volumes removed from the channel that were placed in the ODMDS with the change in capacity of the ODMDS based on placement surveys over the same time period.

Differences in capacity were determined by using software in Bentley InRoads to determine surface areas and to make volume computations. Actual dredging volumes were obtained from dredging reports maintained in the Savannah District office.

The ODMDS boundary is shown in pink on **Figure 2**. To comply with 40 CFR §227.28 disposal shall occur no less than 330 feet (100 meters) inside the site boundaries. The ODMDS footprint (shown in yellow) for placement of material is 3,242 acres.

Figure 1: Ocean Dredged Material Disposal Site (ODMDS) Location

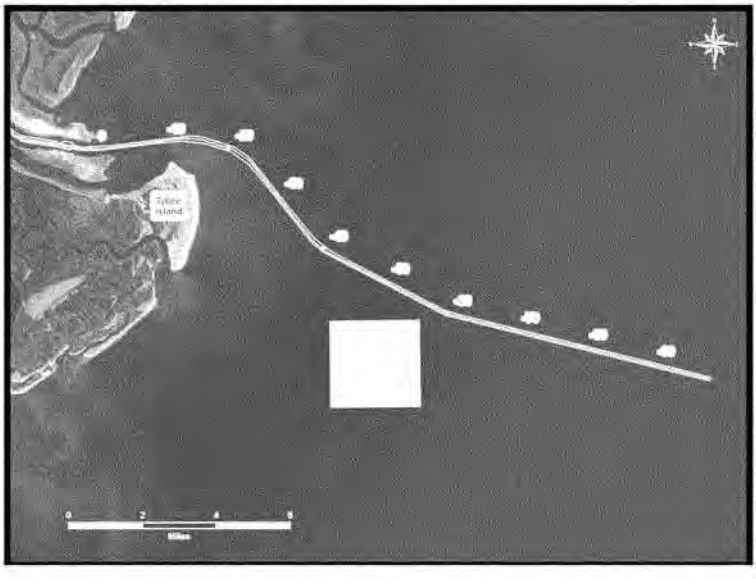


Figure 2: ODMDS Boundary and Bathymetry

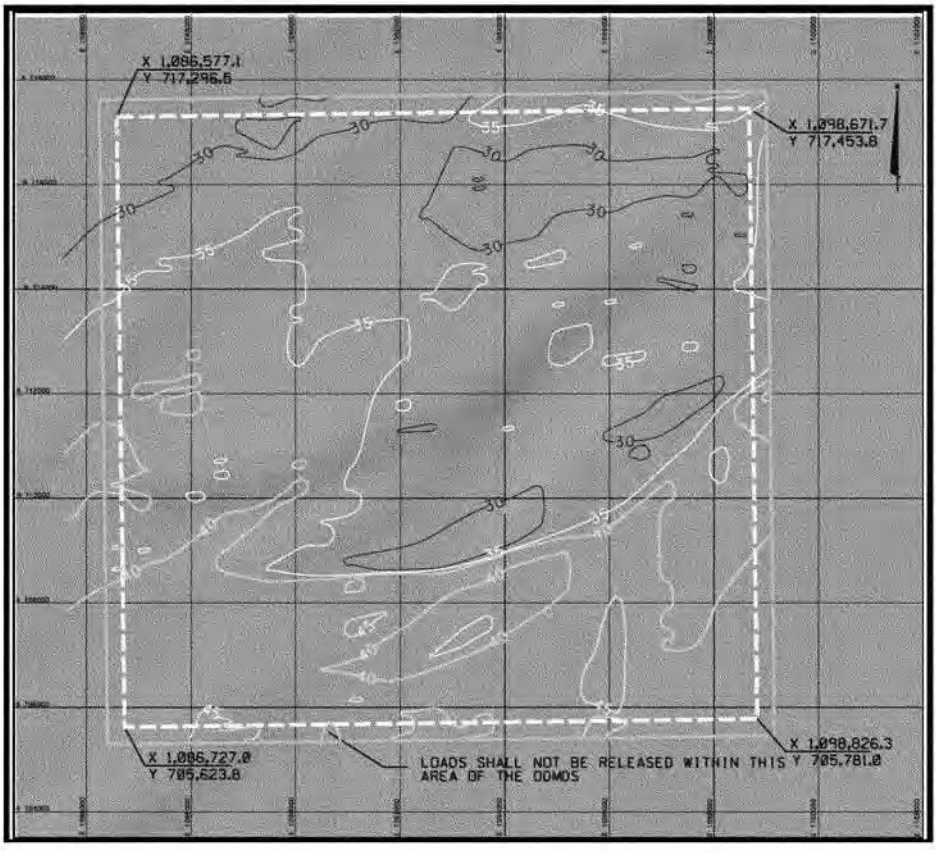


Table 1 shows the quantity of material dredged from the entrance channel from 2002 to 2007 as well as the change in capacity of the ODMDS based on placement surveys made over the same time period. Results show that roughly 93% of the material dredged from the channel remains in the ODMDS after placement, possibly because of the presence of fines in the dredged material that do not settle out or may leave the area before settling or losses during the dredging process.

Table 1: Material Dredged versus ODMDS Change in Capacity

Year	Quantity Dredged (cy)	ODMDS Capacity* (cy)	
2002	186,537	57,836,270	
2003	635,163		
2004	620,642		
2005	888,101		
2007	973,463	54,766,930	
Total Dredged	3,303,906		
Change in Capacity		3,069,340	
		percentage placed	93%

NOTE: *ODMDS capacity is determined from the surface to -25 feet MLLW

Tables 2 and **3** show results of the remaining capacity of the ODMDS for existing conditions and assuming the material placed from the Savannah Harbor Expansion is equivalent to 93% of the material dredged, based on the results from **Table 1**. Results displayed are based on the upper limit for material placement in the ODMDS as 25 feet below MLLW. The sediments would also be placed with a 100-meter (330 foot) setback from the ODMDS border.

Table 2: ODMDS Capacity (Existing Conditions)

ODMDS capacity (2012)	57,087,926 cy
Average Annual O&M Dredge Volume	1,057,721 cy
Years Remaining until Capacity is Exceeded (without deepening)	55

Table 3 on the following page shows the results for all depth alternatives. The capacity/life of the ODMDS would be reduced with a deeper project due to the greater volume of material required to be removed/placed during its initial construction and the increased maintenance since a deeper project requires a longer channel length to reach naturally-deep water in the ocean.

The average annual Operations and Maintenance (O&M) dredged material volumes were calculated based on historical dredging records. The volume of available undredged material that remains after dredging (primarily due to funding constraints) was also considered.

Given the constraints for the Savannah Harbor ODMDS of a surface area of 3,242 acres and upper height limit of 25 feet below MLLW, with materials added from the offshore channel for the 48 foot project depth, the remaining capacity for the ODMDS would last between 40 years. For the 47 foot project, capacity would last between 42 years. Without material from the Savannah Harbor Expansion Project, the capacity would last 55 years to hold annually dredged O&M material.

Table 3: ODMDS Capacity (with project)

	46 ft depth (44 ft project)	47 ft depth (45 ft project)	48 ft depth (46 ft project)	49 ft depth (47 ft project)	50 ft depth (48 ft project)
Percentage of Dredged Material on ODMDS Floor	93%	93%	93%	93%	93%
2014 Capacity (after 2 yrs of existing O&M)	54,972,484	54,972,484	54,972,484	54,972,484	54,972,484
New Work Quantity	4,326,189	6,305,655	8,410,259	10,646,413	12,950,110
2017 Capacity (after new work material)	50,949,128	49,108,225	47,150,943	45,071,320	42,928,881
Average Annual O&M Dredging Volume (after expansion)	1,066,299	1,066,587	1,066,738	1,066,778	1,067,000
O&M Dredging Volume (3 yrs during expansion)	3,198,896	3,199,761	3,200,213	3,200,333	3,201,000
2017 Capacity (after expansion new work and O&M)	47,974,155	46,132,447	44,174,745	42,095,010	39,951,951
Years Remaining until Capacity is Exceeded	48	47	45	42	40

Effects on Existing DMMP

This update was prepared to identify the expected effects of the proposed harbor deepening on the existing DMMP for the Savannah Harbor Navigation Project. If the SHEP is constructed, some events will not occur as expected, even though they have been predicted using the best practices available. Savannah District will conduct a detailed and lengthy post-construction monitoring program to identify how the estuary responds to the harbor deepening.

As part of the post-construction monitoring, the Corps will assess the maintenance patterns and identify if any changes in the shoaling patterns occurred as expected. If those patterns are sufficiently different from what is expected, the District may seek approval for changes to the advance maintenance program to allow it to maintain the harbor more efficiently.

As another part of the post-construction monitoring, the District will assess the volume of sediment storage capacity remaining in the Savannah ODMDS. If the storage capacity is substantially less than the predicted 42 years after deepening, the District would likely begin work to modify the ODMDS to restore a 50-year capacity. Modification of an ODMDS or designation of a new site is a complicated process which can take several years. The District would begin the required physical and biological studies no later than when data indicates the ODMDS will not provide the harbor's sediment disposal needs for the next 20 years.

Savannah District expects to develop a full DMMP that addresses all dredging and sediment placement issues in the harbor (to replace the DMMP developed as part of the 1996 LTMS) after data become available from a reasonable portion of the 10-year post-construction monitoring period.

ENVIRONMENTAL IMPACT STATEMENT
APPENDIX S: Essential Fish Habitat Evaluation

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

US Army Corps
of Engineers
Savannah District
South Atlantic Division

Essential Fish Habitat Evaluation

TABLE OF CONTENTS

TOPIC **PAGE**

1.0 OVERVIEW 1

2.0 POTENTIAL EFFECTS IN ESTUARINE ENVIRONMENTS 4

3.0 IMPACTS ON ESTUARINE EMERGENT WETLANDS 5
- 3.1 Impacts from Excavation of Estuarine Emergent Wetlands 5
- 3.2 Mitigating Excavation of Estuarine Emergent Wetlands 9

4.0 PALUSTRINE EMERGENT WETLANDS 11
- 4.1 Impacts on Palustrine Emergent Wetlands 11
- 4.2 Avoiding and Minimizing Impacts to Palustrine Emergent Wetlands 12
- 4.3 Mitigation for Impacts to Palustrine Emergent Wetlands 28

5.0 ESTUARINE WATER COLUMN 36
- 5.1 Temporary Increase in Turbidity 36
- 5.2 Decrease in Dissolved Oxygen in Water Column 36
- 5.3 Mitigating for Decrease in Dissolved Oxygen in Water Column 48

6.0 POTENTIAL EFFECT IN MARINE AREAS 51

7.0 MARINE AREA WATER COLUMN 52
- 7.1 Temporary Increase in Turbidity 52

8.0 CREATION OF FISH HABITAT 53

9.0 IMPACTS TO LIVE AND HARD BOTTOMS 55

10.0 GEOGRAPHICALLY DEFINED HABITAT AREAS OF PARTICULAR CONCERN 56

11.0 IMPACT SUMMARY FOR ESSENTIAL FISH HABITAT 60

Addendum 1 NMFS Draft Essential Fish Habitat Conservation Recommendations

Addendum 2 Responses to NMFS Draft Essential Fish Habitat Conservation Recommendations

List of Tables

Table 1-1 Essential Fish Habitat Species for the Project Area (GA and SC) 1
Table 1-2 Categories of Essential Fish Habitat and Habitat Areas of Particular Concern in the Project Vicinity and Potential Impacts 3
Table 1-3 Habitat Areas of Particular Concern in the Project Vicinity and Potential Impacts 4
Table 3-1 Summary of Direct Impacts to Wetlands 5
Table 3-2 Revegetation Rate for Created Marsh 10
Table 4-1 Summary of Project-Related Impacts Without Mitigation 12
Table 4-2 Mitigation Options 14
Table 4-3 Mitigation Combinations 14
Table 4-4 Wetland/Marsh Mitigation Evaluation, Average River Flows, 50% Salinity Exceedance, Values 6-Foot Deepening Alternative 15
Table 4-5 Wetland/Marsh Mitigation Evaluation, Average River Flows, 50% Salinity Exceedance Values, 44-Foot Deepening Alternative 25
Table 4-6 45- Foot Deepening Alternative 25
Table 4-7 46- Foot Deepening Alternative 26
Table 4-8 47- Foot Deepening Alternative 26
Table 4-9 48- Foot Deepening Alternative 26
Table 4-10 Cost Effectiveness of Flow-Altering Mitigation Plan for the 48- Foot Deepening Alternative 27
Table 4-11 Cost Effectiveness of the Flow-Altering Mitigation Plan for the 44- Foot Deepening Alternative 27
Table 4-12 Predicted Impacts to Wetlands for Each Depth Alternative 28
Table 4-13 SOP Factors 32
Table 4-14 Preservation Needs as Determined by SOP Calculations for Wetland Impacts 33
Table 4-15 Summary of SOP Calculations 47-Foot Alternative 33
Table 4-16 Proposed Land Acquisition 34
Table 5-1 Average Dissolved Oxygen Levels under Existing Conditions 40
Table 5-2 Lowest D.O. in Each Zone under Existing Conditions 41
Table 5-3 Predicted Dissolved Oxygen Decreases: 48-foot Channel (No Mitigation) 43
Table 5-4 Predicted Dissolved Oxygen. Decreases: 47-foot Channel (No Mitigation) 44
Table 5-5 Predicted Dissolved Oxygen Decreases: 46-foot Channel (No Mitigation) 45
Table 5-6 Predicted Dissolved Oxygen Decreases: 45-foot Channel (No Mitigation) 46
Table 5-7 Predicted Dissolved Oxygen Decreases: 44-foot Channel (No Mitigation) 47
Table 5-8 Dissolved Oxygen System Design Capacities 48
Table 5-9 Mitigation Success for D.O. Injection System Design (%) 51

List of Figures

Figure 3-1 Proposed excavation areas near Kings Island Turning Basin 6
Figure 3-2 Proposed excavation areas near Hutchinson Island 7
Figure 3-3 Proposed excavation areas near the Tidegate 8
Figure 3-4 Restoration area at Disposal Area 1S 11
Figure 4-1 Potential flow-altering mitigation measures 13
Figure 4-2 Plan 3 17
Figure 4-3 Plan 3b 18
Figure 4-4 Plan 3c 19
Figure 4-5 Plan 6 20
Figure 4-6 Plan 6a 21
Figure 4-7 Plan 6b 22
Figure 4-8 Plan 7 23
Figure 4-9 Plan 8 24
Figure 4-10 Potential wetland restoration and creation sites 30
Figure 4-11 Refuge acquisition boundary 35
Figure 5-1 Spatial zones-SHEP dissolved oxygen study 38
Figure 5-2 Modeled locations for dissolved oxygen injection systems 49
Figure 5-3 Site design for proposed dissolved oxygen injection systems 50
Figure 8-1 Location of placement areas as initially proposed 54
Figure 9-1 Proposed channel extension corridor 55
Figure 10-1 Commercial shellfish harvest areas near Savannah Harbor 58

Essential Fish Habitat Evaluation

1.0 Overview. The Fishery Management Plan Amendments of the South Atlantic Fishery Management Council identify over 30 categories of Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC). Those categories and areas are listed in Tables 1-1 and 1-2, and 1-3. While all of these habitat categories occur in waters of the southeastern United States, only a few occur in the immediate project vicinity and/or the project impact zone. Those absent include estuarine scrub/shrub mangroves, which require a more tropical environment, and several areas that are geographically removed from the project area including: Hoyt Hills located in the Blake Plateau area in water 450-600 meters deep. In addition, there are no Council-designated Artificial Reef Special Management Zones, Intertidal Flats, Oyster Reefs & Shell Banks, Aquatic Beds, Creeks, Seagrass Beds, or Submerged Aquatic Vegetation in the potential project impact area, although some of these habitat types may occur in the vicinity of Savannah Harbor, particularly in and around the Savannah River estuary. Impacts on fish resources as a result of the proposed action are discussed in Section 5.3 of the EIS. Impacts on habitat categories that are potentially present in the project vicinity are discussed below.

Table 1-1. Essential Fish Habitat (EFH) Species for the Project Area (Georgia and South Carolina)

Management Plan Agency	Fishery Management Plan (FMP)	COMMON NAME OF SPECIES	SCIENTIFIC NAME OF SPECIES	LIFE STAGES BY ECOSYSTEM		HABITAT AREAS OF PARTICULAR CONCERN
				Marine	/ Estuarine	Identified by SAFMC
SAFMC	Snapper Grouper	Black Sea Bass	*Centropristis striata*			
SAFMC	Coastal Migratory Pelagics	Cobia	*Rachycentron canadum*	ELPJA	LPJA	Snapper Grouper HAPC- oyster shell, inlets, state nursery areas
SAFMC	Snapper Grouper	Crevalle Jack	*Caranx hippos*			
SAFMC	Snapper Grouper	Sheepshead	*Archosargus probatocephalus*			
SAFMC	Shrimp	Brown shrimp	*Farfantepenaeus aztecus*	ELA	PJA	Penaeid Shrimp HAPC – tidal inlets, state nursery and overwintering habitats
SAFMC	Shrimp	White shrimp	*Lytopenaeus setiferus*	LA	PJS	Penaeid Shrimp HAPC – tidal inlets, state nursery and overwintering habitats
SAFMC	Shrimp	Pink shrimp	*Farfantepenaeus duorarum*	LA	PJS	Penaeid Shrimp HAPC – tidal inlets, state nursery and overwintering habitats
SAFMC	Coastal Migratory Pelagics	Spanish mackerel	*Scomberomorous maculatus*	JA	J	
SAFMC	Snapper Grouper	Gray snapper	*Lutjanus griseus*	LA	PJA	
SAFMC	Snapper Grouper	Lane snapper	*Lutjanus synagris*	A	J	

SAFMC	Council Authority (no FMP)	Striped Bass	*Morone saxatilis*	A	ELPJS	
MAFMC	Bluefish	Bluefish	*Pomatomus saltatrix*	LJA	JA	
MAFMC	Summer Flounder	Summer flounder	*Paralichthys dentatus*	LJA	LJA	
NMFS	Highly Migratory Species	Atlantic sharpness shark	*Rhizoprionodon terraenovae*	J		
NMFS	Highly Migratory Species	Blacknose shark	*Carcharhinus acronotus*	J		
NMFS	Highly Migratory Species	Bonnethead shark	*Sphyrna tiburo*	JA		
NMFS	Highly Migratory Species	Bull shark	*Carcharhinus leucas*	J		
NMFS	Highly Migratory Species	Dusky shark	*Carcharhinus obscurus*	J		
NMFS	Highly Migratory Species	Finetooth Shark	*Carcharhinus isodon*	LLPJSA		
NMFS	Highly Migratory Species	Lemon Shark	*Negaprion brevirostris*	J		
NMFS	Highly Migratory Species	Sandbar shark	*Carcharhinus plumbeus*	J		
NMFS	Highly Migratory Species	Sandtiger shark	*Odontaspis taurus*	J		
NMFS	Highly Migratory Species	Scalloped hammerhead	*Sphyrna lewini*	J		
NMFS	Highly Migratory Species	Spinner shark	*Carcharhinus brevipinna*	JA		

Note: **1**. These Essential Fish habitat species were compiled from **Essential Fish Habitat: <u>A Marine Fish Habitat Conservation Mandate for Federal Agencies</u>**: February 1999 (Revised 10/2001) Appendices 2, 3, 6, 7, and 8) and input from NMFS staff. Although 49 species are listed in Appendix 3 under National Marine Fisheries Service management, only 35 of these species have EFH listed in Appendix 8.

2. Organizations responsible for Fishery Management Plans include: SAFMC = South Atlantic Management Council; MAFMC = Mid-Atlantic Fishery Management Council; NMFS = National Marine Fisheries Service.

3. Life stages include: E = Eggs, L = Larvae, P = Post Larvae, J = Juveniles, S = Sub Adults, A = Adults

Table 1-2. Categories of Essential Fish Habitat and Habitat Areas of Particular Concern in the Project Vicinity and Potential Impacts

	Potential Presence		Potential Impacts	
	In/Near Project Vicinity	Project Impact Area	Dredge Plant Operation	Sediment Placement Activities
Estuarine Areas				
Estuarine Emergent Wetlands (Loss through direct impact)	Yes	Yes	Moderate	No
Estuarine Emergent Wetlands (impact through salinity changes only)*	Yes	Yes	Significant	No
Estuarine Scrub/Shrub Mangroves	No	No	No	No
Submerged Aquatic Vegetation (SAV)	No	No	No	No
Oyster Reefs & Shell Banks	Yes	No	No	No
Intertidal Flats	Yes	No	No	No
Palustrine Emergent & Forested Wetlands (Impact through salinity changes only)*	Yes	Yes	Yes	No
Aquatic Beds	No	No	No	No
Estuarine Water Column	Yes	Yes	Minor and Temporary	Minor and Temporary
Marine Areas				
Inlet	Yes	Yes	No	No
Live/Hard Bottoms	Nearshore	Yes	No	Possible
Coral & Coral reefs	Offshore	No	No	No
Artificial/Manmade Reefs	Offshore	No	No	No
Sargassum	Offshore	No	No	No
Water Column	Yes	Yes	Temporary	Temporary

** Potential Long term Water Quality impacts of the proposed deepening on estuarine emergent, palustrine emergent, and forested wetlands in the Savannah River estuary are discussed below in item #3 and in the Mitigation Plan found in Appendix C.

Table 1-3. Habitat Areas of Particular Concern in the Project Vicinity and Potential Impacts

	Potential Presence		Potential Impacts	
	In/Near Project Vicinity	Project Impact Area	Dredge Plant Operation	Sediment Placement Activities
Area Wide				
Council-designated Artificial Reef Special Mgt Zones	Yes	No	No	No
Hermatypic (reef-forming) Coral Habitat & Reefs	Offshore	No	No	No
Hard Bottoms	Nearshore Ocean	No	No	No
Sargassum Habit	Offshore	No	No	No
State –designated Areas of Importance of Managed Species (PNAa)	Yes	No	No	No
Submerged Aquatic Vegetation (SAV)	No	No	No	No
Georgia				
Gray's Reef	Offshore	No	No	No
South Carolina				
None	N/A	N/A	N/A	N/A

NOTE: Essential Fish Habitat areas are identified in Fishery Management Plan Amendments for the South Atlantic and Mid-Atlantic Fishery Management Councils. Habitat Areas of Particular Concern are identified in Fishery Management Plan Amendments affecting the South Atlantic Area. Areas listed in this table were derived from Essential Fish Habitat: A Marine Fish Habitat Conservation Mandate for Federal Agencies February 1999 (Revised 10/2001) (Appendices 4 and 5).

2.0 Potential Effects in Estuarine Areas. The Corps evaluated the project with respect to the estuarine areas identified as essential fish habitat (Table 1-2). The Corps concluded that the project would not affect estuarine scrub/shrub mangroves, submerged aquatic vegetation or aquatic beds because none are located in or near the project area. Although oyster reefs, shell banks, and intertidal flats are found in the project vicinity, none are found in the project impact area since most of the deepening is to occur within the existing channel prism. Shallow areas to be deepened as part of the flow re-routing plan (McCoys Cut and upper portions of Middle and Little Back Rivers) will remain subtidal. As such, no impacts to existing oyster reefs, shellbanks, or intertidal flats are expected in these areas. The following subsections of Section 3- 5 provide an analysis of impacts that would result to essential fish habitat in estuarine areas and the mitigation that would be provided to compensate for those impacts.

3.0 Impacts on Estuarine Emergent Wetlands

NOAA defines estuarine emergent wetlands as initially determined by Cowardin *et al.* (1979) and considered to be the Federally-accepted standard: "*Deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the ocean, with ocean-derived water at least occasionally diluted by freshwater runoff from the land. The upstream and landward limit is where ocean-derived salts measure less than .5 ppt during the period of average annual low flow. The seaward limit is (1) an imaginary line closing the mouth of a river, bay, or sound; and (2) the seaward limit of wetland emergents, shrubs, or trees when not included in (1).*" These wetlands would be considered brackish and saltmarsh areas.

3.1 Impacts from Excavation of Estuarine Emergent Wetlands

There would be direct adverse impacts to wetlands from dredging along the shoreline of the navigation channel. Six locations would be impacted in this way. Four areas are located on the west side of Hutchinson Island, in Georgia waters. One is located on the east side of Hutchinson Island (Tidegate abutment in Georgia). The sixth site is located along a portion of the Tidegate abutment in South Carolina. Two of the locations (the first two in the Table 3-1 below) are within the Savannah National Wildlife Refuge (Figure 3-1). Figure 3-2 and 3-3 illustrate the locations of impacts occurring at the other sites. The extent of the impacts would not differ substantially between channel depth alternatives and is summarized as follows (Table 3-1):

Table 3-1. Summary of Direct Impacts to Wetlands

Location (Channel Station)	Affected State	Wetland Acres Affected by Excavation
Refuge Lands		
102+600	Georgia	2.2
Kings Island Turning Basin	Georgia	0.8
Non-Refuge Lands		
88+000	Georgia	3.4
70+000	Georgia	0.8
Tidegate	Georgia	7.63
Tidegate	South Carolina	0.85
	Total	**15.68 acres**

The Corps would mitigate for the direct impacts to these wetlands.

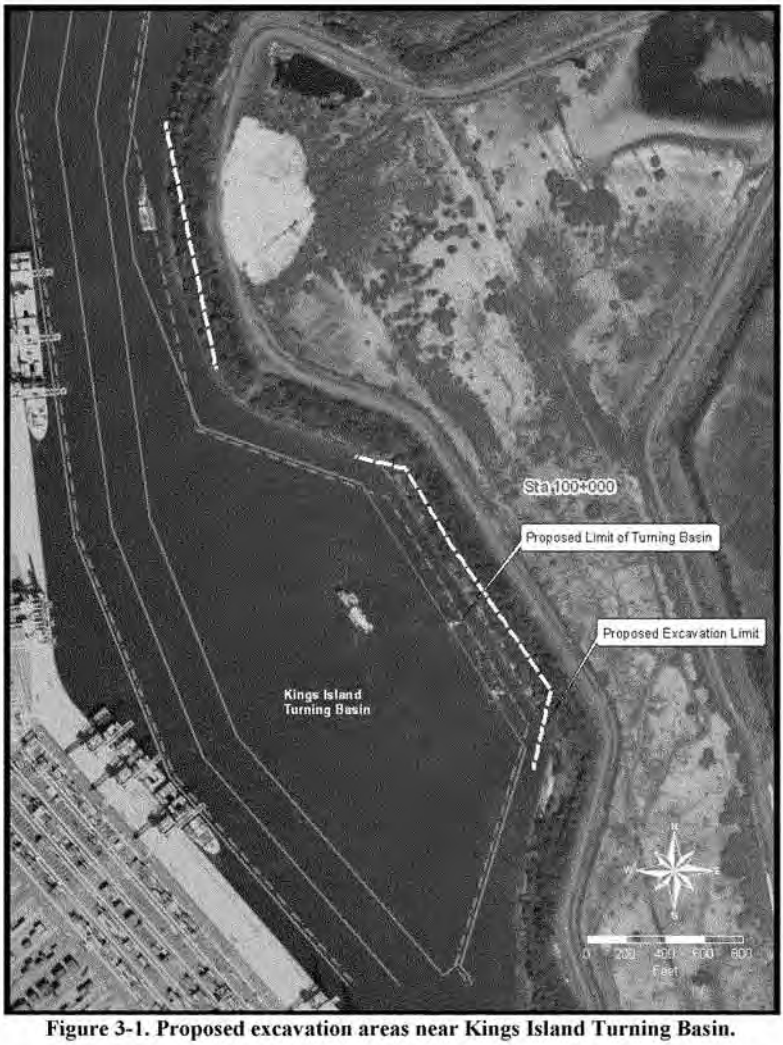


Figure 3-1. Proposed excavation areas near Kings Island Turning Basin.

Figure 3-2. Proposed excavation areas near Hutchinson Island.

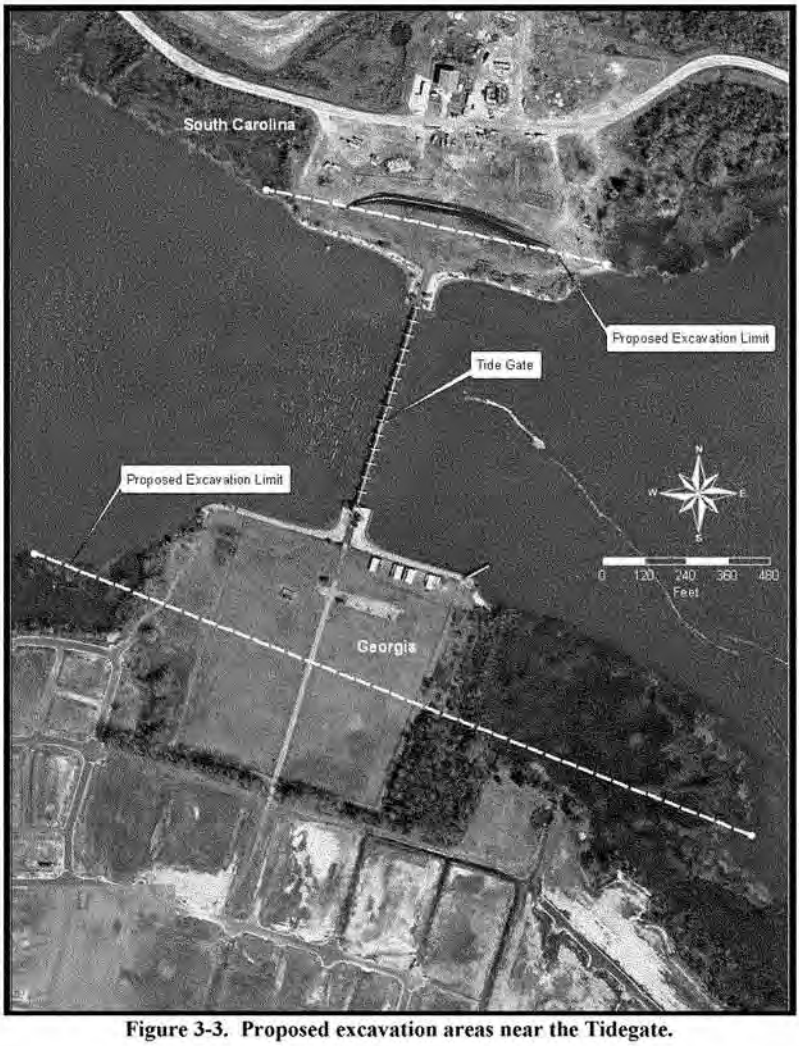


Figure 3-3. Proposed excavation areas near the Tidegate.

3.2 Mitigating Excavation of Estuarine Emergent Wetlands

Coordination with the natural resource agencies resulted in a request for "in kind/in basin" mitigation for direct impacts to salt and brackish marsh. The proposed harbor deepening would result in the excavation of approximately 15.68 acres of brackish marsh, and the resource agencies did not consider preservation of land adjacent to the Savannah National Wildlife Refuge to be appropriate mitigation for that impact. USEPA recommended use of a salt marsh mitigation bank, the preferred choice of mitigation as specified in the USEPA/USACE Final Compensatory Mitigation Rule, published in the Federal Register on March 31, 2008. However, there are currently no salt marsh mitigation banks serving coastal Georgia (One salt marsh mitigation was approved by the Interagency Review Team (IRT) in 2007, but the owner declared bankruptcy before the bank was operational). Thus, the USACE was obligated to explore other mitigation opportunities. The USACE evaluated several sites within coastal Georgia, but the resource agencies subsequently indicated a preference for mitigation of these impacts within the Lower Savannah River Basin. Ultimately, a previously-used sediment placement area (Disposal Area 1S) within Savannah Harbor was identified as having the greatest opportunity to support the long term success of a restored brackish marsh system. Disposal Area 1S is located at the confluence of Front River and Middle River, and it is located within the boundaries of the Savannah National Wildlife Refuge. Much of the site is currently "high ground" as a result of the previous sediment disposal actions, which were terminated at least 20 years ago. The proposed restoration area is approximately 42.0 acres as shown in Figure 3-4. A small portion of the site was graded down by GPA several years ago as mitigation for work at their facilities. The Corps would expand the restoration acreage to include GPA's existing brackish marsh acreage (1.7 acres). The USACE used the Regulatory SOP to determine the number of acres that would be required to restore to adequately compensate for the direct excavation impacts (See Appendix A at the end of this Mitigation Plan). The 15.68 acres of impact to brackish marsh equates to approximately 138.0 mitigation credits. Calculations derived from the SOP indicate that approximately 28.8 acres of restored brackish marsh would be required to mitigate for the 15.68 acres of impact. The Corps intends to restore approximately 40.3 acres of brackish marsh at Disposal Area 1S. The roughly 11.5 acres of excess restored brackish marsh would be used as mitigation for any other SHEP requirements and for approved projects in the Savannah Harbor Navigation Project Operations and Maintenance Program.

Restoration of the Disposal Area 1S site would occur by grading it down to an elevation that would allow the growth of Spartina (i.e., +7.6 to +7.8 MLLW) (Figure 3-4). The Corps selected that elevation range after inspection and surveying the elevations of natural marsh that is immediately adjacent to the proposed restoration site. Once the new elevations have been established, the approximately 42-acre site would be allowed to naturally vegetate. The Corps would let the site naturally revegetate, which is expected at a rate illustrated in the following table:

Table 3-2. Revegetation Rate for Created Marsh

Time Period	Percent Vegetative Cover
Construction	0
Year 1	15
Year 2	25
Year 3	40
Year 4	60
Year 5	80
Year 6	85
Year 7	90

A reference marsh site would be established in the vicinity of the restoration site so that the marsh growth in Disposal Area 1S could be compared to that area. If the site does not revegetate at the following rates, the Corps would plant Spartina to provide the basis for subsequent growth across the entire site.

The USFWS requested a "feeder" creek system be constructed toward the interior of the restored marsh. The creek would provide another mechanism of ensuring adequate exchange of brackish, surface water with pore waters that are located on the interior of the site.

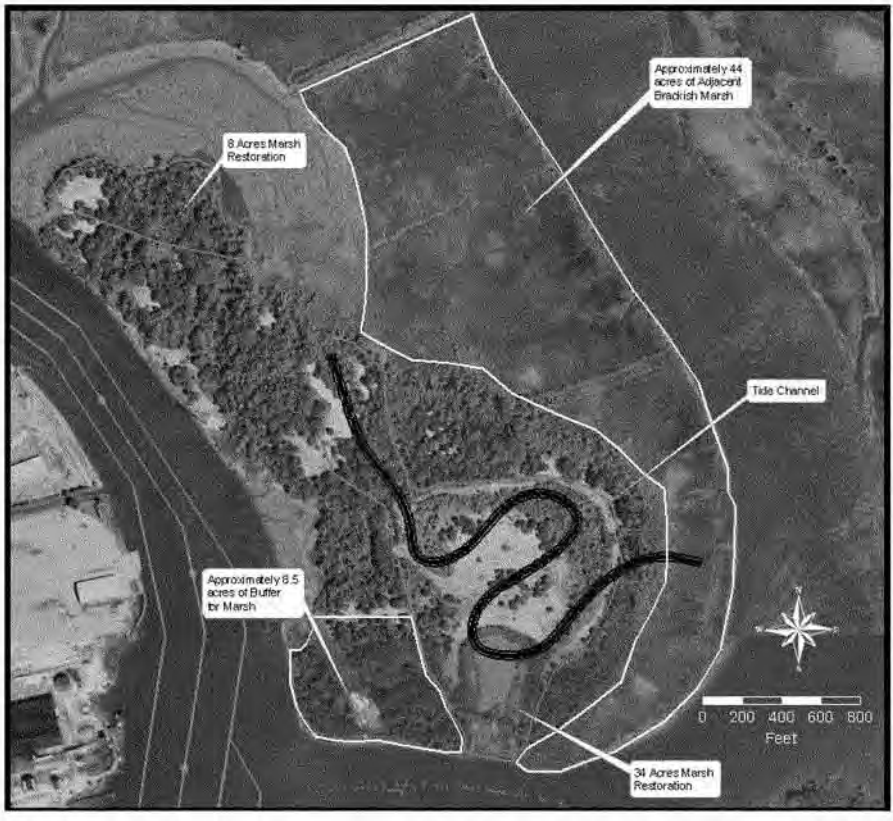


Figure 3-4. Restoration area at Disposal Area 1S.

4.0 Palustrine Emergent Wetlands

Palustrine emergent wetlands are *"All nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and all such tidal wetlands where ocean-derived salinities are below .5 ppt."* These wetlands would be considered tidal freshwater wetlands (Cowardin et al., 1979).

4.1 Impacts on Palustrine Emergent Wetlands

Deepening the Federal navigation channel in the Savannah River will increase salinity further upstream and would adversely impact tidal freshwater marsh (0.0 to 0.5 ppt Salinity) within the Savannah National Wildlife Refuge. The Corps used the

hydrodynamic and water quality models to evaluate measures that could be used to reduce project-induced impacts. Since tidal freshwater marshes were identified by the USFWS as the single most critical natural resource in the harbor, the Corps focused on reducing project impacts to that resource. The other natural resource agencies concurred with this priority. Salinity is the primary determining factor in the conversion of tidal freshwater marshes, so that parameter was identified as the focus of the mitigation modeling efforts. The baseline amount of tidal freshwater wetlands within the project area is about 4,072 acres within the project area. The table below summarizes the impacts of the depth alternatives **with no mitigation** (Table 4-1).

Table 4-1. Summary of Project-Related Impacts Without Mitigation

	---------- DEPTH ALTERNATIVES ----------				
	44-Foot	**45-Foot**	**46-Foot**	**47-Foot**	**48-Foot**
Salinity	Move further into estuary	Same effect, but greater amount	Same effect, but greater amount	Same effect, but greater amount	Same effect, but greater amount
Freshwater Wetlands	-551 acres	-967 acres	-1,057 acres	-1,177 acres	-1,212 acres
Brackish Marsh (Loss)	- 7.2 acres	Same	Same	Same	Same

4.2 Avoiding and Minimizing Impacts to Palustrine Emergent Wetlands

The Corps used the hydrodynamic and water quality models to evaluate measures that could be used to reduce project-induced impacts. Salinity is the primary determining factor in the conversion of tidal freshwater marshes, so that parameter was identified as the focus of the mitigation modeling efforts. The intent was to identify alterations that could be made in rivers and tidal creeks to reduce salinity levels in critical areas of the estuary. If such measures could be identified, those alterations would be expected to provide long term sustainable beneficial effects. The vertical extent of the tide (tidal range) is also important in determining the vitality of a tidal marsh system. This parameter became important during evaluation of some potential mitigation measures.

The Corps evaluated numerous potential alterations to water flow in the estuary, and modeled a total of 38 alterations at 7 locations. Those locations are shown in Figure 4-1.

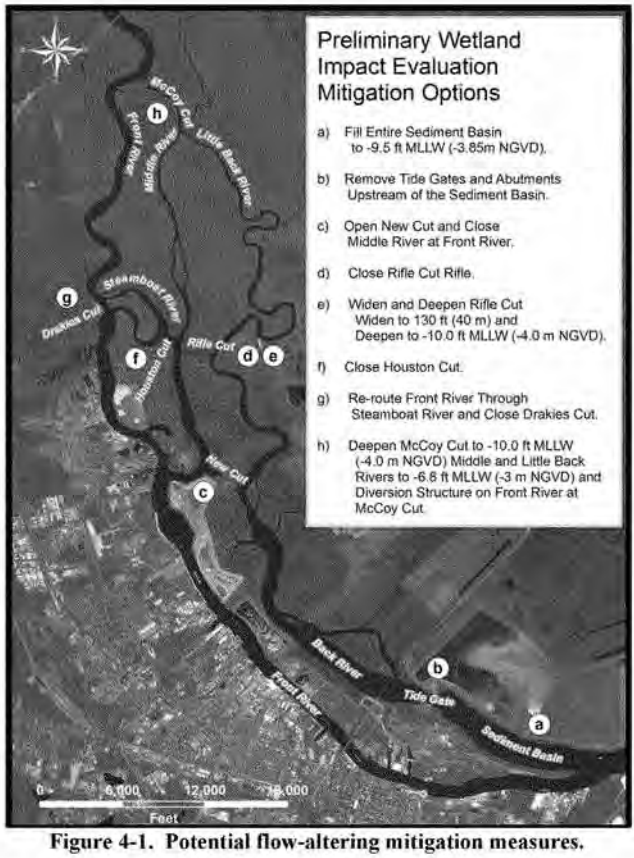


Figure 4-1. Potential flow-altering mitigation measures.

Natural resource agencies reviewed initial modeling results in July 2006 and the interagency team jointly identified alterations to pursue further. After some additional modeling work was performed, the Corps determined what design/size would be most effective at each location. That determination was based on the extent to which salinity would be decreased coupled with reductions in adverse effects which may appear in other portions of the estuary.

Based on the effectiveness observed in the initial modeling and preliminary estimates of construction cost, the Corps ranked the 5 best measures in the order of decreasing cost effectiveness, as shown below in Table 4-2.

Table 4-2. Mitigation Options

MITIGATION OPTION	COMPONENT ADDED
C	Deepen McCoys Cut
D	Fill Sediment Basin
A	Close Middle River, Open New Cut, Close Houston Cut
E	Remove Tidegate
B	Reroute flow through Steamboat River

The Corps followed an incremental approach to evaluate how these measures could be combined. Since some measures result in similar effects, the order in which they are combined was found to be important. As a result of additional modeling performed after the interagency meeting and considering potential implementation difficulties, the Corps developed the dual approach shown below in Table 4-3. The dual approach primarily resulted from uncertainties about the potential adverse effects of both (1) the filling the Sediment Basin on harbor maintenance activities, and (2) relocating the downstream end of Middle River in Mitigation Option A. After additional modeling was performed, a decision would be made whether the path with Plans 1-2-3 or Plans 1-4-5 was more effective. After making that determination, the Corps would then evaluate two other Mitigation Options, removing the Tidegate (Option E) and rerouting flow through Steamboat River (Option B). The natural resource agencies concurred in this approach in August 2006.

Table 4-3. Mitigation Combinations

MITIGATION PLAN	MITIGATION COMBINATION	COMPONENT ADDED
1	C	McCoys Cut
2	C + D	Sediment Basin
3	C + D + F	Rifle Cut
1	C	McCoys Cut
4	C + A	Middle River, New Cut, Houston Cut
5	C + A + D	Sediment Basin
6	3 or 5 + E	Tidegate
7	3 or 5 + B	Steamboat River

With the various channel depths considered, over 160 modeling runs were required to evaluate the effects of each mitigation plan. The modeling was conducted for each of the five depth alternatives. The results of the modeling are summarized in the following table prepared for the 6-foot deepening alternative.

Table 4-4. Wetland/Marsh Mitigation Evaluation
Average River Flows
50% Salinity Exceedance Values

6-Foot Deepening Alternative

	Marsh Acreage	Net Acres Adversely Impacted
Existing Conditions	4,072	------
Deepening Only (No Mitigation)		1,932
Plan 1		988
Plan 2		988
Plan 3		834
Plan 4		1,334
Plan 5		325

Similar information was developed for the three alternative scenarios, which were considered as sensitivity analyses. One scenario used 2001 drought flows, rather than the average river flows. Two other scenarios included different amounts of sea level rise (25 or 50 cm) over the 50-year life of the project. The adverse impacts to freshwater wetlands were the same or less in two of the three sensitivity analyses. That trend did not hold up when the 50-cm of sea level rise was considered. Under that scenario, the flow re-routing plans would not be as effective in reducing adverse impacts to freshwater wetlands. Some of those wetlands would have already been converted to brackish marshes as a result of the saltwater intrusion from the sea level rise, even without further harbor deepening. In general, the table above shows the largest amount of adverse impacts to tidal freshwater wetlands of the four scenarios that were considered.

The Corps discussed the results of this modeling at an interagency meeting in June 2007. Several agreements were reached at the meeting, including the following:

- 50%-tile exceedance value was identified as the best single characterization of modeled salinity for any given point across the range of river stations and river flows.
- Average river flows would be used for the basic impact evaluation since that flow better represents the entire range of flows.
- Existing sea level would be used for the basic impact evaluation since it best represents what occurs near the time of construction.
- The path with Mitigation Plans 1-4-5 appears to be unacceptable because it substantially reduces the height of the tide range in critical areas of the estuary.

- Mitigation Plan 3 would be used as a base for analysis of Plans 6 and 7.
- All tidal freshwater marshes within the estuary possess the same ecological value.
- The mitigation plan for the direct marsh impacts should evaluate the feasibility of grading down a high ground site to produce tidal freshwater wetlands.
- An oxygen injection system would likely remove the impacts identified to American shad and likely result in net improvements in habitat volume.
- An oxygen injection system would likely remove the impacts identified to Southern flounder and likely result in net improvements in habitat volume.
- Average river flows (50%-tile) were identified as appropriate for identifying project impacts to Striped bass.
- Further increases in flow would not likely be effective at increasing Striped bass habitat, since even flows at the 80% cumulative frequency level do not reduce the adverse effects of a harbor deepening.
- Training walls would not likely be equally effective each year at increasing Striped bass habitat because the spawning location likely shifts with river flows, rendering the structures ineffective during some flow conditions.
- Closing the lower arm of McCoys Cut as a means of increasing Striped bass habitat should be examined.
- Including a flow partitioning structure at the junction of Little Back and Middle Rivers as a potential adaptive management tool to increase Striped bass habitat should be evaluated.

The Corps then conducted additional modeling of the flow-altering components of the mitigation plans. The Corps modelers developed additional plans to try and identify a plan that would be more effective in reducing wetland impacts. They developed the following variations to existing plans – Plans 3A, 3B, 3C, 6A, and 6B. While not a complete listing, Figures 4-2 to 4-10 show examples of how the flow-altering measures were combined into plans for analysis.

In September and October 2007 results became available on the effectiveness of the flow-altering features in reducing impacts to wetlands in the project area. The agencies suggested a slightly different methodology to graphically quantify impacts to the wetlands. The Corps used that alternate approach for the remainder of the study, so the numerical results of this iteration are not directly comparable with the initial impact quantification. The results for the second modeling iteration are shown after Figure 4-10.

After coordination of these modeling results, the USFWS proposed an additional plan, which was designated as Plan 8. That plan is shown in Figure 4-10. Initial modeling found that this plan would not be particularly effective at mitigating impacts to freshwater wetlands. It would result in a lower tidal range in the upper portion of Middle River, which would likely adversely affect wetlands located there. Therefore, this plan was not considered further.

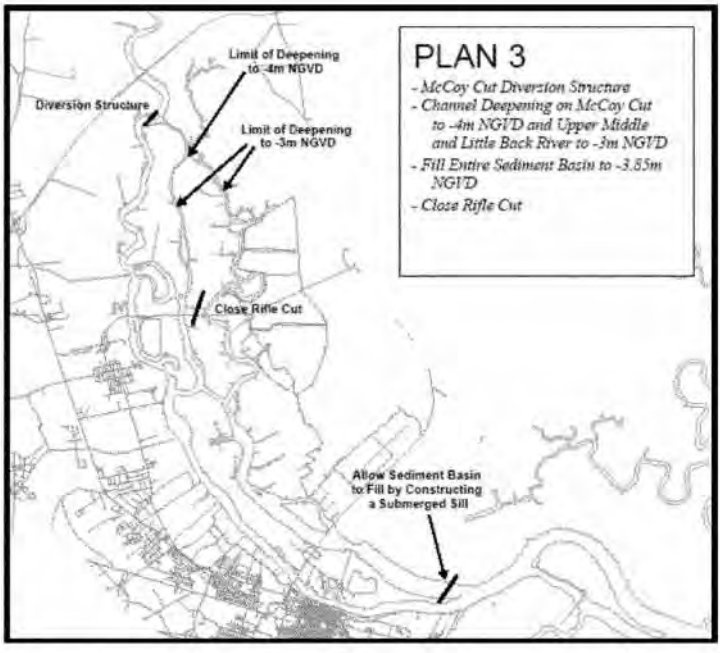


Figure 4-2. Plan 3.

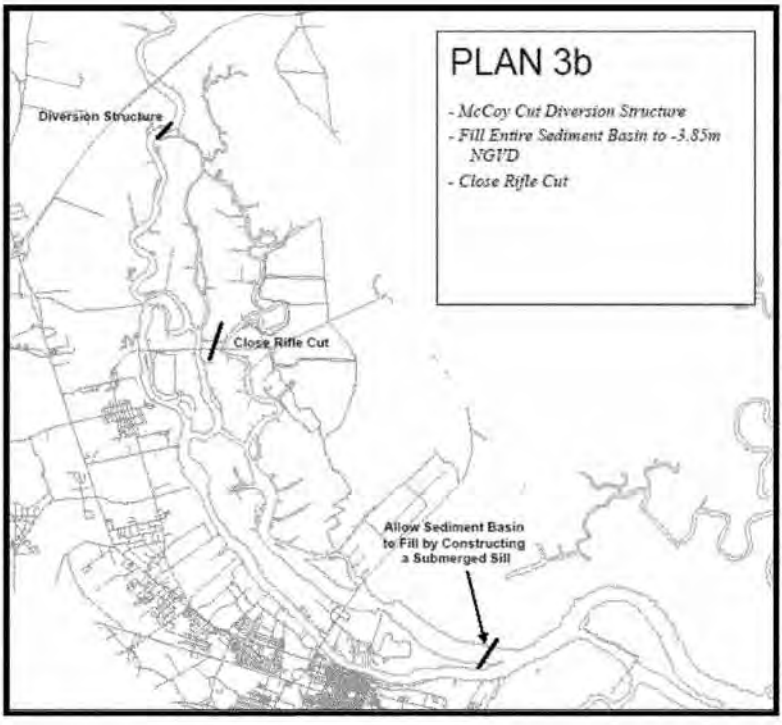


Figure 4-3. Plan 3b.

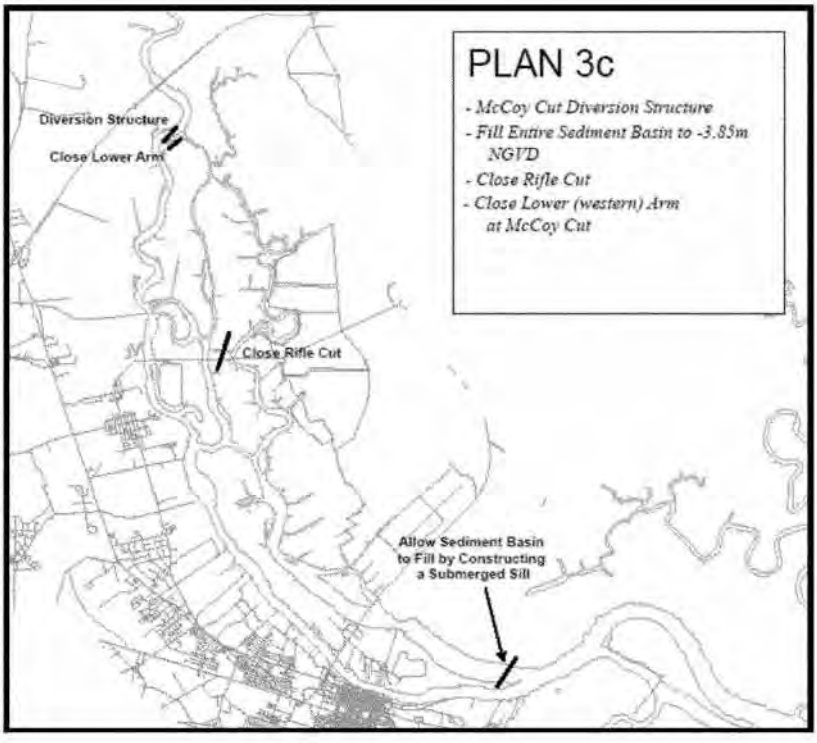


Figure 4-4. Plan 3c.

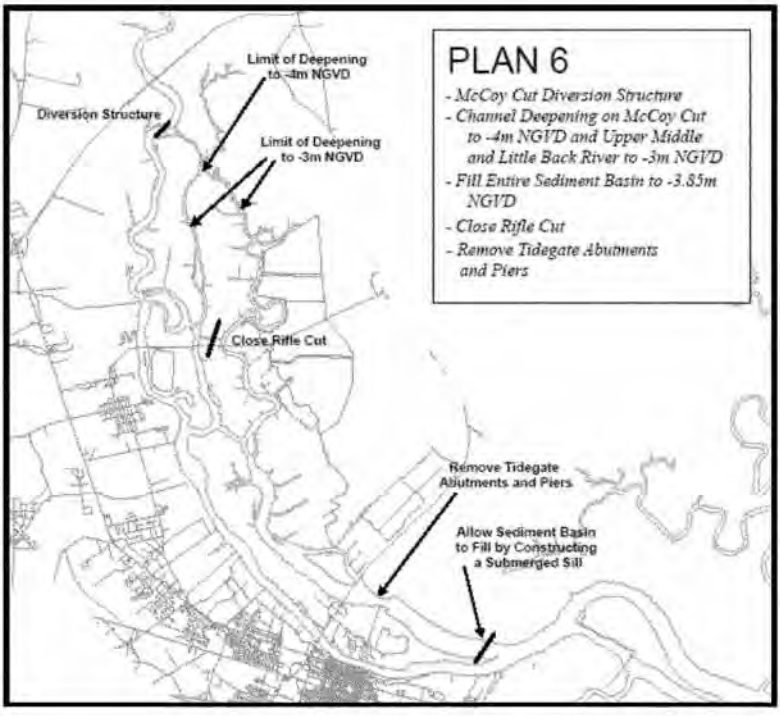


Figure 4-5. Plan 6.

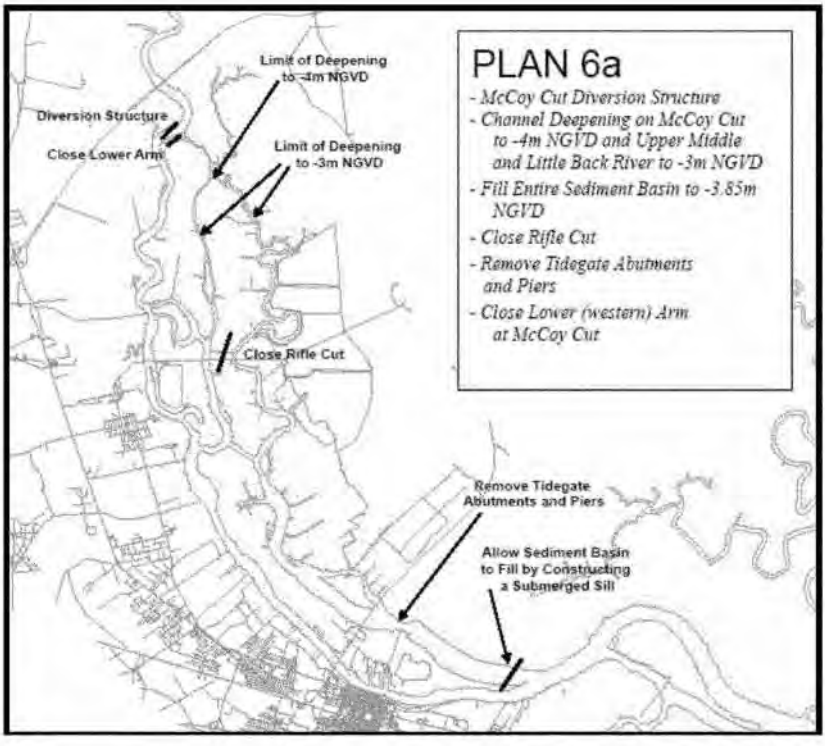


Figure 4-6. Plan 6a.

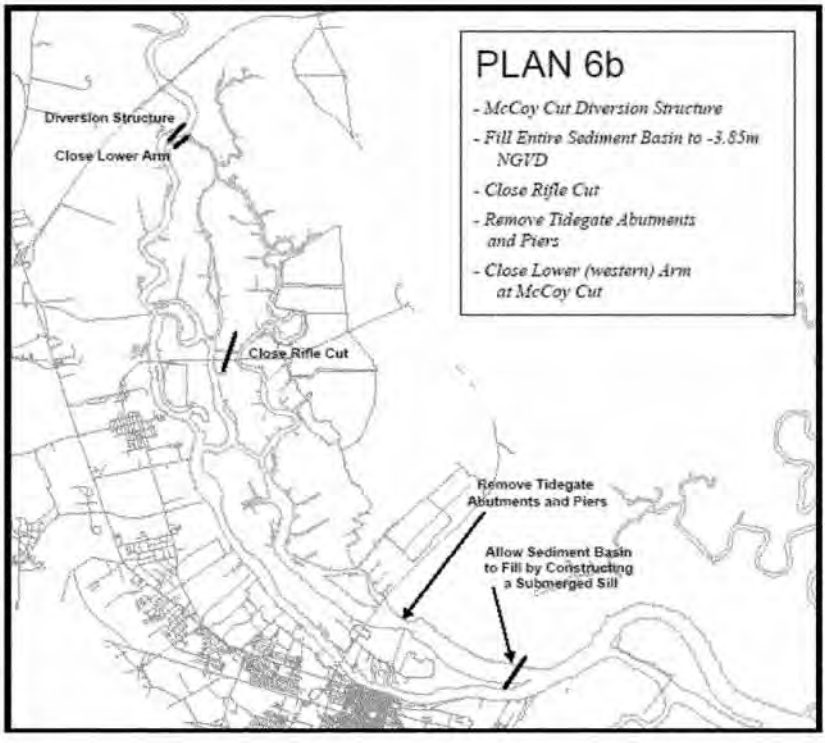


Figure 4-7. Plan 6b.

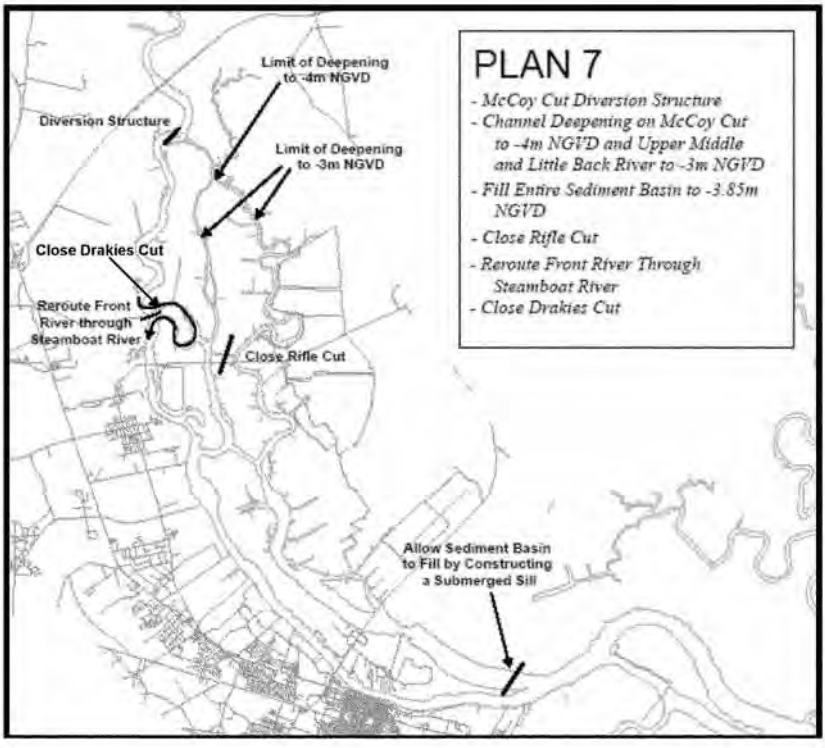


Figure 4-8. Plan 7

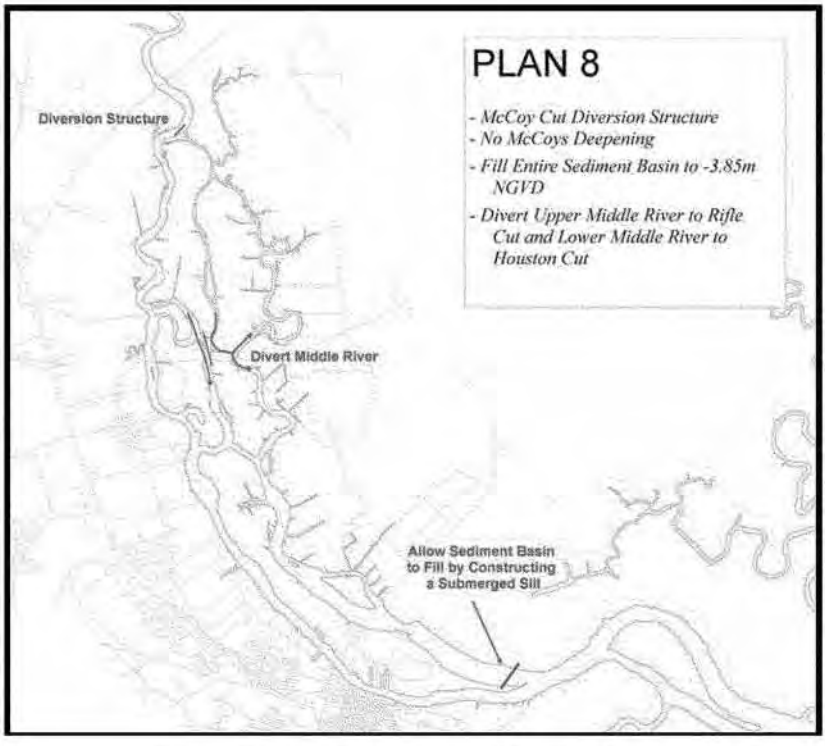


Figure 4-9. Plan 8 SHEP Project Mitigation Plans.

The effectiveness of these plans at reducing adverse impacts from the harbor deepening alternatives to freshwater marshes (<0.5 ppt) is displayed in the following table.

Table 4-5. Wetland/Marsh Mitigation Evaluation
Average River Flows
50% Salinity Exceedance Values

44-Foot Deepening Alternative

	Marsh Acreage	Net Acres Adversely Impacted
Existing Conditions	4,072	------
Deepening Only (No Mitigation)	3,521	551
Plan 3	4,093	-21
Plan 3A	3,973	99
Plan 3B	3,821	251
Plan 3C	3,872	200
Plan 6	4,792	-720
Plan 6A	4,844	-772
Plan 6B	4,394	-322

NOTE: Negative adverse impact numbers means that the plan would result in positive effects of freshwater marshes.

Table 4-6. 45-Foot Deepening Alternative

	Marsh Acreage	Net Acres Adversely Impacted
Existing Conditions	4,072	------
Deepening Only (No Mitigation)	3,105	967
Plan 3	3,718	354
Plan 3A	3,798	274
Plan 3B	3,572	500
Plan 3C	3,626	446
Plan 6	4,038	34
Plan 6A	4,040	32
Plan 6B	3,865	207

Table 4-7. 46- Foot Deepening Alternative

	Marsh Acreage	Net Acres Adversely Impacted
Existing Conditions	4,072	------
Deepening Only (No Mitigation)	3,015	1,057
Plan 3	3,753	319
Plan 3A	3,840	232
Plan 3B	3,521	551
Plan 3C	3,599	473
Plan 6	3,817	255
Plan 6A	3,871	201
Plan 6B	3,610	462
Plan 7	4,285	-213

Table 4-8. 47- Foot Deepening Alternative

	Marsh Acreage	Net Acres Adversely Impacted
Existing Conditions	4,072	------
Deepening Only (No Mitigation)	2,895	1,177
Plan 6A	3,849	223

Table 4-9. 48- Foot Deepening Alternative

	Marsh Acreage	Net Acres Adversely Impacted
Existing Conditions	4,072	------
Deepening Only (No Mitigation)	2,860	1,212
Plan 3	3,584	488
Plan 3A	3,531	541
Plan 3B	3,406	666
Plan 3C	3,383	689
Plan 6	3,715	357
Plan 6A	3,735	337
Plan 6B	3,610	462
Plan 7	3,772	300

In addition to the effectiveness of a measure in reducing project impacts, the Corps must also consider the cost of the measure. Preliminary cost estimates had been developed for each of the flow-altering measures. Those costs were combined to estimate the cost of the entire flow-altering plan. Information on the cost effectiveness of those plans for the 6-foot depth and 2-foot depth alternatives is as follows:

Table 4-10. Cost Effectiveness of Flow-Altering Mitigation Plan for the 48- Foot Deepening Alternative

	Net Acres Adversely Impacted	Acres Mitigated	Preliminary Construction Cost (1,000s)	Cost/Acre Mitigated
Plan 3	488	724	$50,500	$70,000
Plan 3A	541	671	$51,700	$77,000
Plan 3B	666	546	$30,400	$56,000
Plan 3C	689	523	$32,600	$62,000
Plan 6	357	855	$51,600	$60,000
Plan 6A	337	875	$52,900	$60,000
Plan 6B	462	750	$32,800	$44,000
Plan 7	300	912	$196,400	$215,000

Table 4-11. Cost Effectiveness of Flow-Altering Mitigation Plan for the 44-Foot Deepening Alternative

	Net Acres Adversely Impacted	Acres Mitigated	Preliminary Construction Cost (1,000s)	Cost/Acre Mitigated
Plan 3	-21	597	$50,500	$85,000
Plan 3A	99	478	$51,700	$108,000
Plan 3B	251	325	$30,400	$94,000
Plan 3C	200	376	$32,600	$84,000
Plan 6	-720	1,296	$51,600	$40,000
Plan 6A	-772	1,348	$52,900	$39,000
Plan 6B	-322	898	$32,800	$37,000
Plan 7		576 *	$196,400	$341,000

NOTE: The acres mitigated by Plan 7 were assumed to be 100% of the impacted acreage.

Plan 7 (Re-routing flows through Steamboat River) was not evaluated using the hydrodynamic model with all depth alternatives. For comparison purposes in the 2- and 3-foot deepening alternatives, the acres mitigated by Plan 7 were assumed to be 100% of the impacted acreage. Actual values would be less than the assumed value, so the cost per acre would be greater than shown in the table and its cost effectiveness would be lower.

Although Plan 7 may have other possible ecological benefits, this information indicates that it would be quite expensive. The Corps expects the remaining impacts to other resources could be mitigated at a lower total cost than what would occur with Plan 7. Therefore, this plan was deemed as not being cost-effective and was dropped from further consideration.

Using this information and taking the impact acreage into account, the Corps determined that Plan 6A is the most cost-effective flow-altering component for the 45-, 46-, 47- and 48-foot depth alternatives, while Plan 6B is better for the 44-foot depth alternative.

The Corps then proceeded with the mitigation planning using those flow-altering components as the basis of an overall mitigation plan for each of the channel depth alternatives.

The table below summarizes the impacts of the depth alternatives after avoiding, minimization, and mitigating project impacts (Table 4-12).

Table 4-12. Predicted Impacts to Wetlands for Each Depth Alternative

		DEPTH ALTERNATIVES				
		44-Foot	**45-Foot**	**46-Foot**	**47-Foot**	**48-Foot**
Salinity	Type of Impact	Move further into estuary up Front River	Same effect, but greater amount	Same effect, but greater amount	Same effect, But greater Amount	Same effect, but greater amount
Freshwater Wetlands	Conversion	+ 322 acres	- 32 acres	- 201 acres	- 223 acres	- 337 acres
Brackish Marsh	Conversion	+ 488 acres	+ 861 acres	+ 959 acres	+ 964 acres	+1068 acres
Salt Marsh	Conversion	- 808 acres	- 828 acres	- 757 acres	- 740 acres	- 730 acres
Brackish Marsh	Loss	-15.68 acres	Same	Same	Same	Same

4.3 Mitigation for Impacts to Palustrine Emergent Wetlands

Once the extent of the impacts to wetlands was known and those impacts reduced as much as possible through flow alteration, the Corps consulted natural resource agencies, the Stakeholders Evaluation Group, and other NGOs in an attempt to identify sites where freshwater wetlands could be restored, enhanced or created.

Three sites were initially identified and inspected by the Corps (Figure 18). These sites are within the Savannah estuary and near the impact area. The site labeled Tract A is a

borrow site that was used during construction of US Interstate 95. Soils were re-deposited at the site in the 1970s, and it has since revegetated. Although freshwater marshes no longer occur on the property, an inspection revealed the mixed site contains a considerable amount of wetland vegetation. Thus, a substantial increase in wetland functional values would not be obtained if the site was restored to a tidal freshwater marsh. Therefore, the site was deleted from further consideration.

The site labeled as Tract B consists of forested lands along the SC boundary of the Savannah National Wildlife Refuge (SNWR). The Corps initially identified this as a potential site where tidal freshwater marsh could be created. The property is situated in the estuary where freshwater occurs both now and after a potential deepening project. The site is adjacent to existing freshwater marshes, and tidal creeks could be extended to provide the water necessary to flood the lands. The Corps developed preliminary designs to excavate the site to marsh elevation, move those soils to an adjacent property, and enlarge a creek to bring tidal flows to the site. Roughly 1,000 acres of freshwater wetlands could be created if lands exceeding a 10-foot MSL elevation were graded down to a 0 MSL elevation. The Corps and USFWS personnel inspected the site in September 2007. One portion of the site had been logged within the past 5 years, while two other portions were in the process of being logged. The Service questioned if the Corps could reliably convert the primarily upland site into a high quality tidal freshwater marsh. USFWS stated that they preferred the Corps not attempt to create wetlands on that site.

The USFWS did, however, acknowledge that the South Carolina lowcountry is rapidly developing, with residential developments seeming to sprout up nearly every month. Lands such as this tract, with its road access and marsh views, seem to be particularly highly desired. Developers had surveyed this site and others along the SNWR boundary and were actively marketing the properties. The Corps consulted with the natural resource agencies about the value of acquiring this site and preserving it to provide a buffer from development along one side of the Refuge. Before the Corps could complete its mitigation evaluation, the site sold for development and is no longer available to the non-Federal sponsor at a reasonable cost. Neither the Georgia Ports Authority nor the Georgia Department of Transportation has condemnation authority in South Carolina.

The site labeled as Tract C is on the Georgia side of the river along St. Augustine Creek. The site had been identified by staff in Savannah District's Regulatory Division as having restoration potential. The site is a mixture of uplands and wetlands, with a breached dike bordering most of St. Augustine Creek. Planning Division staff inspected the site in September 2007. They found sections of dikes to still be present, but several openings allow tidal flows to cover portions of the area. It was not apparent the extent to which the dike segments are still reducing tidal flows to the site. A drainage ditch from GA Highway 21 crosses the site, likely reducing water levels on some of the tract. Active use of the ditch to drain the highway may limit the ability to block the ditch to raise adjacent water levels. The restoration potential may well be limited to removing the dike segments and restoring marsh vegetation within the footprint of the dikes. That seemed to present a limited opportunity and the site was dropped from further consideration for this project.

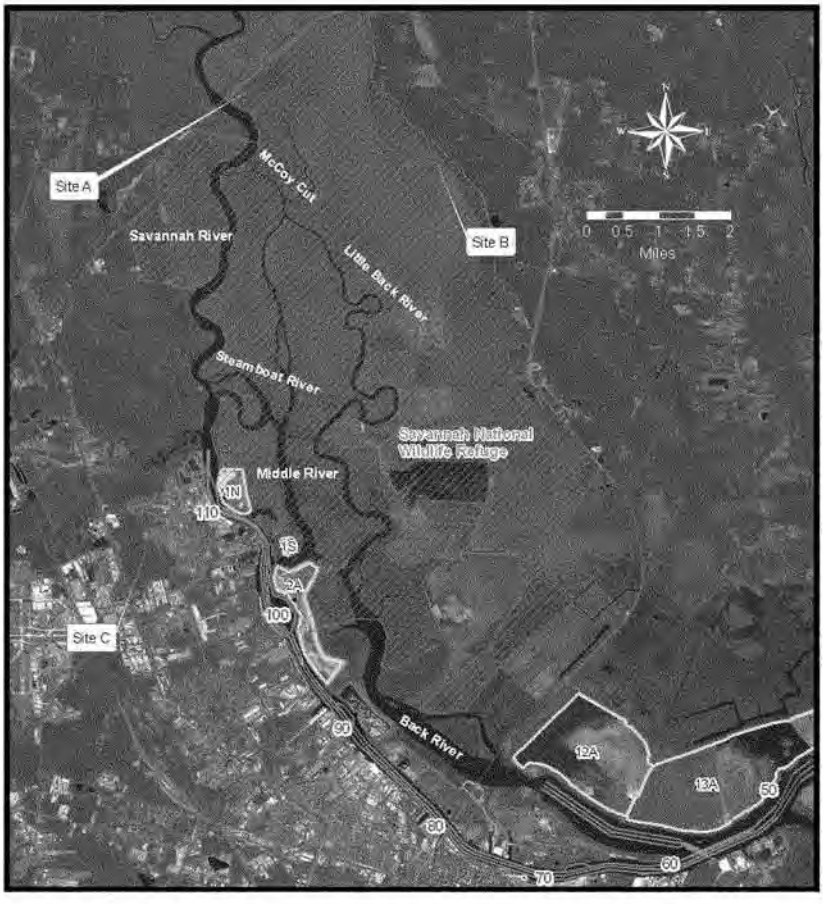


Figure 4-10. Potential wetland restoration and creation sites.

After pursuing ways to avoid and minimize project impacts, and then restore or enhance existing environmental functions, one looks to preservation as a means of addressing expected project impacts. For impacts to freshwater wetlands, the Corps used the Standard Operating Procedures (SOP), which have been adopted by the natural resources agencies in Georgia to evaluate impacts and calculate compensatory mitigation on projects requiring Section 404 permits. Although the SOP was developed by the interagency Mitigation Banking Review Team for actions permitted through the Corps' Regulatory Division, it can also serve as a framework to quantify impacts from civil

works projects such as this. EPA Region 4 suggested the Corps consider use of the SOP for this project. In brief, the SOP uses several factors to quantify the ecological impacts and benefits expected from various project actions. For impacts, those factors include the type of impact, the duration of the impact, the type of vegetation being impacted, and the preventability of the impact. For restoration, the factors include: expected improvement in hydrology and vegetation, timing of the restoration, maintenance that is expected to be needed, monitoring which would be performed, and control over the land to reduce future impacts. For preservation, the factors include: degree of threat to the identified lands, type of vegetation occurring on the lands, and control over the land to prevent future impacts.

The Corps took the impact data produced by the approved hydrodynamic model as the starting point for the SOP. The output included acreage for wetlands at different levels of salinity. The Corps then evaluated the output both before and after the flow-altering features are included in the project. Wetland types that would experience a net loss in acreage were identified as ones that would experience an adverse impact. In a similar manner, wetlands that would experience an increase in net acreage would benefit from and be restored by the project. Finally, the model output was used to characterize and quantify 3 classifications of wetlands – Freshwater (<0.5 ppt), Brackish (0.5 to 4.0 ppt), and Saltmarsh (>4.0 ppt).

Using the previously described approach, adverse impacts (conversion from one wetland type to another) were evaluated with respect to wetlands classified as Freshwater, Brackish and/or Saltmarsh. Model results documented that restoration could occur in either Freshwater or Brackish marsh. The flow-altering features were the primary means through which the net acreage in Freshwater and Brackish marsh would increase. In the 44-foot depth alternative, the flow-altering features of Plan 6B would result in net increases in both Freshwater and Brackish marsh acreage, with a corresponding decrease in Saltmarsh acreage. The natural resource agencies had previously determined Freshwater and Brackish marshes to be more valuable than Saltmarsh in the evaluation of this project. Since the 44-foot depth alternative with the Plan 6B flow-altering features would result in net increases in Freshwater and Brackish marsh acreage, the plan would fully mitigate that alternative's adverse impacts to wetlands.

The SOP considers many factors in its calculations of the ecological extent of a project's impact, and the value of the restoration and/or preservation features. Those factors are summarized on the following page:

Table 4-13. SOP Factors

	FACTORS INCLUDED		
FACTORS	**ADVERSE IMPACTS**	**RESTORATION**	**PRESERVATION**
Type of Impact	X		
Duration of Impact	X		
Existing Condition	X		
Type of Habitat	X		
Preventability	X		
Rarity of Habitat	X		
Improvement in Vegetation		X	
Improvement in Hydrology		X	
Timing of Restoration		X	
In-Kind Vs Out-Of-Kind Mitigation		X	X
Maintenance Requirements		X	
Monitoring Plan		X	
Type of Control		X	X
Degree of Threat			X

One of the factors considered in the SOP is the degree of protection to be provided over the lands to be acquired and preserved. That is the issue addressed in the factor titled "Type of Control". Lands that are owned in fee or by a government agency are considered more protected from future adverse impacts than are lands protected only by a restrictive covenant or conservation easement. A conservation easement can sometimes be obtained from a private owner without the government needing to resort to condemnation. However, more lands under easement would be needed to provide the same SOP-derived value as would fewer lands under government ownership. The Corps consulted the natural resource agencies to determine the type of real estate interest that the agencies believed would be most appropriate in this situation. The USFWS stated that fee ownership would be required.

The Corps applied the SOP to this project using the acreage outputs from the hydrodynamic model at various salinity levels. The Corps also evaluated the extent of impact that would occur to existing marshes (i.e., conversion of one intertidal marsh type to another) and the benefit that would occur to marshes as a result of the flow-altering features. The Corps also considered development pressures that are on waterfront properties in this estuary. Using the SOP, the 48-foot alternative would result in 7,705 units of adverse impacts to wetlands. The impacts must be mitigated by at least an equal number of restoration and preservation units. In Georgia, the resource agencies' policy is that acceptable mitigation should consist of at least 50 percent restoration. For this

project, restoration through the flow-altering features would comprise 58 percent of the total wetland mitigation for the 48-foot alternative, 60 percent for the 47-foot and 46-foot alternatives, and 65 percent for the 45-foot alternative. Using the SOP, the Corps calculated the minimum number of acres that need to be acquired and preserved to acceptably mitigate for wetland impacts. For the project, those numbers are shown below.

Table 4-14. Preservation Needs as Determined by SOP Calculations for Wetland Impacts

DEPTH ALTERNATIVE	MINIMUM ACRES NEEDED
44-FOOT	0
45-FOOT	1,643
46-FOOT	2,188
47-FOOT	2,245
48-FOOT	2,683

The following table summarizes the results of the SOP calculations for the 48-foot alternative. The details of the SOP application for each depth alternative are shown at the end of Appendix C.

Table 4-15. Summary of SOP Calculations 47-Foot Alternative

	Freshwater	Brackish	Saltmarsh	Total
Impacted Wetlands				
Acres	223		740	
Units	2007		4736	6743
Restoration				
Acres		964		
Units		4048.8		4048.8 (60.0%)
Preservation				
Acres	2245			
Units	2694.2			2694.2 (40.0%)

Savannah District consulted the Corps' Center of Expertise for Ecosystem Restoration to confirm that the Regulatory SOP was a technically sufficient method of determining the number of acres that the Project would need to acquire and preserve in order to compensate for adverse impacts to wetlands. The Center concurred that the SOP was a technically sound technique. They noted that -- as with other techniques -- the results

depend heavily on the values assigned to specific parameters in the analysis. They also noted that with the approach followed in this application, much of the mitigation requirement was being driven by conversion of saltmarsh to brackish marsh, an activity which was reportedly a goal of the natural resource agencies for this estuary.

Table 4-16. Proposed Land Acquisition

CHANNEL DEPTH ALTERNATIVE	FRESHWATER WETLAND IMPACTS	REQUIRED ACQUISITION ACREAGE
44-FOOT	+322*	N/A
45-FOOT	-32	1,643
46-FOOT	-201	2,188
47-FOOT	-223	2,245
48-FOOT	-337	2,683

* Denotes an increase in freshwater wetlands in conjunction with mitigation plan

The USFWS and the Savannah National Wildlife Refuge have identified properties within the estuary that they believe are ecologically valuable and provide positive contributions to the goals of the Refuge and enhance the area's fish and wildlife resources. The latest version of the Refuge's Acquisition Plan is dated July 2007 and is included in the document titled "Final Environmental Assessment and Land Protection Plan; Proposed Expansion of Savannah National Wildlife Refuge". The Corps proposes to acquire lands from the Refuge's Acquisition Plan and provide them to the USFWS to manage as additions to the Savannah National Wildlife Refuge, to mitigate for the remaining wetland impacts from this project. The USFWS previously identified the ecological value of those properties and believes they would be valuable additions to, and advance the goals of, the Savannah Refuge. The Refuge has the authority to accept these lands, since the lands are already included in the Refuge's approved Acquisition Plan. The USFWS would manage these properties using funds obtained through the Department of Interior's normal budget process. Although there are 45,836 acres in the Refuge's approved Acquisition Plan, not all of those properties would provide the type of habitat that is desired as mitigation for this project. The location of these tracts is shown in Figure 4-11 from the Refuge's Acquisition Plan. The project would acquire properties from the Refuge's Acquisition Plan that best meet the needs of the project. Those needs would be met by properties that are dominated by freshwater wetlands. The Corps has consulted with the Refuge and will lean heavily on the Refuge's identified priorities.

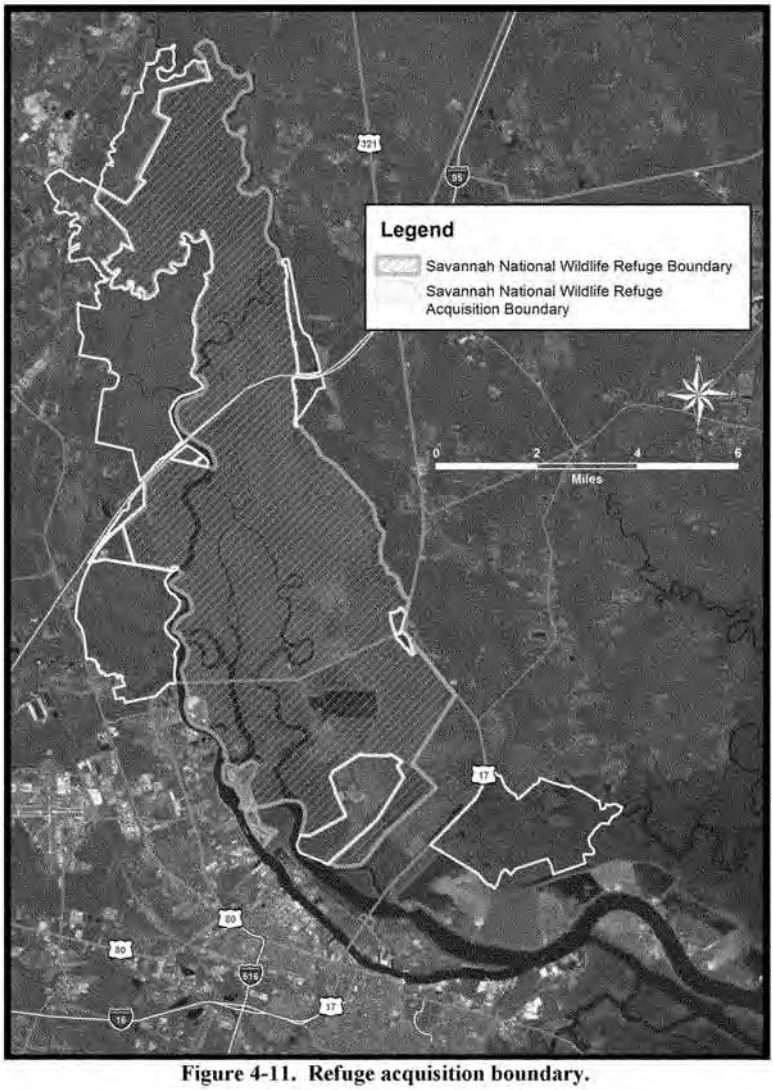


Figure 4-11. Refuge acquisition boundary.

5.0 Estuarine Water Column

The estuarine water column is classified as essential fish habitat. It is located between the sediment-water interface and the surface of the water. Section 5 of this document details the potential short term and long term impacts the project would have on the water column.

5.1 Temporary Increase in Turbidity

Extensive studies have been conducted on the behavioral responses of fish to increased turbidity in the water column. These studies measured reactions such as cough reflexes, swimming activity, gill flaring, and territoriality that may lead to physiological stress and mortality; however, specific studies on sturgeon responses are limited. The effects of suspended sediment on fish should be viewed as a function of concentration and exposure duration (Wilber and Clarke, 2001). The behavioral responses of adult salmonids for suspended sediment dosages under dredging-related conditions include altered swimming behavior, with fish either attracted to or avoiding plumes of turbid water (Newcombe and Jensen, 1996).

Dredging and sediment placement operations conducted during project construction may create impacts in the estuarine water column in the immediate vicinity of the activity. These impacts may include minor and short-term suspended sediment plumes and related turbidity, as well as the release of soluble trace constituents from the sediment. Studies performed by Dr. D. F. Hayes in 1984 on a hydraulic cutterhead dredge operating in Savannah Harbor indicated that average suspended sediment concentrations within 1,600 feet of the dredge were generally raised less than 200 mg/l in the lower water column and less than 100 mg/l and 50 mg/l in the middle and upper water column, respectively. The Savannah River has a naturally high suspended sediment load which during storm events increase well beyond the 200 mg/l increase created by a hydraulic dredge. In addition, during storm events the higher suspended sediment loads originating from upriver would likely be more uniform throughout the water column in the estuary due to mixing as the plume proceeds downstream. Stratification due to salinity may decrease the mixing of these sediment loads.

Turbidity impacts to the water column as a result of proposed dredging activities are expected to be temporary, with suspended particles settling out within a short time frame. These sediment disturbance impacts are expected to be minimal in nature and are not expected to have a measurable effect on water quality beyond the frequent natural increases in sediment load.

5.2 Decrease in Dissolved Oxygen in Water Column

Many facets of a harbor deepening project have the potential to adversely affect the water quality regime. From a construction perspective, dredging and disposal of contaminated sediments, turbidity increases during the dredging process, etc. have the potential to impair water quality. However, studies that were conducted in support of the SHEP

indicate that dredging and sediment placement activities will not have major impacts on the water quality regime in the estuary. These findings are presented in Chapter 5 of the EIS.

Model studies indicate that all of the channel deepening alternatives under consideration would decrease dissolved oxygen levels without mitigation. Degradation of the dissolved oxygen regime in Savannah Harbor has the potential to adversely affect numerous aquatic species. The SHEP study team believed this issue warranted a cumulative impact analysis.

Dissolved oxygen concerns relating to harbor deepening can be divided into three issues: (1) as the channel depth increases, the ability of oxygen to reach the river bottom decreases, causing lower average concentrations of dissolved oxygen at the bottom, (2) as the channel prism enlarges, additional saltwater is moved to the upper portions of the harbor and into the estuary, decreasing the ability of those waters to accept oxygen from the air, and (3) as the channel prism enlarges, the average velocity decreases, reducing the mixing of oxygen throughout the water column. If dissolved oxygen concentrations decrease to unacceptable levels, it could have deleterious effects on fish and other aquatic organisms. Lower dissolved oxygen concentrations also reduce the ability of the estuary to handle the point- and non-point source loads of pollutants entering the estuary.

The primary area of concern for dissolved oxygen is the Savannah River estuary. More specifically, it is the portion of the Savannah River between Fort Pulaski (River Mile 0.0) and the Seaboard Coastline Railroad Bridge (Mile 27.4). This section of the Savannah River estuary is the area that would be affected by the SHEP. Evaluation of impacts to the dissolved oxygen regime is critical, because this segment of the river is on the State of Georgia's Section 303(d) list as impaired for dissolved oxygen.

Model studies conducted by EPA as part of its 2006 TMDL assessment for Savannah Harbor indicate that construction of the existing project (42 foot channel, turning basins, Sediment Basin, etc.) has impacted the dissolved oxygen regime. The model estimates that the dissolved oxygen concentration in Savannah Harbor is 1 mg/l lower because of project improvements that have been made since the baseline year and condition (i.e., 1854 and a 12-foot controlling depth). Model predictions from the SHEP studies indicate that further deepening will have additional impacts on the dissolved oxygen regime in Savannah Harbor.

Two models were used during the SHEP to evaluate the impacts of the deepening alternatives on the dissolved oxygen regime in Savannah Harbor. The Environmental Dynamics Code (EFDC) model was used to develop the hydrodynamic data and then linked to the Water Quality Analysis Simulation Program Version 7.0 (WASP7) to obtain the dissolved oxygen data predictions. As specified by the Water Quality Interagency Coordination Team, the Corps conducted its basic dissolved oxygen impact analyses using typical summer drought river flow condition (August 1999). The interagency team also requested the Corps evaluate the project's potential effects under other conditions as sensitivity tests for the input conditions. These additional analysis included evaluating a

normal river flow condition (August 1997), natural conditions (i.e., river depths prior to any harbor deepening), 2004 point source loads, and full permitted point source loads. The results of those analyses can be found in the GRR Engineering Appendix.

The sensitivity analyses indicated that project impacts to dissolved oxygen were higher during drought flow conditions rather than during average flow conditions. The study evaluated 26 spatial zones that extended from Clyo, Georgia (61 miles above Fort Pulaski) to the Atlantic Ocean (17 miles offshore from Fort Pulaski). Figure 5-1 shows the 26 zones, which included 11 zones for Front River (FR), 6 zones for Middle River (MR), 3 zones for Back River (BR), 3 zones for Little Back River (LBR), 2 zones for South Channel (SC), and 1 zone for the Savannah River (SR). The South Carolina standards for dissolved oxygen were used to evaluate severity of impacts, because they were the most restrictive at the time of the study (daily average of 5mg/l, with an instantaneous minimum of 4.0 mg/l, applied throughout the water column).

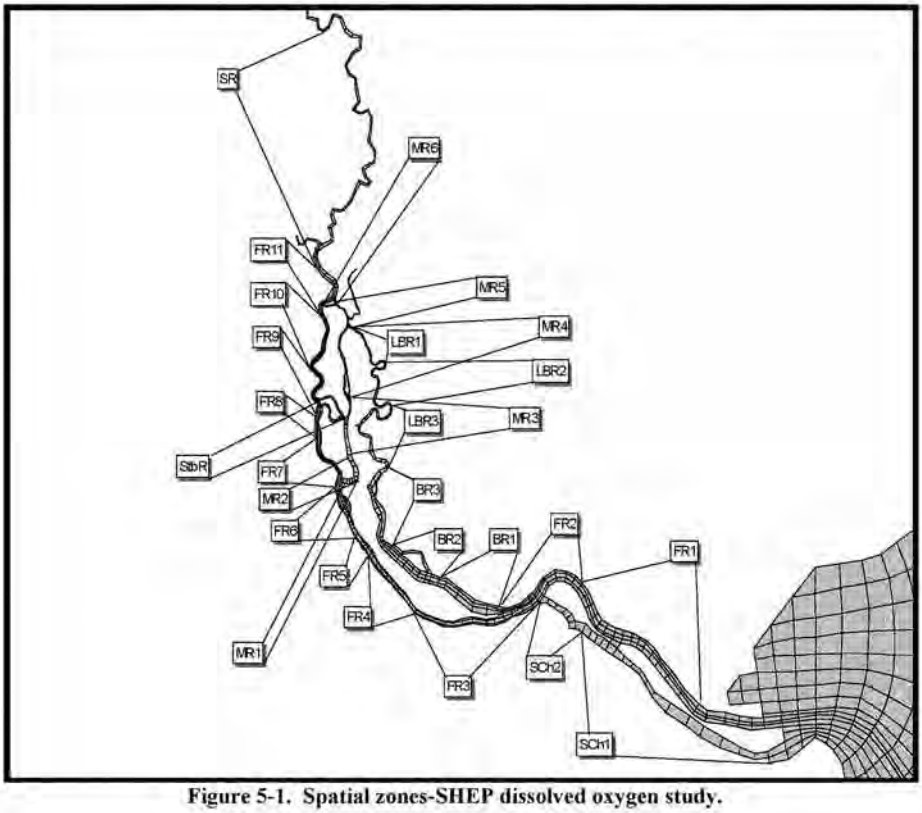


Figure 5-1. Spatial zones-SHEP dissolved oxygen study.

Using the previously described models, existing D.O. concentrations were quantified with respect to each of the zones. Tables 5-1 and 5-2 illustrate the existing D.O. concentrations within the Savannah Harbor.

Table 5-1. Average Dissolved Oxygen Levels under Existing Conditions

Zone Name	D.O. Concentration Percentiles (mg/L)								
	1%	5%	10%	25%	50%	75%	90%	95%	99%
FR1	4.09	4.16	4.21	4.32	4.44	4.55	4.68	4.76	4.82
FR2	3.86	3.91	3.95	4.15	4.28	4.41	4.51	4.58	4.62
FR3	3.58	3.66	3.72	3.88	4.06	4.25	4.52	4.60	4.81
FR4	3.52	3.57	3.61	3.82	3.96	4.18	4.75	5.15	5.41
FR5	3.53	3.62	3.69	3.91	4.08	4.58	5.26	5.53	5.69
FR6	3.79	3.83	3.92	4.13	4.36	5.04	5.69	5.86	5.97
FR7	4.25	4.36	4.52	4.92	5.78	6.15	6.38	6.53	6.68
FR8	4.71	4.92	5.13	5.57	6.13	6.42	6.67	6.79	6.96
FR9	5.60	5.87	5.99	6.24	6.53	6.80	7.05	7.21	7.33
FR10	5.71	5.85	6.01	6.30	6.57	6.81	7.16	7.23	7.32
FR11	4.88	5.10	5.28	5.59	5.88	6.18	6.45	6.55	6.68
MR1	4.29	4.41	4.55	4.79	5.06	5.47	5.77	5.89	5.99
MR2	4.17	4.29	4.47	4.73	5.05	5.40	5.73	5.84	5.98
MR3	3.84	4.02	4.09	4.36	4.71	5.19	5.55	5.67	5.79
MR4	4.38	4.50	4.60	4.77	5.04	5.23	5.43	5.53	5.69
MR5	2.31	2.55	2.96	3.46	5.33	6.16	6.53	6.82	7.01
MR6	2.15	2.53	3.05	3.58	5.69	6.32	6.80	6.94	7.27
LBR1	4.29	4.49	4.58	4.79	4.98	5.18	5.29	5.44	5.56
LBR2	3.69	3.80	3.95	4.13	4.35	4.55	4.70	4.76	4.89
LBR3	3.52	3.56	3.63	3.77	3.93	4.08	4.22	4.31	4.42
BR1	3.42	3.47	3.52	3.77	3.90	4.06	4.24	4.32	4.42
BR2	3.17	3.25	3.34	3.47	3.65	3.83	3.96	4.11	4.19
BR3	3.36	3.41	3.46	3.52	3.63	3.74	3.84	3.87	3.90
SCh1	3.40	3.46	3.53	3.61	3.72	3.87	3.95	4.02	4.08
SCh2	3.84	3.94	3.99	4.11	4.26	4.38	4.48	4.53	4.63
SR	4.90	4.95	5.18	5.52	5.84	6.17	6.35	6.41	6.48
StbR	4.73	4.91	5.07	5.39	5.75	6.06	6.25	6.38	6.54

Table 5-2. Lowest D.O. in Each Zone under Existing Conditions

Zone Name	D.O. Concentration Percentiles (mg/L)								
	1%	5%	10%	25%	50%	75%	90%	95%	99%
FR1	3.86	3.93	3.99	4.13	4.3	4.43	4.56	4.62	4.69
FR2	3.56	3.66	3.74	3.91	4.1	4.28	4.46	4.52	4.91
FR3	3.36	3.47	3.5	3.71	3.9	4.14	4.59	4.9	5.48
FR4	3.34	3.43	3.49	3.74	3.91	4.23	4.78	5.14	5.36
FR5	3.45	3.55	3.68	3.88	4.1	4.7	5.26	5.51	5.68
FR6	3.55	3.66	3.78	3.95	4.19	4.8	5.55	5.78	5.95
FR7	3.98	4.06	4.14	4.4	4.86	5.93	6.22	6.34	6.48
FR8	4.48	4.62	4.9	5.41	6.09	6.43	6.71	6.83	7.11
FR9	4.72	4.87	5.22	5.62	6.24	6.57	6.83	6.99	7.18
FR10	4.31	4.78	4.95	5.32	5.91	6.43	6.68	7.01	7.21
FR11	4.17	4.7	4.93	5.24	5.66	6.14	6.49	6.64	7.13
MR1	4.22	4.34	4.47	4.72	5.05	5.51	5.81	5.93	6.19
MR2	4.01	4.13	4.3	4.6	5.02	5.47	5.73	5.84	5.98
MR3	3.68	3.88	3.94	4.16	4.47	4.95	5.66	5.93	6.28
MR4	3.87	4.02	4.11	4.37	4.59	4.87	5.04	5.15	5.39
MR5	1.49	2.04	2.41	3.05	4.97	6.23	6.56	6.89	7.11
MR6	2.11	2.49	3.01	3.51	5.61	6.35	6.8	7.06	7.32
LBR1	3.57	4.35	4.74	5.12	5.42	5.64	5.97	6.15	6.47
LBR2	3.68	3.86	3.97	4.15	4.38	4.59	4.77	4.86	5.24
LBR3	2.88	3.28	3.46	3.67	3.92	4.31	4.7	4.95	5.18
BR1	3.15	3.28	3.44	3.59	3.82	4.05	4.26	4.34	4.45
BR2	2.43	2.72	2.86	3.11	3.3	3.54	3.67	3.74	3.82
BR3	2.87	3.12	3.32	3.48	3.65	3.8	3.93	4	4.13
SCh1	2.25	2.41	2.53	2.68	2.88	3.3	3.69	3.8	4.08
SCh2	3.62	3.78	3.88	4.02	4.19	4.35	4.48	4.56	4.7
SR	4.69	4.74	4.97	5.31	5.62	5.97	6.11	6.16	6.23
StbR	3.83	4.19	4.53	5.01	5.66	6.16	6.47	6.62	6.81

From a general perspective, the model shows that harbor deepening without mitigation would result in insignificant (1-2%) increases in the percentage of the harbor's waters with violations of existing dissolved oxygen standards. There would be upstream shifts of lower dissolved oxygen zones in bottom and surface layers of the estuary as the channel deepening increases in magnitude. The studies also indicate that deteriorations of the lowest dissolved oxygen values along critical cells (the cell with the lowest dissolved oxygen concentrations during specified simulation period) of major parts of the estuary increase proportionately to the amount of deepening.

NOTE: The following data shows dissolved oxygen levels without mitigation for D.O. but with the flow re-routing components of the harbor deepening alternatives. These data also reflect conditions in the bottom half of the water column (i.e., bottom 3 layers of the 6-layer model), where dissolved oxygen levels are lower. For the data shown in Tables 5-3 through 5-7, the Corps identified a decrease in dissolved oxygen as substantial when values reported in the 10%-tile Project-Baseline Difference category were reduced by 0.25 mg/l.

Table 5-3 shows the predictions for the dissolved oxygen regime deterioration for the 48-foot channel project (1999 drought conditions). The most dissolved oxygen deterioration would occur with the 48-foot channel project. Critical cells of Front River Zones FR6, FR7, FR8, FR9, FR11, and Middle River Zones MR1, as well as critical cells in Back River Zones BR1, BR2 and BR3 show a substantial decrease in dissolved oxygen levels, while dissolved oxygen would increase in Middle River Zones MR3, MR4, MR5, MR6, and Lower Back River Zones LBR1 and LBR2.

Table 5-3. Predicted Dissolved Oxygen Decreases: 48-foot Channel (No Mitigation)

Zone Name	Relative Percent Difference from Existing Condition								
	1%	5%	10%	25%	50%	75%	90%	95%	99%
FR1	0.8	0.5	0.0	0.0	-0.7	-0.9	-2.2	-2.4	-3.0
FR2	-0.8	8.5	8.8	7.4	5.6	4.4	3.4	3.5	-2.2
FR3	4.5	2.6	2.9	2.2	-0.5	-2.9	-5.7	-2.9	-4.7
FR4	5.1	3.8	2.9	1.1	-0.8	-5.0	-9.6	-8.0	-1.9
FR5	4.6	4.2	2.7	0.8	-1.2	-8.1	-13.9	-11.6	-10.0
FR6	1.7	1.1	-0.5	-0.3	-3.3	-10.8	-14.1	-11.6	-9.7
FR7	-4.5	-3.2	-3.1	-6.6	-11.9	-21.4	-11.7	-5.5	-3.1
FR8	-7.4	-8.0	-11.0	-15.0	-11.5	-7.2	-5.4	-4.2	-5.8
FR9	6.4	11.3	6.5	5.2	1.3	0.6	1.0	2.0	4.2
FR10	8.8	5.4	5.9	4.3	-0.2	-1.6	-1.3	-2.3	-0.8
FR11	0.2	-2.6	-2.4	-2.3	-0.2	0.0	-1.4	0.3	-2.8
MR1	-5.5	-5.3	-5.6	-5.9	-5.5	-9.1	-8.6	-8.1	-4.2
MR2	4.2	4.4	3.0	0.9	-2.4	-6.8	-5.2	-4.8	-4.8
MR3	12.8	10.6	11.9	10.6	9.2	3.0	-6.0	-7.3	-9.1
MR4	11.6	10.2	10.5	8.5	9.6	9.0	10.9	10.7	11.1
MR5	47.7	35.8	29.5	26.6	7.8	-0.6	-0.8	-1.6	-1.3
MR6	191.0	153.0	114.0	89.2	23.0	13.9	9.1	6.4	4.0
LBR1	14.0	10.8	7.6	7.2	7.0	8.2	5.9	6.2	3.6
LBR2	16.3	18.1	18.1	18.6	17.4	17.4	16.4	17.1	10.9
LBR3	-13.5	-19.5	-19.4	-18.0	-15.8	-16.0	-18.9	-21.2	-21.8
BR1	-43.5	-35.4	-23.3	-7.0	3.4	12.3	12.0	11.3	10.8
BR2	-40.7	-33.1	-29.7	-23.2	-13.9	-3.1	2.2	3.2	4.2
BR3	-41.8	-38.1	-38.9	-36.8	-32.9	-24.5	-15.5	-13.5	-11.1
SCh1	-7.1	-0.8	1.2	1.9	4.5	17.9	13.6	14.7	11.5
SCh2	-0.8	-2.6	-2.1	-1.0	-0.7	-1.1	-1.3	-1.5	-2.3
SR	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
StbR	-4.7	2.1	-0.9	0.4	-1.8	-3.1	-3.2	-3.9	-3.2

Table 5-4 shows the predictions for the dissolved oxygen regime deterioration of the 47-channel project. For the 47-foot channel, a substantial decrease in dissolved oxygen would occur in the critical cells of Front River Zone FR7, FR8, and Middle River Zone MR1, as well as Back River Zones BR1, BR2 and BR3. Dissolved oxygen would increase in Middle River Zones MR2, MR3, MR4, MR5, MR6, and Lower Back River Zones LBR1 and LBR2.

Table 5-4. Predicted Dissolved Oxygen Decreases: 47-foot Channel (No Mitigation)

Zone Name	Relative Percent Difference from Existing Condition								
	1%	5%	10%	25%	50%	75%	90%	95%	99%
FR1	0.5	0.5	0.3	0.2	-0.7	-0.9	-1.8	-1.9	-1.9
FR2	-2.8	7.9	8.6	6.9	5.6	4.4	3.6	3.8	-2.4
FR3	4.5	2.3	2.6	1.9	-0.3	-2.4	-4.6	-0.2	-2.9
FR4	5.1	3.5	2.6	0.8	-0.5	-4.5	-8.2	-6.0	0.6
FR5	4.6	3.1	1.4	0.0	-2.2	-11.3	-12.2	-11.8	-10.4
FR6	2.0	1.6	0.0	0.3	-2.9	-9.2	-11.7	-9.9	-8.1
FR7	-4.3	-2.7	-2.9	-6.4	-11.3	-18.7	-7.7	-4.3	-2.8
FR8	-6.5	-6.9	-10.2	-14.0	-9.0	-5.8	-4.9	-4.0	-5.6
FR9	1.1	6.2	2.9	5.5	1.9	1.7	2.5	3.0	2.5
FR10	8.8	5.4	5.7	4.3	-0.3	-1.7	-1.3	-2.3	-0.8
FR11	0.2	-2.3	-2.4	-2.5	-0.2	0.0	-1.4	0.3	-2.7
MR1	-4.7	-4.6	-5.4	-5.1	-5.0	-8.3	-7.6	-6.7	-3.7
MR2	4.5	5.1	3.5	0.0	-4.2	-7.5	-5.9	-5.5	-1.7
MR3	12.8	11.1	12.2	11.1	9.6	3.8	-5.5	-6.6	-8.1
MR4	12.1	10.2	11.2	8.7	9.8	8.8	10.5	10.5	11.1
MR5	47.7	36.3	29.5	26.6	7.8	-0.6	-0.5	-1.6	-1.1
MR6	191.0	153.4	114.3	89.2	23.0	13.9	9.0	6.4	4.0
LBR1	13.7	10.8	7.8	7.2	6.8	8.0	5.9	6.2	3.4
LBR2	21.5	18.4	18.1	18.3	17.4	17.2	16.4	16.7	10.7
LBR3	-12.2	-18.9	-18.5	-17.4	-15.3	-16.0	-18.7	-21.6	-22.6
BR1	-46.3	-38.7	-26.5	-8.1	2.9	11.9	12.4	11.8	11.0
BR2	-43.6	-36.8	-32.5	-25.4	-15.2	-4.2	0.8	2.4	4.5
BR3	-44.6	-41.3	-41.9	-39.4	-35.3	-27.4	-17.3	-15.5	-13.1
SCh1	-4.0	-2.9	0.8	3.4	1.7	-4.5	-3.8	-3.2	-5.9
SCh2	-1.4	-2.6	-2.1	-1.0	-0.7	-1.1	-0.7	-1.3	-1.3
SR	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
StbR	-2.6	1.9	0.2	1.2	-0.5	-2.4	-2.6	-2.9	-2.8

Table 5-5 shows the predictions for the dissolved oxygen regime deterioration of the 46-channel project. For the 46-foot channel, a substantial decrease in dissolved oxygen would occur in the critical cells of Front River Zone FR6, FR8, FR9, FR11, Middle River Zone MR1 as well as Back River Zones BR1, BR2 and BR3. Dissolved oxygen would increase in MR2, MR3, MR4, MR5, MR6 and Lower Back River Zones LBR1 and LBR2.

Table 5-5. Predicted Dissolved Oxygen Decreases: 46-foot Channel (No Mitigation)

Zone Name	Relative Percent Difference from Existing Condition								
	1%	5%	10%	25%	50%	75%	90%	95%	99%
FR1	0.5	-0.3	-0.5	0.0	-0.7	-0.5	-1.5	-1.5	-2.1
FR2	-5.1	7.4	7.8	6.9	5.6	4.7	3.6	3.8	-2.0
FR3	3.9	1.7	2.3	1.9	0.0	-1.7	-2.8	2.0	-2.0
FR4	3.6	2.9	2.3	0.8	-0.5	-4.0	-6.9	-3.7	2.1
FR5	4.1	3.1	2.2	0.8	-1.0	-6.4	-9.9	-6.9	-5.8
FR6	2.3	1.6	0.3	0.8	-2.1	-7.5	-8.1	-6.7	-5.2
FR7	6.0	7.4	8.7	8.2	10.5	-0.3	1.0	1.7	9.4
FR8	-5.1	-6.3	-9.0	-12.4	-7.4	-4.5	-3.7	-3.2	-4.6
FR9	-6.1	-7.4	-10.2	-11.9	-6.9	-3.2	-2.8	-3.6	-2.5
FR10	8.8	5.4	5.5	4.5	-0.2	-1.9	-1.2	-2.3	-1.0
FR11	0.2	-2.8	-2.4	-2.5	0.0	0.0	-1.4	0.3	-2.8
MR1	-4.0	-4.1	-4.3	-4.2	-4.0	-7.8	-5.9	-5.4	-2.1
MR2	5.2	5.3	3.5	1.5	-1.4	-5.3	-3.7	-2.9	-3.3
MR3	14.1	10.3	11.4	11.5	9.2	3.2	-6.2	-8.4	-9.6
MR4	12.4	10.4	11.2	9.2	9.8	9.2	10.5	10.3	10.9
MR5	47.7	36.3	29.0	26.6	7.6	-0.6	-0.5	-1.6	-1.1
MR6	191.0	153.4	114.3	89.2	23.0	13.9	9.0	6.4	4.0
LBR1	12.6	10.6	8.0	7.0	6.8	8.0	5.9	6.3	3.2
LBR2	0.0	17.9	17.9	18.6	17.4	17.0	16.4	16.9	10.7
LBR3	-10.8	-18.9	-18.2	-16.9	-15.3	-16.0	-19.1	-21.4	-22.2
BR1	-48.6	-42.7	-29.9	-10.0	1.8	11.4	12.4	12.0	11.0
BR2	-48.6	-40.4	-36.4	-27.7	-16.1	-5.1	0.3	2.1	4.2
BR3	-47.7	-44.2	-43.7	-40.8	-36.4	-29.5	-19.1	-16.5	-14.8
SCh1	-5.3	-3.7	1.6	3.0	1.0	-4.2	-4.9	-2.6	-4.2
SCh2	-0.6	-1.1	-1.3	-1.2	-1.0	-1.1	-1.1	-0.9	-0.9
SR	-0.2	0.0	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
StbR	-0.8	2.6	1.3	2.0	-0.5	-1.3	-2.0	-2.4	-2.8

Table 5-6 shows the predictions for the dissolved oxygen regime deterioration of the 45-channel project. For the 45-foot channel, a substantial decrease in dissolved oxygen would occur in the critical cells of Front River Zone FR7, FR8, FR9, and FR11 and Middle River Zone MR1 as well as Back River Zones BR1, BR2 and BR3. Dissolved oxygen would increase in Middle River Zones MR3, MR4, MR5, MR6 and Lower Back River Zones LBR1 and LBR2.

Table 5-6. Predicted Dissolved Oxygen Decreases: 45-foot Channel (No Mitigation)

Zone Name	Relative Percent Difference from Existing Condition								
	1%	5%	10%	25%	50%	75%	90%	95%	99%
FR1	0.8	0.0	0.0	0.2	-0.5	-0.5	-0.9	-1.1	-1.5
FR2	-7.9	7.9	8.3	6.9	5.9	4.7	4.0	4.0	-1.8
FR3	3.9	1.7	2.3	3.0	0.5	-0.7	-2.0	2.4	-1.3
FR4	3.6	2.3	2.3	2.1	0.8	-1.9	-3.6	0.8	3.0
FR5	4.1	2.5	0.8	0.0	-1.7	-11.5	-8.4	-7.6	-6.7
FR6	2.3	2.2	0.8	1.5	-1.0	-4.8	-4.5	-4.3	-2.4
FR7	-3.0	-1.7	-2.4	-4.5	-8.2	-11.8	-3.4	-2.5	-1.9
FR8	-4.5	-5.4	-7.6	-10.2	-5.1	-3.6	-3.6	-2.5	-3.5
FR9	-5.3	-6.4	-8.8	-9.8	-5.4	-2.4	-2.3	-3.6	-2.5
FR10	8.8	5.4	5.5	4.3	-0.2	-1.9	-1.2	-2.3	-1.0
FR11	0.2	-2.3	-2.4	-2.5	0.0	0.0	-1.4	0.2	-2.7
MR1	-3.1	-3.2	-3.4	-3.4	-3.0	-6.4	-4.3	-3.5	-1.3
MR2	5.2	5.6	4.0	1.7	-0.8	-4.2	-2.8	-1.9	-2.8
MR3	13.9	12.1	12.4	11.5	10.3	4.6	-4.1	-4.9	-7.2
MR4	13.2	10.4	11.7	9.2	9.8	8.8	10.5	10.3	10.8
MR5	48.3	37.3	29.0	25.9	7.6	-0.6	-0.6	-1.6	-1.1
MR6	191.0	153.8	114.6	89.2	23.0	13.7	9.0	6.4	4.0
LBR1	12.3	10.8	8.2	7.0	6.6	7.8	5.7	6.2	3.1
LBR2	21.5	18.7	18.1	18.6	17.1	17.2	16.4	17.3	23.5
LBR3	-10.1	-17.7	-17.6	-16.9	-14.8	-15.5	-18.7	-21.4	-22.2
BR1	-53.0	-46.3	-33.7	-11.4	1.6	10.9	12.9	12.0	11.7
BR2	-51.4	-41.5	-38.1	-30.5	-17.6	-5.9	-0.3	1.6	3.1
BR3	-52.6	-47.1	-46.4	-42.5	-38.6	-31.6	-20.6	-18.5	-15.5
SCh1	-7.1	1.2	0.0	2.2	7.3	19.7	16.0	15.5	12.0
SCh2	0.0	-1.1	-0.5	-0.7	-0.5	-0.9	-0.9	-0.9	-0.4
SR	-0.2	-0.2	-0.2	-0.2	0.0	-0.2	-0.2	-0.2	-0.2
StbR	2.3	3.8	2.4	2.4	-0.2	-1.0	-1.7	-2.0	-1.6

Table 5-7 shows the predictions for the dissolved oxygen regime deterioration of the 44-channel project. For the 44-foot channel, a substantial decrease in dissolved oxygen would occur in the critical cells of Front River Zones FR6, FR7, FR8, Middle River Zone MR1, Lower Back River Zone LBR 3 as well as Back River Zones BR1, BR2 and BR3. Dissolved oxygen would increase in MR3, MR4, MR6 and Lower Back River LBR1 and LBR2. The changes in dissolved oxygen profiles for the 44-foot depth alternative are considerably different from the other alternatives since the flow rerouting components are different with this channel depth alternative.

Table 5-7. Predicted Dissolved Oxygen Decreases: 44-Foot Channel (No Mitigation)

Zone Name	Relative Percent Difference from Existing Condition								
	1%	5%	10%	25%	50%	75%	90%	95%	99%
FR1	-0.3	-0.8	-1.0	-0.5	-0.7	-0.2	-0.9	-0.4	-1.3
FR2	-9.0	7.4	7.0	6.4	5.9	4.9	4.0	4.4	-1.8
FR3	3.0	0.9	1.4	2.4	0.8	0.0	1.3	3.9	-0.2
FR4	3.3	1.7	2.0	1.3	0.5	-1.9	-2.9	-1.8	0.9
FR5	3.2	1.7	-0.5	-0.8	-2.7	-11.1	-7.0	-6.0	-4.9
FR6	1.4	0.3	-1.1	0.5	-1.9	-6.0	-4.0	-2.9	-1.7
FR7	-2.5	-1.7	-1.9	-3.9	-7.2	-6.7	-2.6	-2.2	-1.5
FR8	-3.6	-4.1	-6.3	-8.5	-3.1	-2.0	-2.8	-2.5	-3.5
FR9	7.0	14.0	10.0	9.1	3.4	2.4	3.2	2.7	2.4
FR10	7.0	4.8	4.0	3.0	-1.0	-2.6	-1.6	-3.6	-1.1
FR11	-13.9	-12.8	-11.6	-9.0	-0.7	-1.1	-2.2	-1.7	-4.1
MR1	-2.6	-2.5	-2.5	-2.8	-2.6	-6.0	-2.6	-1.9	-0.6
MR2	3.7	4.1	2.1	0.4	-2.6	-4.2	-1.6	-1.0	-1.5
MR3	11.4	7.7	9.6	8.2	6.7	1.6	-7.4	-8.4	-9.6
MR4	-0.8	16.2	19.5	19.0	19.0	18.3	20.2	21.4	24.7
MR5	-6.0	-23.5	-24.5	-16.4	0.8	-1.9	-1.7	-2.5	-2.0
MR6	157.3	134.9	104.7	86.0	21.2	12.4	8.4	5.8	3.4
LBR1	-10.9	-3.4	1.7	2.3	1.5	2.7	1.8	2.3	0.6
LBR2	3.8	6.5	6.0	6.0	5.9	5.9	5.0	6.4	8.4
LBR3	-39.6	-41.2	-40.8	-35.1	-30.4	-28.8	-29.8	-30.7	-32.0
BR1	-70.5	-57.6	-49.1	-32.9	-19.1	-3.7	-3.3	-3.5	-3.1
BR2	-79.0	-72.1	-64.3	-46.9	-33.3	-29.1	-24.0	-21.4	-19.1
BR3	-75.6	-68.3	-66.6	-60.3	-54.8	-41.6	-28.8	-24.8	-22.3
SCh1	-3.1	-1.7	0.4	0.7	1.0	-3.0	-3.5	-1.6	-3.9
SCh2	0.0	-1.1	-0.8	-0.7	-0.5	-0.9	-0.9	-0.9	0.0
SR	-0.2	-0.2	-0.2	-0.2	0.0	-0.2	-0.2	-0.2	-0.2
StbR	5.7	5.7	3.5	3.2	0.4	-0.6	-1.4	-1.1	-0.9

5.3 Mitigation for Decrease in Dissolved Oxygen in Water Column

Deepening the navigation channel would adversely impact dissolved oxygen levels in the harbor. Since this is a critical resource in the harbor, the Corps has included a feature in the mitigation plan for each depth alternative that minimizes that adverse effect.

The Corps' studies indicate that oxygen injection is the most cost-effective method for raising D.O. levels in the harbor. Due to site-specific requirements, the Corps believes that a land-based injection system would be the most effective solution. It identified the use of Speece cones as the specific technique to inject oxygen into the water, although another land-based technique could be found to be more cost-effective. A different injection technique could be substituted at the time of construction without further NEPA coordination if impacts to wetlands, water quality or fisheries remain the same as with the Speece cones. The hydrodynamic and water quality modeling indicate that a system of injection locations would be needed, as summarized in the following table. These systems would remove the incremental effects of the channel deepening alternatives.

Table 5-8. Dissolved Oxygen System Design Capacities

Depth Alternative	Number of Injection Locations	Number of Cones Operated	Number of Cones Installed	Capacity to Increase D.O. (lbs/day)
44-foot	3	9	11	36,000
45-foot	3	8	10	32,000
46-foot	3	9	11	36,000
47-foot	3	10	12	40,000
48-foot	3	11	13	44,000

The locations identified for these systems are shown in Figure 5-2. All three locations (near Georgia Power's Plant McIntosh, Hutchinson Island – west, Hutchinson Island – east) would be needed for each channel depth alternative. The systems would be land-based, with water being withdrawn from the river through pipes, then super-saturated with oxygen and returned to the river. The water intake structure would include screens to reduce the intake of trash and other suspended solids. The screens would be sized to keep flow velocities from exceeding 0.5 foot per second to minimize entrainment of fish larvae. The intake and discharge would be located along the side of the river and not extend out into the authorized navigation channel. Figure 5-3 shows a typical layout for the oxygen injection facility. The systems would be operated during the months of July/August/September to provide the amounts of oxygen shown in Table 5-8. The Corps would begin to operate the systems on 15 June to allow the dissolved oxygen to be fully distributed throughout the estuary by 1 July.

With all oxygen injection designs, dissolved oxygen levels are higher near the injection site and taper off to lower levels as distance from the site increases. Removing the incremental project effect at a great distance from injection site requires substantially greater amounts of oxygen. A tradeoff results between the amount of oxygen required and the distance from the injection site. This becomes a tradeoff between the amount of

oxygen required (operating expense) and the number of injection locations (capital expense). As the number of injection locations increases, the complexity of maintaining numerous systems also increases. The D.O. system configuration is designed to remove the incremental effect of a deeper channel in 97 percent of the cells in the hydrodynamic model. The minor impact at distances away from the injection location is balanced by the higher dissolved oxygen levels that would occur close to where the oxygen is added. The District believes the 97 percent level of performance recognizes both the higher D.O. levels close to the injection sites and the limitations of the model at distinguishing small differences between different run conditions.

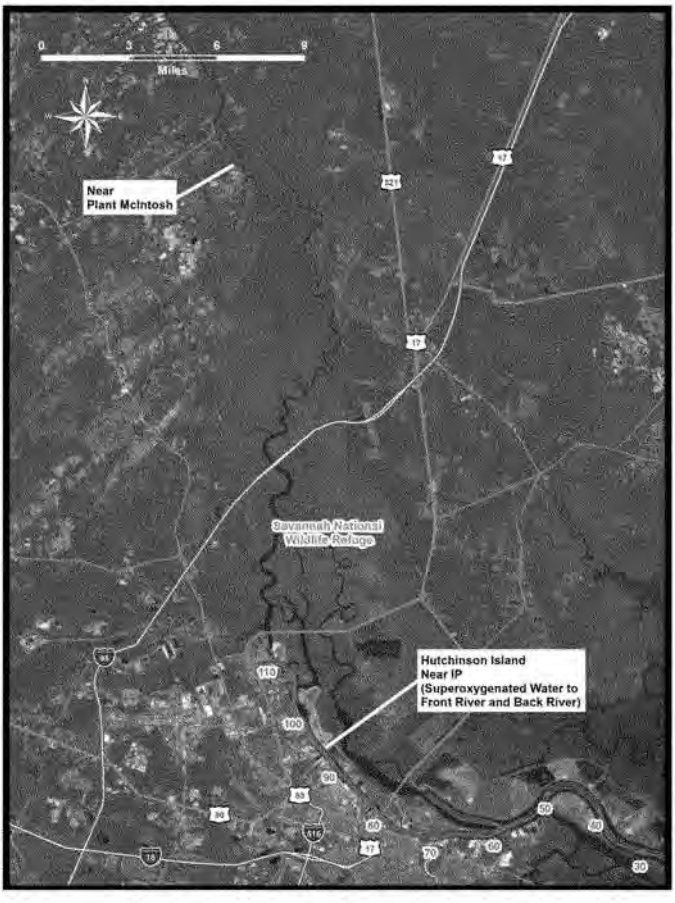


Figure 5-2. Modeled locations for dissolved oxygen injection systems.

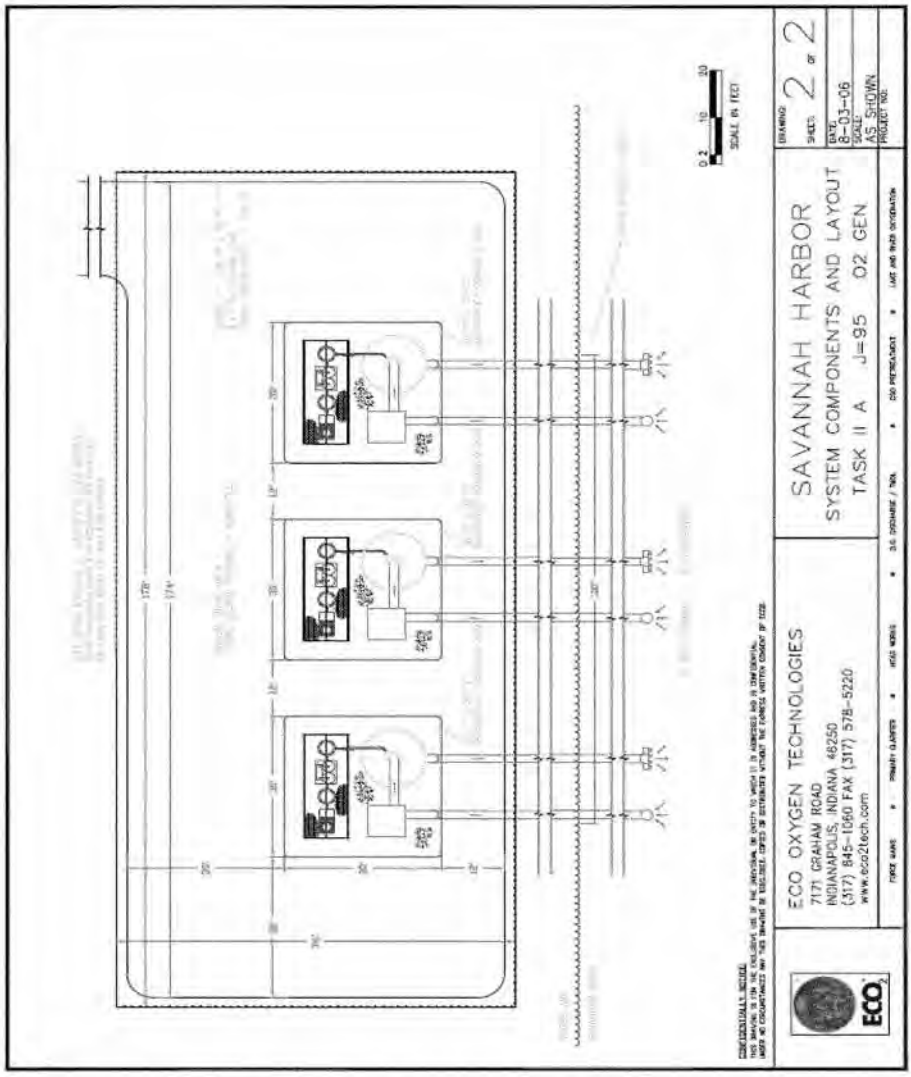


Figure 5-3. Site design for proposed dissolved oxygen injection systems.

Since dissolved oxygen levels would be higher near the injection site and taper off away from the site, the Corps analyzed the model outputs and found that the systems would increase dissolved oxygen levels above their present levels over much of the harbor. Such improvements are a secondary benefit of a system that is designed to remove the incremental effect of a deeper channel in 97 percent of the bottom cells. The following information shows the extent of the improvements that would occur (Table 5-9):

Table 5-9. Mitigation Success for D.O. Injection System Design (%)

	Vertical Layer	44 ft depth	45 ft depth	46 ft depth	47 ft depth	48 ft depth
5th percentile	Surface	99.9	99.7	99.9	99.9	99.9
	Mid-Depth	94.4	98.3	98.1	98.7	98.5
	Bottom	97.2	97.4	97.8	98.1	97.2
	Water Column	98.3	99.9	99.9	99.9	99.9
10th percentile	Surface	99.9	99.9	99.8	99.9	99.9
	Mid-Depth	95.3	99.2	99.1	99	99.1
	Bottom	97.5	97.5	97.9	98.4	97.1
	Water Column	98.4	99.9	99.9	99.9	99.9
25th percentile	Surface	99.9	99.9	99.9	99.9	99.9
	Mid-Depth	95.5	99.4	99.3	99.1	99.2
	Bottom	97.9	97.7	98	98.1	97.7
	Water Column	98.7	99.9	99.9	99.9	99.9
50th percentile	Surface	99.9	99.9	99.9	99.9	99.9
	Mid-Depth	96.3	97.7	97.7	98.1	97.8
	Bottom	98	98.4	97.8	97.2	97.1
	Water Column	99.1	99.9	99.8	99.8	99.9

The proposed system designs provide the best balance of system spacing, size and effectiveness, when the issues of operating complexity, existing land uses, and over-compensation of impacts are considered. The systems are also scalable so that it could be expanded in the future if desired to produce net improvements in harbor D.O. levels.

6.0 Potential Effect in Marine Areas

The Corps evaluated the project with respect to the marine areas identified as essential fish habitat (Table 1-2). The Corps concluded that the project would not affect coral and coral reefs, artificial/manmade reefs, and Sargassum. To date, current evidence also indicates that the project would not impact live/hard bottoms. The Corps will conduct on-

site investigations to confirm this understanding. The following subsections of Sections 7-9 provide an analysis of essential fish habitat impacts that would result in marine areas.

7.0 Marine Area Water Column

The marine area water column is classified as essential fish habitat. It is located between the sediment-water interface and the surface of the water in the nearshore and offshore environments of the project area. Section 7 of this document details the potential short term impacts the project would have on the water column.

7.1 Temporary Increase in Turbidity

Extensive studies have been conducted on the behavioral responses of fish to increased turbidity in the water column. These studies measured reactions such as cough reflexes, swimming activity, gill flaring, and territoriality that may lead to physiological stress and mortality; however, specific studies on sturgeon responses are limited. The effects of suspended sediment on fish should be viewed as a function of concentration and exposure duration (Wilber and Clarke, 2001). The behavioral responses of adult salmonids for suspended sediment dosages under dredging-related conditions include altered swimming behavior, with fish either attracted to or avoiding plumes of turbid water (Newcombe and Jensen, 1996)

Dredging and sediment placement operations conducted during project construction may create impacts in the marine area water column in the immediate vicinity of the activity. These impacts may include minor and short-term suspended sediment plumes and related turbidity, as well as the release of soluble trace constituents from the sediment. Studies performed by Dr. D.F. Hayes in 1986 on a hydraulic cutterhead dredge operating in Savannah Harbor indicated that average suspended sediment concentrations within 1,600 feet of the dredge were generally raised less than 200 mg/l in the lower water column and less than 100 mg/l and 50 mg/l in the middle and upper water column, respectively. The Savannah River has a naturally high suspended sediment load which during storm events increase well beyond the 200 mg/l increase created by a hydraulic dredge.

Hopper dredges would predominantly be used within the marine areas like the ocean bar channel (Stations 0+000 to -98+600) of the harbor. Hopper dredge suction arms hydraulically remove sediment from the navigation channel and discharge the material into the storage hoppers on the dredge. During filling, fine sediments (primarily silt, clays, and fine-sands) are washed overboard to maximize the load of coarse sediments transported to the placement site. This washing and overflow process is a source of turbidity plumes and sedimentation generated by the hopper dredge. The distance that sediment plumes may extend is dependent upon the type of dredge, how it is operated, currents, and the nature of the sediments within the excavation area. Elevated sediment levels from hopper dredge operations have been recorded at about 1,100 feet from an excavation site (Blair *et al.* 1990). Furthermore, according to Neff (1981 and 1985),

concentrations of 1000 ppm immediately after discharge decreased to 10 ppm within one hour. The minimal impact of settling particles from hopper dredge turbidity plumes was further supported by a study from Poopetch (1982), which found that the initial hopper dredge overflow concentrations of 3,500 mg/l were reduced to 500 mg/l within 50 meters. Another source of turbidity and sedimentation from hopper dredges is through the deposition of their sediment loads at the placement sites.

Mechanical dredges could be used throughout the proposed project (Station 103+000 to -98+600B). The primary time when turbidity would be generated would be when the full bucket travels through the water column to the surface and is empted into an adjacent barge. However, the magnitude of the river flows (i.e., the Savannah River has an average discharge of 11,290 cubic feet per second) indicate that rapid dilution of effects can be expected. Moreover, turbidity within the ocean bar would be quickly dissipated due to currents, wind and wave action.

Turbidity impacts to the water column as a result of proposed dredging activities are expected to be temporary, with suspended particles settling out within a short time frame. These sediment disturbance impacts are expected to be minimal in nature and are not expected to have a measurable effect on water quality beyond the frequent natural increases in sediment load.

8.0 Creation of Fish Habitat

Several alternative placement alternatives for both new and maintenance sediment were proposed to provide beneficial uses of dredged material. Two sites – Sites 11 and 12 – would be constructed to provide a large change in bottom elevation. The change would alter currents in the immediate vicinity, thus enhancing the sites' values as fishery habitat. The sites are described as follows and are shown in Figure 8-1.

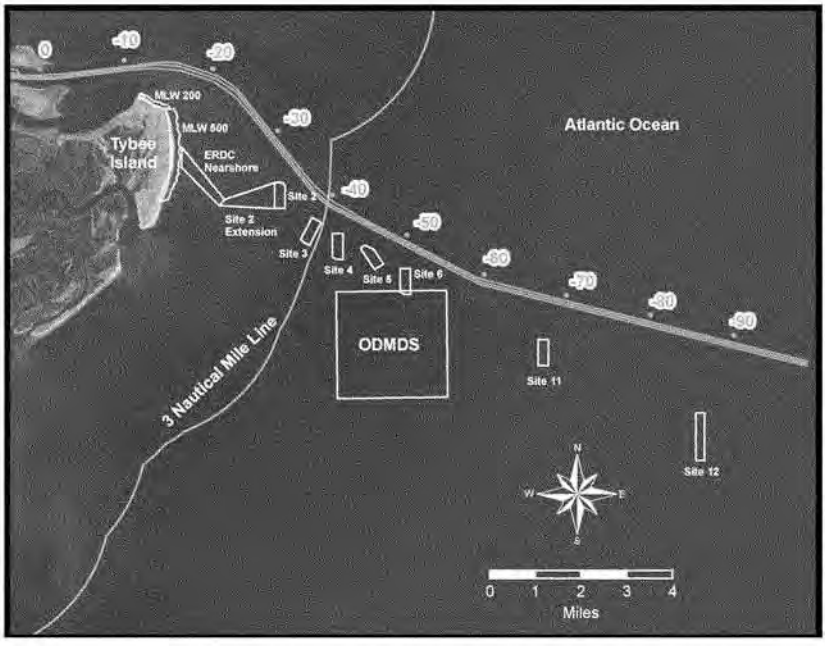


Figure 8-1. Location of placement areas as initially proposed.

Site 11 has a total capacity of 2.1 MCY and is located below the mean low water contour (MLW) in the nearshore area off Tybee Island. At total capacity, the top elevation of the placement site would extend to -10 feet MLW. This mound would provide fish habitat. This site was authorized within the LTMS (USACE 1996).

Site 12 has a total capacity of 3.0 MCY and is located below the mean low water contour (MLW) in the nearshore area off Tybee Island. At total capacity, the top elevation of the placement site would extend to -10 feet MLW. This mound would provide fish habitat. This site would provide habitat by establishing a variation in contours of the water bottoms.

Based on comments received from the GA DNR-CRD during the review of the DEIS, placement of dredged material into Sites and 11 and 12 was eliminated from project plans. The GA DNR was concerned about the impacts of shifting sands from Sites 11 and 12 on the marine environment as well as commercial and recreational fishing.

9.0 Impacts to Live and Hard Bottoms

The proposed project will not impact known live or hard bottom communities. On March 2, 2010, NMFS provided a figure that illustrates the potential location of hardbottom EFH (Figure 9-1) in the vicinity of the project. The yellow squares represent the potential location of hardbottom habitat and the purple square represents the location of the ODMDS sediment placement site. As illustrated, the existing terminus of the entrance channel is located within a potential hardbottom habitat. However, years of maintenance dredging within the channel have confirmed that the area is comprised only of coarse-grained sand.

Prior to the start of construction, the Corps would conduct additional surveys of the proposed channel extension corridor. Surveys would include a physical analysis of the ocean floor within and in the vicinity of the yellow square, which is located toward the end of the proposed entrance channel (Figure 9-1). The results of those surveys would be coordinated with NMFS prior to construction of the entrance channel extension. If hardbottoms are identified, then the Corps will work with NMFS to develop a course of action that includes the selection of appropriate mitigation options.

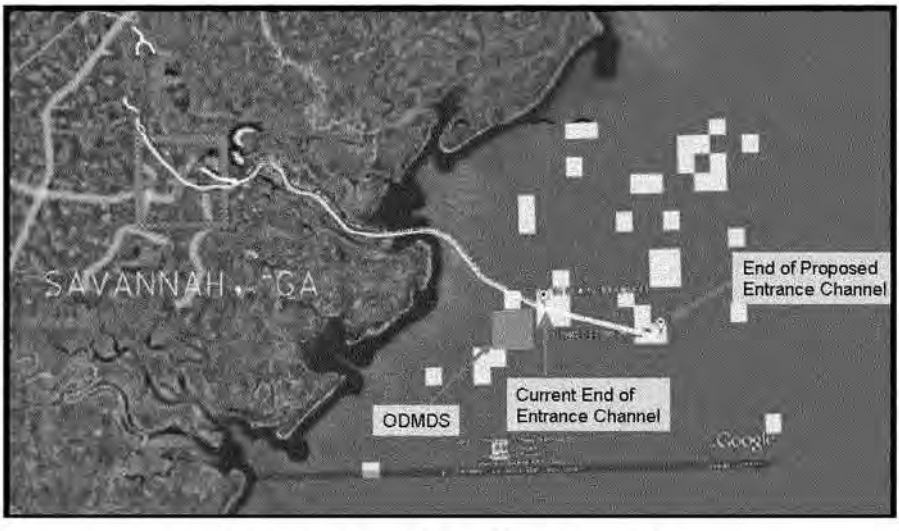


Figure 9-1. Proposed channel extension corridor.

10.0 Geographically Defined Habitat Areas of Particular Concern

A. Impacts to Gray's Reef, Georgia. Gray's Reef National Marine Sanctuary is one of the largest nearshore live-bottom reefs in the southeastern United States. It is governed by the National Marine Sanctuaries Act and managed by the National Oceanic and Atmospheric Administration (NOAA). It is located about 40 nautical miles southeast of Savannah Georgia in about 60 to 70 feet of water. The proposed action would not impact Gray's Reef since the site is not located within or near the project area.

B. Impacts to Charleston Bump, SC. The Charleston Bump is a deepwater bottom feature 80 to 100 miles southeast of Charleston, South Carolina. The Bump rises off the Blake Plateau from depths of about 2,200 ft and extends upward toward the surface. The Bump stops some 1,200 ft below the sea surface. The proposed work will not adversely impact the Bump since it is not located within or near the project area.

C. Impacts to Hurl Rocks, SC. Hurl Rocks are located off Myrtle Beach, South Carolina, which is about 225 miles northeast of Savannah. The proposed action will not adversely impact Hurl Rocks.

D. Impacts on Broad River, SC. The Broad River is a tidal channel in Beaufort and Jasper County, South Carolina. The Coosawhatchie River flows into the Broad River at the head. It joins Coosaw River channel Northeast and continues Southeast to Atlantic Ocean as Port Royal Sound. It is over 30 miles to the northeast of Savannah and is outside the project area. No adverse impacts are anticipated.

E. Impacts on Sargassum. *Sargassum* is a pelagic brown algae which occurs in large floating mats on the continental shelf in the Sargasso Sea and in the Gulf Stream. It is a major source of productivity in a nutrient-poor part of the ocean. Masses of *Sargassum* provide extremely valuable habitat for a diverse assemblage of animal life, including juvenile sea turtles, sea birds, and over 100 species of fish. Unregulated commercial harvest of *Sargassum* for fertilizer and livestock feed has prompted concerns over the potential loss of this important resource. While smaller clumps of this seaweed may float into the project area, it typically occurs much further offshore. Since *Sargassum* occurs in the upper few feet of the water column, it is not subject to impacts from dredging or sediment placement activities associated with the proposed action.

F. Impacts on Reef-forming Corals. Hermatypic, or reef-forming, corals consist of anemone-like polyps occurring in colonies united by calcium encrustations. Reef-forming corals are characterized by the presence of symbiotic, unicellular algae called zooxanthellae, which impart a greenish or brown color. Since these corals derive a very large percentage of their energy from these algae, they require strong sunlight and are, therefore, generally found in depths of less than 150 feet. They require warm water temperatures (68 to 82 F) and generally occur between 30 degrees N and 30 degrees S latitudes. Off the east coast of the United States, this northern limit roughly coincides with northern Florida. Although they occur off the Georgia and South Carolina coast,

they are not known from the immediate project vicinity and they should not be affected by the proposed action.

G. Impacts on Artificial Reefs. The Georgia DNR-Coastal Resources Division lists one artificial reef in the project vicinity. Artificial Reef SAV is located 6 nautical miles southeast of Tybee Island and average water depth at mean low water is from 30 to 40 feet. Dredging and sediment placement within the nearshore area off Tybee Island and the ocean bar channel would not be conducted near this artificial reef, so the Corps does not expect adverse impacts to the reef to occur. Turbidity plumes may be produced by placement of the dredged sediment within the nearshore and ocean areas as fine sediments are washed away by littoral processes. If such plumes are still detectable as far offshore as the Artificial Reef SAV, their effects should be minor, temporary and should quickly dissipate. The proposed action will not significantly impact any GA DNR-CRD reefs.

H. Impacts to State-designated Recreational and Commercial Shellfish Harvesting Areas. The GA DNR-CRD has designated recreational and commercial shellfish harvesting leases in the project area. These shellfish harvesting areas would not be impacted by any increase in suspended sediment or increased turbidity because these areas are separated from the navigation channel by Elba, Long and Cockspur Islands and saltwater marsh. Moreover, any increase in suspended solids or turbidity within the river would quickly dissipate because all sediments deposited along the river would be placed and retained in upland CDFs. There is no unconfined placement of sediments in the Savannah River. Sediments may be used to construct the sill (broad berm portion) at the Sediment Basin, but large dredges are not expected to be used for that placement.

I. Impacts on Hardbottoms. See Section 5.04, above.
As indicated previously, in June 2001, Vittor & Associates (2001) surveyed about 2,500 acres south of the ocean bar channel and in the nearshore area for cultural resources and hard bottoms. No high relief hard bottom communities that constitute good foraging habitat for sea turtles were found. Years of maintenance dredging in the entrance channel has not revealed any hard bottom areas. Consequently, the project is not expected to impact this type of habitat.

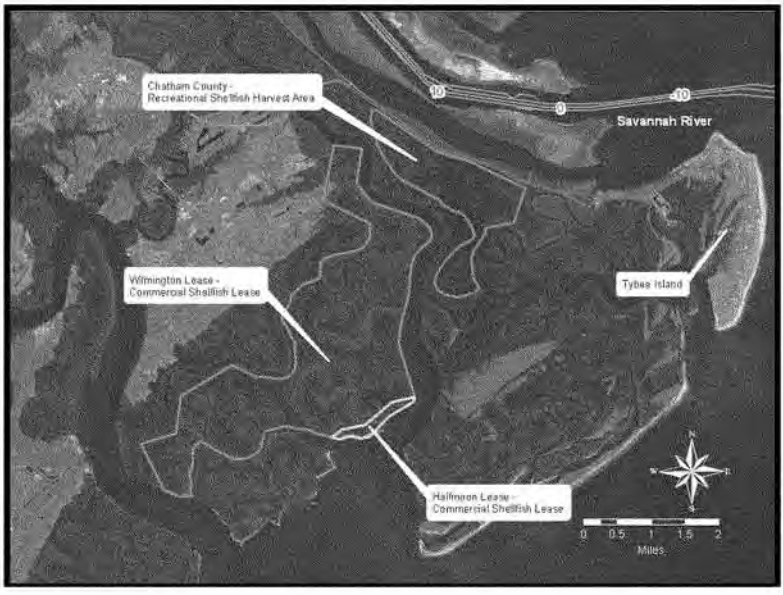


Figure 10-1. Commercial shellfish harvest areas near Savannah Harbor.

J. Impacts on Mud Bottoms. The proposed action involves the deepening of the Federal navigation channel and placement of sediment in CDFs and in the ODMDS. Mud bottoms are not located within the sediment placement sites and, therefore, would not be within the areas affected by this action.

K. Impacts of Larval Entrainment. See Section 5.04.2 (D), above regarding a detailed discussion on the impacts of dredging on larval entrainment. Based on the information in Section 5.04.2 (D), the proposed actions impacts on larval entrainment is not anticipated to be a significant impact.

L. Impacts on State-designated Areas Important for Managed Species. Primary Nursery Areas (PNAs) have not been designated by the Georgia DNR, Coastal Resources Division within the project area. Many fish species undergo initial post-larval development in these PNAs. This project will not impact PNAs because they are not present in the project impact area.

M. Impacts on other Habitat Areas of Particular Concern (HAPC). Tidal inlets comprise HAPC for several important species, including the planktonic larvae of brown shrimp, white shrimp, pink shrimp, as well as the eggs and larvae of red drum. These species are sometimes present in the Savannah River inlet, which is the location of the entrance channel to Savannah Harbor. Therefore, channel dredging will likely impact the early life stages of these species through entrainment during dredging. While individual mortality is the result, population-level impacts are considered to be insignificant, as is explained in Section 5.04, Entrainment Impacts. The surf zone represents HAPC for adult bluefish and red drum that feed extensively in this portion of the ocean. Sediment placement operations along the beach can result in increased turbidity and mortality of intertidal macrofauna that serve as food organisms for these and other species. Therefore, feeding activities of these species may be interrupted in the immediate area of nearshore sediment placement. However, these mobile species are expected to temporarily relocate to other areas as the work proceeds. Once the placement operation has passed, physical conditions in the impact zone quickly recover and biological recovery soon follow. Surf-feeding fish can then resume their normal activities in these areas. Therefore, these impacts are considered temporary and minor.

11.0 Impact Summary for Essential Fish Habitat. As indicated in Section 5 of the DEIS, the proposed action would have adverse impacts on habitat for the Endangered Shortnose sturgeon, Striped bass, freshwater marshes, and brackish marsh. Mitigation is proposed for these impacts and detailed information regarding this matter is found in the Section 5 of the EIS and in the Mitigation Plan (see Appendix C in the EIS).

Based on the information in the various paragraphs above, with the mitigation and monitoring plans in place and the hardbottom surveys in the nearshore placement areas off Tybee Island completed, the proposed action is not expected to cause significant adverse impacts to Essential Fish Habitat or EFH species. Impacts are expected to be minor on an individual project and cumulative effects basis.

ENVIRONMENTAL IMPACT STATEMENT
APPENDIX S: Essential Fish Habitat Evaluation

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

ADDENDUM 1

NMFS Draft Essential Fish Habitat Conservation Recommendations

US Army Corps of Engineers
Savannah District
South Atlantic Division

Essential Fish Habitat provisions of the
Magnuson-Stevens Fishery Conservation and Management Act

The NMFS Southeast Region's Habitat Conservation Division has reviewed the Draft Environmental Impact Statement (EIS), Draft General Re-evaluation Report (GRR), and the additional information provided by the U.S. Army Corps of Engineers (COE) for the essential fish habitat (EFH) consultation for the Savannah Harbor Expansion Project (SHEP). The COE concludes SHEP would not have significant adverse impacts on EFH or federally managed fishery species. The documents and information provided are sufficient for NMFS to evaluate this determination and to provide appropriate EFH conservation recommendations.

EFH Consultation History
Section 1 of the Biological Opinion provides a chronology of the coordination that has occurred between the COE and NMFS since 1991. While not a list of all meetings that occurred, the chronology includes the key elements of the EFH consultation and is incorporated into this review by reference.

Proposed Project
Section 2.1 of the draft Biological Opinion describes the proposed action, and that section of the draft Biological Opinion is incorporated into this review by reference. Since the Draft EIS and Draft GRR were released in November 2010, two modifications to SHEP have occurred that are significant for the EFH consultation:

- NMFS anticipates the COE will identify the National Economic Development (NED) plan in the Final EIS and Final GRR as its preferred alternative; i.e., the COE will propose deepening the federal navigation channel to 47 feet. In the Draft EIS and Draft GRR, the COE discussed a proposal by the Georgia Ports Authority to deepen the channel to 48 feet (i.e., there was a Locally Preferred Plan and the COE indicated it was inclined to accept that plan as the Recommended Plan), but the Georgia Ports Authority has since withdrawn this proposal. Should the project be amended to deepen the channel to 48 feet, the COE would need to reinitiate EFH consultation.
- NMFS anticipates the Final EIS and Final GRR will specify placement of all sediment from the Entrance Channel (Ocean Bar Channel) into either the Savannah Ocean Dredged Material Disposal Site (ODMDS) or an upland confined disposal site. The COE communicated this change to NMFS on March 23, 2011, in the COE's detailed response to the comments NMFS provided on January 25, 2011. Should the project be amended to reintroduce disposal at locations other than the ODMDS or upland confined disposal sites, the COE would need to reinitiate EFH consultation.

Entrance Channel (Ocean Bar Channel) Deepening and Extension
In November 2009, the COE first advised NMFS of the need to extend the Ocean Bar Channel seaward of station -60+000B (which marks the seaward limit of the existing channel). The length and dredging needed for this extension would depend on the project depth (DEIS Table 3-1). Under the NED plan, the channel would be lengthened 37,860 feet. Table 3-9 of the Draft EIS does not list the volume of material that would need to be dredged to extend the channel to the 47-foot depth contour, but based on the information provided it appears to be on the order of four million cubic yards.

It is uncertain whether hardbottom habitat occurs in the path of the proposed channel extension. The Southeast Area Monitoring and Assessment Program (SEAMAP-SA 2001[1]) reports hardbottom may be present within or adjacent to the proposed channel extension (Draft EIS, Appendix S, Figure 9-1). The precision of the maps within SEAMAP-SA (2001) is limited. While some data examined include direct observations of the sea bottom, habitat affinities of fish caught by trawls or traps are also considered and used to infer whether hardbottom is near the trawl or trap. Also, because of the difficulties of accurately determining sample locations of historical data, SEAMAP-SA (2001) reports habitat after aggregating data into grid cells measuring 1 minute of latitude by 1 minute of longitude. Based on anecdotal accounts, the COE believes no hardbottom habitat occurs in the path of the proposed channel extension. The late inclusion of the channel extension component into the overall project design has prevented the COE from performing the sea bottom surveys normally included in a Draft EIS. To address this deficiency, the COE proposes to survey the area when developing the detailed plans needed for soliciting dredging contracts (i.e., after conclusion of interagency and public coordination required by the National Environmental Policy Act).

Any hardbottom habitat impacted from extending the Ocean Bar Channel would be a Habitat Area of Particular Concern (HAPC). Over 30 fish species managed by the South Atlantic Fishery Management Council have an affinity for hardbottom habitat and are used by SEAMAP-SA (2001) as an indicator that hardbottom habitat occurs near a fish trap or trawl. These species include four of the five finfish managed by the South Atlantic Fishery Management Council that are currently listed as overfished and likely to occur near the Ocean Bar Channel (black sea bass, red grouper, red porgy, and red snapper). Given the importance of any hardbottom habitat within the channel extension and their HAPC designation, the COE should closely coordinate with NMFS during the planning and execution of the hardbottom survey. Any hardbottom found would likely require compensatory mitigation; working through the State of Georgia's artificial reef program may be a viable option for providing this mitigation. These surveys and plans for any compensatory mitigation required should be completed before the Record of Decision is signed.

Direct Impacts to Salt Marsh

The extent of direct impacts to salt marsh from excavating channel bend wideners, enlarging Kings Island Turning Basin, and removing the Tidegate is projected to be 14.08 acres for the 47-foot alternative (please note Section 6.04 lists the impacts as 15.48 acres and Appendix C lists them as 15.68 acres). As compensatory mitigation, the COE proposes to regrade approximately 42 acres of a former confined disposal site (CDF 1S) near the confluence of the Front and Middle rivers to an elevation that would support the cordgrass *Spartina alterniflora*. The regraded area would then be allowed to revegetate naturally; planting of *Spartina alterniflora* would be conducted only if the area did not achieve 15% vegetative cover after one year and 80% vegetative cover after five years (with interim goals of 25, 40, and 60% cover at the end of two, three, and four years, respectively). NMFS agrees with this approach and notes the value of

[1] Southeast Area Monitoring and Assessment Program-South Atlantic. 2001. Distribution of Bottom Habitat on the Continental Shelf from North Carolina through the Florida Keys. SEAMAP-SA Benthic Mapping Workgroup. Atlantic States Marine Fisheries Commission. Washington DC. 166 pages.

having clear success criteria for judging performance and triggering corrective actions. A tidal creek also would be constructed within the restored marsh. Additional detail on the alignment and depth of this creek is needed, and NMFS offers to assist the COE with these determinations.

In various parts of the Draft EIS, the COE suggests more mitigation is being provided at CDF 1S than is necessary and that this excess mitigation would be applied to future projects. NMFS does not support this approach. Substantial amounts of salt marsh would be indirectly impacted by the flow rerouting included in SHEP (Table 1), and mitigation for this impact is occurring via preservation of uplands, freshwater wetlands, and tidal freshwater wetlands (i.e., the mitigation is not type-for-type). Consequently, if any excess mitigation is being provided, the excess is in the form of preserved freshwater marsh, not restored salt marsh, since salt marsh will still have a net decrease from the project even after counting the enhanced acres at CDF 1S.

Indirect Impacts to Tidal Marsh and Creeks

The Department of Interior concludes previous deepening projects within the Savannah River Estuary have reduced the amount of tidal freshwater marsh from 12,000 acres to 3,300 acres, and the majority of the remaining tidal freshwater wetlands occur within the Savannah National Wildlife Refuge. The Draft EIS and Draft GRR discuss indirect[2] impacts to marsh communities by examining five salinity regimes (tidal freshwater < 0.5 ppt, salt marsh > 4.0 ppt, and three levels of brackish marsh 0.6 to 1.0 ppt, 1.1 to 2.0 ppt, and 2.1 to 4.0 ppt). The amounts and locations of these communities within the Savannah River Estuary reflects a dynamic interaction of the inflows of seawater from the ocean and freshwater from the Savannah River; this interaction occurs through a network of tidal rivers, creeks, and marshes. Sea level rise will affect the long-term input of seawater to the estuary and management of upstream reservoirs, and future basin-wide precipitation patterns (e.g., drought) will affect medium- and long-term inputs of freshwater. As was true for past deepenings of the navigation channel, SHEP will increase the amount of seawater flowing into the Savannah River Estuary, thereby resulting in new mixing patterns for seawater and freshwater. These new salinity levels, and their persistence, will determine the amounts and locations of post-construction marsh communities.

After making assumptions on sea level rise and river flows, the COE estimates the net conversion of tidal freshwater and brackish marsh into salt marsh (Table 1). The extent of these conversions for the NED plan is not clear. A 47-foot alternative for the navigation channel was not examined for SHEP until the late planning stages, well after much of the detailed modeling studies for examining effects on marshes were complete. Consequently, the Draft EIS and Draft GRR have relatively little information about the marsh succession expected to result from a 47-foot channel, and the information that is presented was not subject to the same level of interagency and peer review. In Draft EIS Appendix L (page 31), the COE concludes deepening the federal navigation channel to 47 feet would result in the net loss of 1177 acres of tidal freshwater marsh, a net loss of 298 acres of salt marsh, and a net gain of 1476 acres of brackish marsh. The predicted loss of salt marsh is not intuitive and not consistent with the gains in salt marsh predicted by the COE for the other depth alternatives, including 46 feet and 48 feet (COE

[2] Section 1508.8 of CEQ Regulations for Implementing the National Environmental Policy Act define indirect impacts as impacts that are caused by the action but occur later in time or farther removed in distance, but are still reasonably foreseeable.

2007). As of the date of this letter, the COE has not responded to our requests to verify the acreages in Appendix L.

While the Draft EIS appears to lack precise information on the impacts from the 47-foot channel on marsh communities, inferences can be made based on the predictions associated with other channel depths (Table 1). Approximately 1177 acres of tidal freshwater marsh would be converted to brackish marsh and salt marsh. While much of this marsh conversion would occur within portions of the Savannah National Wildlife Refuge, which the Department of Interior manages for migrating waterfowl, thereby diminishing the value of the marsh for this management purpose, it should be noted that increasing salinities could enhance tidal creek habitat for juvenile fish, crabs, and shrimp that prefer higher salinities than tidal freshwater. Nonetheless the COE aims to minimize the impacts to tidal freshwater marsh by rerouting water flows within the estuary. After examining model predictions of dozens of alternatives, the COE proposes a suite a flow modifications referred to as "Plan 6a" for minimizing impacts to tidal freshwater from the 45-foot, 46-foot, 47-foot, and 48-foot deepening alternatives, and a related suite, "Plan 6b," for the 44-foot alternative. The combination of a 47-foot channel and flow rerouting Plan 6a would result in 223 acres of tidal freshwater marsh and 740 acres of salt marsh being converted to a corresponding amount of brackish marsh.

As compensatory mitigation for these impacts, the COE proposes to purchase for Savannah National Wildlife Refuge tracts of land that include substantial, but not quantified, amounts of freshwater marsh or tidal freshwater marsh. The general plan for these purchases is described in Draft EIS Appendix C (VI Mitigation Plans), and the unnumbered table on page 90 of the appendix indicates 2245 acres of wetlands would be purchased to compensate for impacts resulting from the 47-foot channel. This amount was determined via the "SOP" that is used by staff from the COE's Regulatory Division. The Savannah National Wildlife Refuge has an approved (but largely unfunded) land acquisition plan that totals over 45,000 acres, so the COE envisions meeting the mitigation requirement by working closely with the Refuge to execute a portion of the land acquisition plan.

Indirect Impacts to Dissolved Oxygen Concentrations

The effects of SHEP on the concentrations of dissolved oxygen (DO) within the Savannah Harbor Estuary are complex to measure, model, and forecast. During development of the Draft EIS and Draft GRR, the COE coordinated with resource agencies on several studies that examined DO. Comparison of results from these studies must be done carefully because key model inputs (e.g., river flows, point-source pollution discharges) varied between reports or were not clearly stated and because the portion of the water column summarized differed (efforts to obtain clarification from the COE were not successful). Ideally, four sets of numbers are needed (existing conditions, deepening only, deepening plus flow rerouting, and deepening plus flow rerouting plus the injection of DO) by the COE to calculate mitigation needed to offset the effects of channel deepening and flow rerouting. The COE's use of tables to capture the temporal and spatial variability of DO concentration is effective, so NMFS used this format to assemble the four sets of numbers needed.

Table 2 presents the COE's forecasts of the effects of the project on the concentration of DO on a large portion of the Savannah River Estuary. Currently, large portions of the estuary frequently

experience low concentrations of DO, especially within Middle River, Lower Back River, and Back River. While deepening the navigation channel to 47 feet would increase the frequency of low concentrations of DO, rerouting water flows to bring freshwater to the Savannah National Wildlife Refuge is forecasted to have a greater impact than the deepening on the concentrations of DO within Back River (although rerouting the water is forecasted to partly offset impacts from deepening in portions of the Middle River). The COE plans to offset the impacts by injecting dissolved oxygen into the harbor via Speece cones at three locations (two on Hutchinson Island and one upriver from I-95 before the Savannah River divides into its distributary network).

Monitoring and Adaptive Management Plan (MAMP)
Gauging the effects of the channel deepening and flow rerouting is essential to determining whether the effects of SHEP are within the prescribed limits and that corrective actions, when necessary, are taken in a timely manner. On July 31, 2009, NMFS provided the COE with a detailed review of the MAMP. Those recommendations include several recommendations to increase the value of the monitoring program for understanding impacts to NMFS' trust resources. While the MAMP (Draft EIS Appendix D) has been improved since our last detailed review by updating the budget and adding finfish monitoring, several deficiencies are still present which must be addressed before NMFS can conclude the MAMP is adequate to mitigate impacts to EFH caused by the channel deepening and flow rerouting. The MAMP must:

List specific predictions that will be evaluated and triggers for action. The COE defines adaptive management to include: 1) evaluating the accuracy of the predicted environmental impacts; 2) assessing the effectiveness of the mitigation features; and 3) modifying the project as needed to ensure the levels of environmental effects predicted within the EIS are not exceeded. The plan appearing in Appendix D is not consistent with the COE's definition of adaptive management. Expected ranges of impacts are not provided. Instead, Appendix D emphasizes goals for the calibration of the models. As noted previously by NMFS and others resource agencies, calibration of models does not equate to ecological performance measures. NMFS recommends that the ecological performance measures be expressed as ranges, rather than single targets, to allow predictions to be tailored to seasonal conditions or less predictable environmental drivers (such as drought). Expression as ranges will also allow differentiation of levels that would become points of heightened concern or monitoring from levels that would serve as triggers for corrective actions. Further, the ecologically based performance measure ranges themselves may require adjustment if monitoring shows ecosystem responses differing from predicted outcomes.

Include a component that addresses dissolved oxygen (DO) concentrations. The concentration of DO within the Savannah Harbor Estuary has been reduced by runoff, industrial discharges, flow alterations, and deepening of the navigation channel. Modeling studies conducted to support development of a Total Maximum Daily Load for DO concentrations in the Savannah River Estuary estimate that, because of channel dredging, the existing concentration of DO is 1 mg/L lower than it was during the baseline year (1854) and condition (12-foot controlling depth); deepening the channel to 47 feet would further lower the concentration of DO in the estuary. While the COE believes an injection system can be used to offset any additional reductions in the concentration of DO that would result from a deepened navigation channel, the technology has not been demonstrated to be effective in applications with a tidal range similar to the Savannah

River Estuary. A limited test of the technology in 2007 had equivocal results, and the COE's model results show that several areas within the estuary (e.g., Lower Back River 3) will not be fully mitigated by the injection system. Added to this technological uncertainty is the budgetary uncertainty resulting from the operation of the injection system being dependent on timely federal appropriations in perpetuity for basic operation, maintenance, and increases in capacity should changes in climate or sea level rise result in greater decreases of DO than what was modeled for the Draft EIS and Draft GRR. Given the potential for unacceptable, detrimental impacts to DO concentrations within the estuary resulting from SHEP on tidal or daily time scales, the MAMP should include a process that allows informed decisions to be made in a timely manner (i.e., days) to ensure DO concentrations meet project requirements for shortnose sturgeon and other fishery species.

Include the Dissolved Oxygen Injection System in the "Components of Approved Adaptive Management Plan." Draft EIS, Appendix D, Section 10 describes modifications that could be implemented without further public coordination or agency approvals. The proposed DO injection system has not been proven to be an effective mechanism for sustaining sufficient levels of DO in the environmental setting of the SHEP. Because DO concentration is a key requirement for ensuring the survival of shortnose sturgeon and other benthic fishes, it is imperative that the MAMP provide readily implementable and timely procedures for making adjustments to the deployment and operation of Speece cones to meet the required concentrations of DO. Section 10 B should be amended to include adjusting and/or expanding the DO injection system as required to meet required DO concentrations.

Clarify the decision making process for the MAMP. NMFS and other agencies have consistently indicated to the COE that the success of the overall mitigation plan for SHEP depends on whether there is reasonable assurance that there will be no net harm to the estuary. A key component of a viable MAMP will be the adoption through an interagency collaboration of ecological performance measures. A robust, durable interagency collaborative decision-making process for identifying and adopting these performance measures is a necessary component of the MAMP.

Essential Fish Habitat Conservation Recommendations

NMFS finds the project, as proposed, would have substantial adverse impacts on EFH. Section 305(b)(4)(A) of the Magnuson-Stevens Act requires NMFS to provide EFH conservation recommendations when an activity is expected to adversely impact EFH. Based on this requirement, NMFS provides the following:

EFH Conservation Recommendations

1. The COE shall complete surveys for hardbottom habitat within the proposed Ocean Bar Channel extension, including a 1000-foot buffer from each channel edge. The methods and plans for the survey shall be developed in coordination with NMFS. Any hardbottom habitat shall be mitigated through a plan developed in coordination with NMFS.

2. The COE shall develop ecological performance criteria for each component of the MAMP. The performance criteria shall specify ranges of values believed to be acceptable based on the current understanding of how the Savannah River Estuary is expected to respond to the deepening of the navigation channel, rerouting of river and tidal flows, variability in river inflows, sea level rise, and other factors that affect the dynamic distribution of habitats within the Savannah River Estuary. The COE also shall make publicly available the GIS data (e.g., polygons used for all calculations of marsh acreage) and other information needed to allow resource agencies and the public to examine the basis of the performance criteria and to gauge effects from the project.

3. The COE shall establish, via a charter or similar mechanism, an expert team to independently oversee the MAMP. The team shall include representatives from academia as well as the federal and state resource agencies. The charter shall specify how team members will access monitoring data and reports and the team's decision making authority with respect to certifying the efficacy of the data and reports and determining when corrective measures are needed. A clear commitment to establish the team, as evidenced by including a draft charter in the Record of Decision would help provide NOAA the reasonable assurance it needs to conclude the mitigation plan adequately addresses the potential environmental impacts of the project.

4. The MAMP shall include a real-time component that examines the concentration of DO so that changes to the deployment and/or operations of the Speece cones (or other methods the COE uses to inject oxygen into harbor waters) can be made to achieve established performance criteria. The locations of real-time monitoring shall be developed in consultation with NMFS and, at a minimum, shall include the locations within the estuary expected to have lower concentrations of dissolved oxygen despite the injection. Data from the real-time monitoring shall be available publicly.

5. The MAMP shall include monitoring of crabs and shrimp along with the finfish and vegetation monitoring so that the effects of SHEP on a full suite of fishery species that use the marshes as nursery habitat can be gauged.

6. Dredging shall not occur when the concentration of DO is below 3.0 milligrams per liter within the bottom waters of portion of the estuary that is being dredged. The zones used in the Draft EIS, Draft GRR, and supporting material for examining the concentration of DO would be zones used for implementing this conservation recommendation.

Section 305(b)(4)(B) of the Magnuson-Stevens Act and implementing regulation at 50 CFR Section 600.920(k) require the COE to provide a written response to this letter within 30 days of its receipt. If it is not possible to provide a substantive response within 30 days, an interim

response should be provided to NMFS. A detailed response then must be provided prior to final approval of the action. The COE's detailed response must include a description of measures proposed by your agency to avoid, mitigate, or offset the adverse impacts of the activity. If the COE's response is inconsistent with these EFH conservation recommendations, the COE must provide a substantive discussion justifying the reasons for not following the recommendation.

Comments on Sections of the EFH Assessment (Draft EIS Appendix S)

The following comments, organized by section of the EFH Assessment, are mostly editorial and are provided to guide the COE in completing the project's administrative record. The general comment is that the EFH assessment has very little discussion of impacts to fish and how they interact with the EFH within the project area.

1.0. Overview: Rather than listing the EFH not in the project area, it would be better to list the EFH that is in the project area.

Table 1-1.

- Red drum is no longer managed under the Magnuson-Stevens Act and should be deleted from this table.
- America shad, hickory shad, blueback herring, shortnose sturgeon, and Atlantic sturgeon are not managed by SAFMC, do not have federal fishery management plans, and accordingly do not have EFH designations. These species should be deleted from this table.
- *Lilopenaeus* should be *Lytopenaeus*, and the HAPC designations for brown shrimp also apply to white shrimp.
- Pink shrimp, *Farfantepenaeus duorarum*, should be added to the table.
- Colum "EFH for Life Stages by Ecosystem" should be "Life Stages by Ecosystem."

Table 1-2.

- For the portion of the table focused on estuarine areas, the columns indicating potential impacts should be amended to include a column for the flow rerouting aimed at diverting freshwater towards the Savannah NWR, since this diversion will alter salinity and, accordingly, affect the distribution of marsh and oyster habitats.
- For the portion of the table focused on marine areas, inlet should be added (as a row).
- "Geographically Defined Habitat Areas of Particular Concern" should be "Habitat Areas of Particular Concern" since the table lists HAPCs defined habitat as well as those defined geographically.
- Hoyt Hills, Charleston Bump, Hurl Rocks, and Broad River should be deleted since they are outside the project area.

2.0 Potential Effects in Estuarine Areas. Oyster reefs and intertidal flats are described as not occurring in the project impact area, yet they are common in the areas affected by the rerouting of water flows and the channel deepening.

3.0 Impacts on Estuarine Emergent Wetlands. A citation for this quote should be provided.

3.1 Impacts from Excavation of Estuarine Emergent Wetlands. This section is confusing because the impacts to wetlands are the same for all alternatives, but the total amount of excavation is less for the 44-foot alternative that the others.

Figures 3-1, 3-2, 3-3, and 3-4. The text within the figures is not legible. Captions are needed for all figures to identify the purpose of each figure.

3.2 Mitigating Excavation of Estuarine Emergent Wetlands.

- NMF does not support the COE applying any mitigation that it believes is in excess of SHEP requirement to future projects.
- NOAA as well as FWS requested inclusion of creeks within the restored marsh.

Figure 3-4. The text within the figure is not legible. Figure needs a caption.

Table 4-1 and Table 4-12. The portion of the table dealing with indirect impacts should be expanded to include brackish and salt marsh. Gains in marsh acreage from the channel deepening should be listed as well as the direct losses listed in the bottom row. The portion currently labeled as salt marsh should be modified to indicate direct impacts to salt marsh.

4.2. Avoiding and Minimizing Impacts to Palustrine Emergent Wetlands. The bullets in the latter portion or this section (page 17), discuss impacts to American shad, southern flounder, and striped bass. While discussion of the impacts to these species is relevant to the project, none of these species have EFH designations. Accordingly, this discussion should be removed from the Appendix S and placed in a more appropriate location within the EIS.

4.3 Mitigation for Impacts to Palustrine Emergent Wetlands. Table 4-15 will need to be replaced with a table representing the 47-foot depth alternative.

5.1 Temporary Increases in Turbidity and 7.1 Temporary Increases in Turbidity.

- We agree that the effects of suspended sediments should be viewed as a function of concentration and exposure. So what concentration and exposure combinations is the COE proposing to be acceptable for SHEP?
- A citation should be provided for the work of Dr. Hayes. The relevant studies were performed during 1984, not 1986. Hayes, D.; Raymond, G.; McLellan, T. 1984. Sediment resuspension from dredging activities. Proceedings of Conference Dredging '84: Dredging and Dredged material Disposal, 14-16 November 1984, Clearwater Beach, FL. R.L. Montgomery and J.W. Leach (eds.), American Society of Civil Engineers, NY. Pages 72-82

5.2 Decreases in Dissolved Oxygen in the Water Column. Tables 5-3, 5-4, 5-5, 5-6, and 5-7 should be replaced with tables that provide the predicted concentrations of DO, not the predicted difference from the baseline.

5.3 Mitigation for Decreases in Dissolved Oxygen in Water Column. How will the screens be cleaned to ensure clogging does not increase flow velocities above the 0.5 feet per second?

9.0 Impacts to Live and Hard Bottom. Surveys should be done before completing the ROD.

Table 1. Predicted changes to marsh acreages within the study area from the channel deepening and the flow rerouting. Neither the Draft EIS, Draft GRR, nor any supporting materials provided to NMFS have information to complete the cells highlighted in yellow. This deficiency is not critical. It should be noted that this table does not appear in the Draft EIS or Draft GRR; the table was assembled from several information sources listed below. The acres reported for the 47-foot channel, deepening only, may be an error and have not been verified by the COE.

	Deepening Only (acres)					Deepening and Flow Rerouting (acres)				
	Tidal Freshwater	Brackish Marsh			Salt Marsh	Tidal Freshwater	Brackish Marsh			Salt Marsh
Depth	<0.5 ppt	0.6 to 1.0 ppt	1.1 to 2.0 ppt	2.1 to 4.0 ppt	>4.0 ppt	<0.5 ppt	0.6 to 1.0 ppt	1.1 to 2.0 ppt	2.1 to 4.0 ppt	>4.0 ppt
Current	4072	864	555	834	2506	N/A	N/A	N/A	N/A	N/A
44 feet						4394	1137	749	855	1698
45 feet	3105	1319	630	906	2873	4040	1781	588	745	1678
46 feet	3015	1050	921	789	3057	3871	1650	862	700	1749
47 feet	2895	1009	1355	1365	2208	3849	1641	889	687	1766
48 feet	2860	830	1215	739	3188	3735	1340	1191	790	1776
	Change from Deepening Only (acres)					Change from Deepening and Flow Rerouting (acres)				
44 feet	-551					322	273	194	21	-808
45 feet	-967	455	75	72	367	-32	917	33	-89	-828
46 feet	-1057	186	366	-45	551	-201	768	307	-134	-757
47 feet	-1177	145	800	531	-298	-223	777	334	-147	-740
48 feet	-1212	-34	660	-95	682	-337	476	636	-44	-730

Sources:

- GRR 1.1.31 – Specifically, Table 2 of *Savannah Harbor Expansion Project, Evaluation of Marsh/Wetland Impacts with Proposed Mitigation Plan, November 2007*, which was provided in September 2010.
- Table 1 of *Savannah Harbor Expansion Project, Evaluation of Marsh/Wetland Impacts, Plan 6a ONLY, August 2007*, which was provided to us by email on August 28, 2007, but does not appear to be an appendix to the Draft EIS or Draft GRR.
- Table 5-4 from the Draft EIS, September 2010.
- "Appendix A" of Appendix C to the Draft EIS, September 2010.
- Page 31 of Appendix L from the DEIS.

Table 2. Forecasts of the effects of SHEP, by zone, on the concentrations of dissolved oxygen within bottom waters of the Savannah River Estuary. Upper left panel shows existing conditions, upper right panel shows effects of deepening the federal navigation channel to 47 feet, lower right shows the combined effects of deepening the navigation channel and rerouting water flows, and the lower left panel shows the combined effects of deepening, flow rerouting, and injections of dissolved oxygen. Colors are based on State Water Quality Standards, which are 5.0 mg/L daily average and 4.0 mg/L instantaneous measures, and the level where deleterious effects are commonly reported (3.0 mg/L).

Zones - Existing Conditions

Zone	Episodic				Chronic				Constant
No.	1%	5%	10%	25%	50%	75%	90%	95%	99%
FR1	4.13	4.26	4.26	4.37	4.50	4.59	4.72	4.80	4.84
FR2	3.84	3.99	4.03	4.25	4.37	4.54	4.65	4.69	4.76
FR3	3.70	3.77	3.83	4.03	4.19	4.38	4.71	4.79	4.99
FR4	3.68	3.71	3.75	3.99	4.12	4.37	4.93	5.31	5.54
FR5	3.69	3.70	3.86	4.08	4.27	4.77	5.41	5.65	5.79
FR6	3.96	4.01	4.11	4.32	4.55	5.20	5.78	5.92	6.04
FR7	4.44	4.55	4.69	5.09	5.85	6.18	6.41	6.56	6.70
FR8	4.88	5.05	5.29	5.66	6.15	6.43	6.67	6.80	6.98
FR9	5.67	5.90	6.02	6.25	6.54	6.81	7.07	7.23	7.34
FR10	5.71	5.85	6.02	6.30	6.57	6.81	7.16	7.24	7.32
FR11	4.85	5.10	5.28	5.59	5.88	6.18	6.45	6.55	6.68
MR1	4.48	4.58	4.70	4.89	5.17	5.54	5.84	5.97	6.04
MR2	4.20	4.31	4.51	4.79	5.13	5.50	5.80	5.91	6.03
MR3	3.85	4.04	4.10	4.38	4.74	5.22	5.59	5.72	5.85
MR4	4.39	4.51	4.61	4.78	5.05	5.24	5.44	5.54	5.70
MR5	[illegible]	[illegible]	[illegible]	3.46	5.33	6.15	6.53	6.62	7.01
MR6	[illegible]	[illegible]	3.06	3.65	5.69	6.33	6.80	6.94	7.27
LBR1	4.30	4.50	4.58	4.80	4.99	5.19	5.30	5.45	5.57
LBR2	3.70	3.81	3.96	4.13	4.35	4.55	4.71	4.77	4.89
LBR3	3.84	3.96	3.96	3.78	3.95	4.11	4.24	4.35	4.46
BR1	3.53	3.66	3.64	3.90	4.04	4.21	4.43	4.50	4.60
BR2	3.30	3.35	3.46	3.62	3.82	3.99	4.14	4.30	4.39
BR3	3.49	3.61	3.58	3.63	3.74	3.85	3.97	3.99	4.02
SCh1	3.31	3.06	3.63	3.73	3.83	3.95	4.04	4.10	4.16
SCh2	3.94	4.04	4.09	4.25	4.38	4.49	4.61	4.65	4.73
SR	4.90	4.95	5.18	5.52	5.84	6.17	6.35	6.41	6.48
StbR	4.74	4.93	5.09	5.44	5.79	6.09	6.30	6.43	6.56

Zones - 47 feet

Zone	Episodic				Chronic				Constant
No.	1%	5%	10%	25%	50%	75%	90%	95%	99%
FR1	3.98	4.01	4.06	4.22	4.35	4.47	4.56	4.60	4.65
FR2	3.66	3.74	3.83	4.00	4.15	4.30	4.44	4.49	4.57
FR3	3.51	3.57	3.63	3.83	3.96	4.11	4.45	4.80	5.34
FR4	3.53	3.59	3.65	3.85	3.97	4.12	4.45	4.77	5.45
FR5	3.68	3.72	3.78	3.94	4.08	4.22	4.63	4.95	5.07
FR6	3.70	3.79	3.86	3.99	4.12	4.30	4.76	5.05	5.28
FR7	4.48	4.53	4.65	4.90	5.48	5.99	6.35	6.60	7.11
FR8	4.41	4.49	4.61	4.90	5.70	6.22	6.61	6.82	6.78
FR9	5.26	5.62	5.78	6.12	6.39	6.71	6.97	7.20	7.48
FR10	4.34	4.81	4.97	5.32	5.80	6.42	6.68	7.01	7.22
FR11	4.24	4.65	4.95	5.25	5.65	6.14	6.52	6.65	7.16
MR1	4.26	4.32	4.40	4.53	4.91	5.17	5.43	5.59	5.97
MR2	3.99	4.11	4.27	4.53	4.89	5.24	5.49	5.61	5.78
MR3	3.80	3.98	4.03	4.34	4.68	5.11	5.43	5.57	5.68
MR4	3.92	4.12	4.23	4.48	4.74	5.07	5.27	5.41	5.84
MR5	[illegible]	[illegible]	[illegible]	3.09	4.86	6.24	6.57	6.92	7.11
MR6	[illegible]	[illegible]	3.03	3.59	5.58	6.38	6.81	7.07	7.34
LBR1	3.64	4.25	4.78	5.21	5.45	5.69	5.99	6.18	6.60
LBR2	3.88	3.89	4.00	4.18	4.41	4.59	4.81	4.96	5.32
LBR3	3.16	3.41	3.59	3.87	4.18	4.61	4.86	5.03	5.35
BR1	3.27	3.41	3.59	3.71	3.94	4.16	4.36	4.43	4.61
BR2	3.54	3.58	3.00	3.22	3.43	3.65	3.84	3.91	4.02
BR3	3.01	3.20	3.34	3.51	3.70	3.87	4.02	4.08	4.28
SCh1	[illegible]	[illegible]	[illegible]	[illegible]	3.07	3.30	3.64	3.78	3.95
SCh2	3.68	3.81	3.91	4.12	4.29	4.43	4.57	4.64	4.72
SR	4.69	4.74	4.97	5.31	5.62	5.97	6.11	6.16	6.23
StbR	3.56	4.27	4.54	5.10	5.62	6.03	6.33	6.51	6.74

Zones - 47 feet + Flow Rerouting

Zone	Episodic				Chronic				Constant
No.	1%	5%	10%	25%	50%	75%	90%	95%	99%
FR1	3.93	3.96	4.05	4.20	4.34	4.48	4.56	4.60	4.65
FR2	3.66	4.08	4.17	4.32	4.46	4.61	4.76	4.82	4.93
FR3	3.61	3.66	3.70	3.91	4.04	4.22	4.58	5.09	5.47
FR4	3.61	3.66	3.70	3.92	4.03	4.20	4.60	5.02	5.53
FR5	3.73	3.78	3.88	4.05	4.18	4.38	4.83	5.07	5.28
FR6	3.72	3.83	3.89	4.07	4.19	4.38	4.86	5.15	5.34
FR7	4.40	4.53	4.65	4.89	5.45	5.93	6.31	6.55	7.12
FR8	4.38	4.49	4.60	4.88	5.64	6.14	6.44	6.57	6.72
FR9	4.91	5.32	5.48	5.97	6.38	6.69	7.02	7.20	7.36
FR10	4.69	5.04	5.23	5.55	5.89	6.32	6.60	6.85	7.16
FR11	4.18	4.59	4.81	5.11	5.65	6.14	6.40	6.66	6.94
MR1	4.20	4.34	4.43	4.66	4.94	5.17	5.47	5.66	5.99
MR2	4.22	4.38	4.49	4.71	4.98	5.24	5.55	5.68	5.78
MR3	4.19	4.36	4.44	4.64	4.94	5.19	5.41	5.50	5.53
MR4	4.38	4.45	4.59	4.77	5.06	5.30	5.59	5.69	5.99
MR5	[illegible]	[illegible]	3.12	3.86	5.36	6.19	6.53	6.78	7.03
MR6	6.16	6.32	6.45	6.64	6.90	7.23	7.41	7.51	7.61
LBR1	4.06	4.82	5.12	5.49	5.80	6.10	6.32	6.55	6.70
LBR2	4.46	4.57	4.69	4.92	5.14	5.38	5.56	5.58	5.81
LBR3	[illegible]	[illegible]	[illegible]	3.04	3.32	3.63	3.83	3.89	4.02
BR1	[illegible]	[illegible]	[illegible]	3.90	4.11	4.69	4.94	5.02	5.09
BR2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.16	3.32	3.41	3.58
BR3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.05	3.40	3.53	3.74
SCh1	[illegible]	[illegible]	[illegible]	3.44	3.05	3.73	3.64	3.78	3.91
SCh2	3.89	3.80	3.92	4.09	4.28	4.43	4.55	4.61	4.76
SR	4.88	4.73	4.96	5.30	5.61	5.86	6.10	6.15	6.22
StbR	3.75	4.30	4.59	5.11	5.67	6.05	6.32	6.45	6.66

Zones - 47 feet + Flow Rerouting + DO injection

Zone	Episodic				Chronic				Constant
No.	1%	5%	10%	25%	50%	75%	90%	95%	99%
FR1	4.21	4.27	4.32	4.46	4.57	4.64	4.75	4.82	4.84
FR2	4.16	4.18	4.19	4.44	4.52	4.72	4.79	4.83	4.90
FR3	3.88	3.96	4.03	4.26	4.41	4.55	4.87	4.87	5.00
FR4	3.89	3.97	4.06	4.28	4.41	4.61	5.05	5.37	5.57
FR5	3.97	4.06	4.21	4.38	4.57	4.89	5.37	5.69	5.80
FR6	4.25	4.29	4.37	4.54	4.86	5.15	5.67	5.98	6.16
FR7	4.64	4.69	4.81	5.13	5.78	6.27	6.53	6.65	6.74
FR8	5.00	5.06	5.33	5.65	6.22	6.61	6.87	6.92	7.24
FR9	5.66	5.95	6.07	6.38	6.76	7.07	7.30	7.55	7.71
FR10	6.26	6.37	6.51	6.81	7.07	7.31	7.73	7.87	8.04
FR11	5.51	5.68	5.84	6.14	6.38	6.64	7.01	7.15	7.32
MR1	4.70	4.85	4.98	5.18	5.45	5.74	6.04	6.16	6.22
MR2	4.73	4.87	5.00	5.27	5.53	5.78	6.04	6.12	6.27
MR3	4.74	4.90	4.92	5.20	5.47	5.74	5.99	6.11	6.30
MR4	5.25	5.37	5.47	5.66	5.93	6.16	6.45	6.67	6.86
MR5	3.44	3.73	4.15	4.58	6.34	6.96	7.39	7.62	7.81
MR6	[illegible]	[illegible]	[illegible]	3.37	5.01	5.42	6.56	6.69	6.96
LBR1	5.32	5.61	5.62	5.83	6.03	6.27	6.52	6.70	6.83
LBR2	4.86	4.94	5.10	5.29	5.51	5.75	6.05	6.10	6.27
LBR3	4.10	4.24	4.34	4.49	4.69	4.99	5.23	5.40	5.63
BR1	3.86	4.00	4.01	4.33	4.50	4.66	4.85	4.89	4.98
BR2	3.66	3.74	3.84	3.86	4.18	4.48	4.67	4.69	4.75
BR3	3.57	3.86	3.75	3.88	3.97	4.05	4.26	4.37	4.41
SCh1	3.58	3.66	3.72	3.54	3.94	4.02	4.10	4.16	4.21
SCh2	4.08	4.19	4.22	4.39	4.53	4.61	4.72	4.76	4.83
SR	6.07	6.15	6.30	6.64	6.94	7.22	7.72	7.77	7.89
StbR	5.10	5.32	5.44	5.75	6.08	6.34	6.51	6.59	6.74

Sources: Pages 9, 26, and 31 of GRR 1.1.32 (Evaluation of Water Quality Impacts with Proposed Mitigation Plan, September 2009; Table B-7 of GRR 1.1.4 (Oxygen Injection Design Report Savannah Harbor Expansion Project, Savannah, Georgia, October 15, 2010).

ENVIRONMENTAL IMPACT STATEMENT
APPENDIX S: Essential Fish Habitat Evaluation

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

ADDENDUM 2

Responses to NMFS Draft Essential Fish Habitat Conservation Recommendations

US Army Corps of Engineers
Savannah District
South Atlantic Division

Response to National Marine Fisheries Service Essential Fish Habitat Draft Conservation Recommendations

Listed below are the NMFS' Essential Fish Habitat (EFH) conservation recommendations and the Corps' responses. As described in this document, the Corps intends to implement the EFH recommendations as part of SHEP, with the exception of Recommendation #3. The Corps does not believe implementation of Recommendation #3 is necessary to project purposes and will continue to coordinate with the participating Federal resource agencies as outlined in the FEIS and its appendices.

1. Complete surveys for hard-bottom habitat within the proposed Ocean Bar Channel extension, including a 1,000-foot buffer from each channel edge.

RESPONSE: Concur. The Corps will soon award a contract to perform this survey. We will coordinate the results with NMFS.

2. This Recommendation includes several actions related to the Monitoring and Adaptive Management Plan: (A) Develop ecological performance criteria for each component of the Monitoring and Adaptive Management Plan. (B) The performance criteria shall specify ranges of values believed to be acceptable. (C) Make publicly available the GIS data and other data to gauge effects of the project.

RESPONSE:
(A) Develop ecological performance criteria for each component of the Monitoring and Adaptive Management Plan. The Corps believes that ecological performance criteria are not appropriate for each component of the Monitoring and Adaptive Management Plan. Many components of the project monitoring will be based on examination of physical changes in the estuary – particularly salinity and dissolved oxygen levels. Other components will include biological factors, such as monitoring the distribution of Shortnose sturgeon in the estuary. The Corps has revised the Monitoring and Adaptive Management Plan to incorporate many of NOAA's performance criteria suggestions.

(B) The performance criteria shall specify ranges of values believed to be acceptable. The FEIS states that adaptive management may be needed if an observed result shows a variation from the predicted level that is larger than the variability/accuracy of the model. The Corps has revised the Monitoring and Adaptive Management Plan to incorporate NOAA's suggestion about identifying a range of typical values at the continuous monitoring locations.

(C) Make publicly available the GIS data and other data to gauge effects of the project. Concur. The EIS states that the Corps would release the monitoring reports to the public. The Corps also intends to post water quality data on-line so they would be available to the public in near real-time.

3. Establish an expert team to independently oversee the Monitoring and Adaptive Management Plan. The team shall include representatives from academia as well as the federal and state resource agencies.

RESPONSE: The Corps does not concur with this measure. The Corps has a non-delegable responsibility to comply with all applicable laws, regulation, and policies and to ensure the proper expenditure of appropriated funds. The Corps will consult with the natural resource agencies to obtain their views. The Adaptive Management Plan in the EIS describes how the Corps would coordinate with the public and other agencies, and how the decisions would be made.

4. The Monitoring and Adaptive Management Plan shall include a real-time component that examines the concentration of D.O. The locations of real-time monitoring shall be developed in consultation with NMFS.

RESPONSE: The Monitoring and Adaptive Management Plan includes the proposed locations of the monitoring stations, as well as a description of the Corps' intent to post the water quality data real-time.

5. The Monitoring and Adaptive Management Plan shall include monitoring of crabs and shrimp.

RESPONSE: Concur. The Corps would assess the distribution of crabs and shrimp in the estuary as part of its monitoring of fish distribution. The investigators who conduct the fish sampling in the drop-net sampling of tidal rivers will also document the occurrence and distribution of crabs and shrimp

6. Dredging shall not occur when the concentration of D.O. is below 3.0 mg/liter.

RESPONSE: The Corps would install and operate oxygen injection systems to mitigate for expected impacts to dissolved oxygen caused by deepening project.

Once the systems are operational, the Corps would perform a Transfer Efficiency Study to identify how effective the systems are in delivering oxygen to the estuarine waters. The project would also perform extensive monitoring to ensure the oxygen distributes throughout the estuary as intended. If the oxygen injection systems do not perform as designed, the Corps would modify the systems as part of Adaptive Management.

The Monitoring and Adaptive Management Plan also includes periodic assessments of the project impacts to ensure the impacts to DO levels are not greater than what is estimated by the agency-approved models. If impacts are greater than predicted, Adaptive Management funds would be used to modify the DO systems to ensure that impacts are no worse than the predictions for those field conditions.

Should the Corps need to dredge when D.O. levels are below 3 mg/L, it is required to seek concurrence from GA DNR-EPD. It would also coordinate any such request with NOAA Fisheries.

ENVIRONMENTAL IMPACT STATEMENT APPENDIX T: US Fish and Wildlife Service Savannah National Wildlife Refuge Compatibility Determination

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

US Army Corps of Engineers
Savannah District
South Atlantic Division

Editor's Note: This Compatibility Determination is still a draft. It will not be finalized until after the Savannah Harbor Expansion Project Record of Decision has been signed by the cooperating Federal Agencies.

Compatibility Determination

Use: Hydrological modifications and wetland restoration on the Savannah National Wildlife Refuge as mitigation for the Savannah Harbor Deepening Project.

Refuge Name: Savannah National Wildlife Refuge

Counties: Chatham County, Georgia, and Jasper County, South Carolina.

Establishing and Acquisition Authorities:

On April 6, 1927, Executive Order No. 4626 established the Savannah River Bird Refuge and set aside 2,352 acres as a preserve and breeding ground for native birds. On November 12, 1931, Executive Order No. 5748 added 207 acres to the refuge and renamed the area the Savannah River Wildlife Refuge. An additional 6,527 acres were assigned to the refuge on June 17, 1936, by Executive Order No. 7391. On July 30, 1940, Presidential Proclamation 2416 renamed the refuge the Savannah National Wildlife Refuge. These three Executive Orders established the 9,086 acre core of the present refuge; subsequent acquisition using Duck Stamp funds and other special funding added 3,557 acres. An additional 459 acres were added when the fee title to Hog Marsh Island and adjacent lands to the north were acquired through an exchange of spoilage rights with Chatham County, Georgia. In 1964, Savannah Electric and Power Company deeded 34 acres to the refuge in exchange for a power line right-of-way. In 1978, the 12,472-acre Argent Swamp tract was purchased from Union Camp Corporation using Land and Water Conservation Funds. Bear Island (687 acres) was purchased in fee title, from a private individual, on October 19, 1993. In order to straighten the east boundary, two tracts totaling 54 acres were purchased from Union Camp Corporation, on August 27, 1996. The Barrows tract (535 acres), which lies adjacent to our southeast boundary, was purchased in fee title during 1998. Another tract of land was purchased on the mid-western portion of the refuge; the Solomon tract was purchased in 1999 and is 887 acres. Finally, in 2001, 397 acres was added to the refuge to provide migratory bird habitat. Total refuge acreage is currently 29,175.

Refuge Purposes:

Savannah National Wildlife Refuge was established "as a refuge and breeding ground for birds and wild animals subject to future use in navigation if necessary and to valid existing rights if any" (Executive Order 5748, April 6, 1927); for lands acquired under the Migratory Bird Conservation Act "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds" (16 U.S.C. § 715d); for lands acquired under the Refuge Recreation Act for "(1) incidental fish and wildlife-oriented recreational development, (2) the

protection of natural resources, (3) the conservation of endangered species or threatened species" (16 U.S.C. § 460k); for "the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions" (16 U.S.C. § 3901(b), 100 Stat. 3583, Emergency Wetlands Resources Act of 1968); "for the development, advancement, management, conservation, and protection of fish and wildlife resources" (16 U.S.C. § 742f(a)(4)); and, "for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude" (16 U.S.C. § 742f(b)(1), Fish and Wildlife Act of 1956).

National Wildlife Refuge System Mission:

The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

Description of Use:

The 1999 Water Resource Development Act (WRDA) included conditional authorization of the Savannah Harbor project, which would deepen the Savannah harbor by up to six feet (from 42' up to 48'). Department of Interior, Department of Commerce and Environmental Protection Agency concurrence is required before project implementation. This is a complex project that has the potential to directly and indirectly affect the Savannah National Wildlife Refuge (NWR).

Savannah National Wildlife Refuge lies adjacent to, and upstream of, the Savannah Harbor project. Savannah NWR consists of 29,175 acres of palustrine forested wetlands, palustrine and estuarine emergent wetlands, palustrine scrub-shrub wetlands, riverine wetlands, diked waterfowl impoundments (managed wetlands) and uplands. About 6,000 acres are actively managed wetlands which provide excellent habitat for wintering waterfowl, shorebirds, wading birds, and wood ducks. The refuge encompasses much of the high value fish and wildlife habitat that has been or is likely to be impacted by harbor development.

Deepening the Savannah Harbor (without any mitigation measures) could mean the loss of about 1,212 acres of freshwater wetlands according to the Corps of Engineers. The majority of these wetlands are within the Savannah NWR. These freshwater wetlands would convert to brackish marsh because deepening would allow more saltwater to flow upriver on high tide.

Tidal freshwater marsh is one of the most diverse wetland types and provides excellent fish and wildlife habitat. Cumulative impacts of previous deepening projects have converted most of the tidal freshwater marsh to less diverse brackish marsh. Maintenance of normal tidal and salinity patterns is a major objective of coastal refuges and management areas to meet their wildlife objectives (Weller 1994). Therefore, the Service goal is to avoid loss of tidal freshwater marsh due to salinity increase.

The Corps proposes mitigating these impacts by utilizing engineering solutions, also known as flow modifications. The engineering solutions that would have direct impact on the Refuge include: 1) installation of two diversion structures at McCoys Cut (one on either side of the river); 2) closing the western arm of McCoys Cut; 3) closing Rifle Cut; and 4) deepening the upper portions of the Middle and Back Rivers. (Figure 1).

On-site observations indicate that much of the river flow entering the upstream arm of McCoys Cut flows into the downstream arm and returns to the Front River. It is likely that flow through the downstream arm would reduce the effectiveness of the potential McCoys Cut diversion structure. Therefore it is critical that this portion of McCoy's Cut be closed to insure the maximum amount of fresh water down the Back River.

The diversion at McCoys Cut would consist of two structures, one on each side of the river. A rock diversion structure would extend about 465 feet from the Georgia side of the river and a sheetpile diversion wall would extend roughly 150 feet from the South Carolina shoreline. Working together, they would divert flow through McCoys Cut into the Back and Middle Rivers. The rock diversion structure would extend at a downstream angle from the inside of a bend in the Savannah River to move the deepest part of the channel toward the SC side of the River. It would have a crest elevation of 0 MLLW (Mean Lower Low Water; the average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch), so it would be submerged during most of the tide cycle. The structure would extend nearly half the width of the River, where the river is roughly 10 feet deep MLLW. The sheetpile diversion wall would redirect some of the flow down McCoys Cut while also limiting erosion of the outside of the bend from the additional flow. The sheetpile wall would have a top elevation of + 11 feet MLLW and be exposed except during high river flows. Rock may be placed along the sheetpile wall. Most of the construction would take place from barges to minimize impacts to adjacent lands. Additional design work would be performed prior to construction, so the design parameters described above may be altered slightly to improve the structures' performance.

The Western (downstream) arm at McCoys Cut would be closed by constructing a plug at one end. The end closest to McCoys Cut has been targeted for closure. The plug would be constructed of fill and rock and would extend to 10 feet above mean high water. The Corps design calls for a 185-foot long plug using 3,100 cubic yards of rock. After the rock plug is placed, sediment excavated from McCoys Cut would be deposited mechanically to widen the plug to a top width of 30-feet when measured at the adjacent ground elevation. A clamshell is

expected to be used to reach across the rock plug to deposit the sediments. Construction would take place from barges to minimize impacts to adjacent lands.

The closure plan for Rifle Cut is to construct a rock plug on the Middle River end of the Cut. The plug would be constructed from 3,300 cubic yards of rock to an elevation of 10 feet mean low water or about two feet above mean high water. Barges or removable mats would be utilized to place material in the cut to minimize impacts to adjacent marshes. Based on the current plans, the width of that closure would be about 50 feet. In addition to refuge impacts, there will be some unavoidable disturbance to brackish and saltwater wetlands (estuarine emergent wetlands) off refuge. Brackish tidal marshes occur along free flowing coastal rivers, and are influenced daily by the incoming tides. Although they are flooded by the tides, they receive enough freshwater from the river to dilute the salt water. Brackish marshes are characterized by salt tolerant plant species, typically emergent grasses, sedges, rushes and forbs, making them structurally diverse. Brackish marsh represents the middle of gradient, ranging from coastal salt marsh, to brackish tidal marsh, to freshwater tidal marsh. Typically, brackish marsh is comprised of high marsh, low marsh, and mud flats, all of which provide habitat for a diversity of plant and animal species. Brackish marsh is of high value to estuarine larval marine organisms such as shrimp, crabs, and fish.

Estimates by the Corps are that 15.68 acres of saltwater/brackish wetlands will be lost due to the need to expand (excavate) the Kings Island Turning Basin and the removal of the old tide gate. The Corps proposes to mitigate for the loss of these off-refuge wetlands through restoring a previously disturbed site on the refuge. This restoration effort would restore to its original state, approximately 45 acres of degraded habitat at the south end of Onslow Island. Restoration would include grading down the site (an old spoil deposition area), removal of the woody vegetation, and revegetation of the site with native wetland plant species (Figure 2).

Anticipated Impacts of the Use:

Stream Flow Diversion

Negative impacts of the flow diversion work are predicted to be limited, based on the Corps hydraulic analysis. In each case (McCoys Cut Diversion Structures, closing the western arm of McCoys Cut, Rifle Cut Closure, and deepening of the upper portions of Middle and Back Rivers) construction work will be accomplished from barges, and when necessary, removable mats. Where the McCoys Cut diversion structures tie into the refuge shoreline, we anticipate short-term disturbance to wildlife as a result of increased human activity and noise during construction operations. This disturbance is expected to be minimal and relatively short lived, especially since most of the work will be completed from barges. About 30 feet of shoreline that will be permanently impacted by the addition of rip-rap at the point where the diversion structures meet the shore. These impacts should be small and off-set through site restoration.

Sediments obtained while deepening the upper portions of Middle and Back Rivers would be deposited off the Refuge.

Positive impacts from the increased freshwater flow down the Back River are expected. The Diversion structure at the mouth of McCoys Cut, the closure of the western arm of McCoys Cut, and the deepening of the upper portions of Middle and Back Rivers will insure an adequate supply of fresh water down the Back River. It is anticipated that closing just one end of McCoys Cut would result in a small dead-end creek extending from the Savannah River. This creek would fill over time, but is expected to provide valuable fish habitat until the depths become too shallow, at which point it would be used by waterbirds and wildlife.

The closure of Rifle Cut will prevent saltwater from entering the Back River from Middle River. This will protect the refuge from additional saltwater intrusion and insure adequate fresh water to the refuge. Additionally, it is expected that filling the cut at one end will result in the remainder of the cut functioning as a small dead-end creek, with its opening on Back River. This creek would accumulate sediment over time and become marsh, but would provide shallow fish and wildlife habitat until that occurs.

Wetland Restoration

The restoration of 45 acres of an existing degraded, spoil area, back to a functioning brackish marsh will provide a positive impact for the refuge. This wetland restoration will convert an area that was used for the deposition of dredge material for many years back to its previous natural condition (Figure 2). Current conditions at the site include invasive/exotic plant species, deposited dredge material, and severely disrupted hydrology. While there will be short term disturbance from the construction/restoration activity (noise, surface disturbance, human activity), it is expected that the restoration site will become a functional estuarine habitat and greatly benefit a diversity of plant and animal species.

Cultural Resource Survey

Prior to construction, the Corps will survey the proposed impact areas to identify any cultural or historic resources that could be impacted. The Corps will document any sites that it finds and determine their eligibility for listing on the National Register of Historic Properties. If adverse impacts are expected that cannot be avoided, the Corps will coordinate with the Fish and Wildlife Service staff and the appropriate State Historic Preservation Officer (SHPO) to identify suitable mitigation. The Corps would then implement any mitigation that the SHPO agrees would be appropriate. Since some of these areas have not previously been surveyed for cultural or historic resources, these surveys will provide the Fish and Wildlife Service with additional information about resources located within the Refuge.

Public Review and Comment:

The period of public review and comment began November 10, 2010 and ran through January 11, 2011.

The following methods were used to solicit public review and comment:

- A Press Release for the Savannah Harbor Expansion Plan was issued to local newspapers in Chatham, Effingham and McIntosh counties, Georgia and in Jasper and Beaufort counties, South Carolina; additionally the documents were posted for public review on http://sav-harbor.com. These documents included the draft compatibility determination.

- Paid Advertisements will be purchased in the *Savannah Morning News* ; and,

- The Compatibility Determination was included in the draft Environmental Impact Statement which was distributed to all State, Federal, and Non-governmental agencies with an interest in the Savannah Harbor Expansion Project.

Why was this level of public review and comment selected?

Due to the complexity and potential impacts of the Savannah Harbor Expansion Project it was determined that this Compatibility Determination would go through the same public review as the draft project Environmental Impact Statement. The Corps issued the draft Environmental Impact Statement and General Reevaluation Report for public and agency review on November 10, 2010 through January 11, 2011. No comments were received on the draft Compatibility Determination

DRAFT

Determination: Use is compatible with the following stipulations.

Stipulations Necessary to Ensure Compatibility:

1. As detailed construction plans are developed, the Corps will provide the plans to the Service and meet with the Service to address measures to minimize impacts. All construction and restoration in areas of Savannah NWR will be closely monitored by the Corps and coordinated with Service staff, and will occur prior to or concurrent with harbor deepening

2. The extent of the project on refuge lands will be clearly delineated prior to initiation of construction activities.

3. Work area will be kept clean at all times and the Service will be notified immediately in the event of any type of chemical (fuel) spill.

4. Firearms are not permitted on the refuge.

5. All work related to closure of McCoys Cut, the diversion structure, and closure of Rifle Cut will be conducted from the water. Mats may be used in some circumstances after close coordination with the Service. All necessary materials will be stored on barges and placed only in the project area.

6. Monintoring and contingency plans will be in place for a minimum of seven years after the completion of the restoration project to insure successful restoration of the site. In the event restoration is deemed unsuccessful, the Corps will replant the site to insure success and compliance.

7. The Corps will be responsible for maintaining the structures for the life of the navigation project.

NEPA Compliance for Refuge Use Decision: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement

__X__ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

Justification:

The deepening of the Savannah Harbor up to 48' will negatively impact the Savannah National Wildlife Refuge. However, with the hydrological modifications and the wetland restoration proposed as part of the overall project plan, actual impacts to the Refuge can be reduced. The closure of McCoy's Cut, Rifle Cut, the installation of the diversion structure on the Front River, and the deepening in areas of the Back and Middle River will positively impact the refuge by supplying more fresh water down the Back and Middle Rivers, thus preventing salinity from moving further up river. It is anticipated that closing one end of McCoys Cut would result in a small dead-end creek extending from the Savannah River. This creek would fill over time, but is expected to provide valuable fish habitat until the depths become too shallow, at which point it would be used by waterbirds and wildlife. The closure of Rifle Cut will prevent saltwater from entering the Back River from Middle River. This will protect the refuge from additional saltwater intrusion and insure adequate fresh water to the refuge. Additionally, it is expected that filling the cut at one end will result in the remainder of the cut functioning as a small dead-end creek, with its opening on Back River. This creek would accumulate sediment over time and become marsh, but would provide shallow fish and wildlife habitat until that occurs.

Restoration of an old confined disposal area back to natural salt marsh will also be beneficial to the Refuge. The existing area has not been used in years and contains invasive plant and animal species that will be eliminated during the restoration. While there will be short term disturbance from the construction/restoration activity (noise, surface disturbance, human activity) the restoration site will become a functional estuarine habitat and greatly benefit a diversity of plant and animal species.

Signature: Refuge Manager: _____
(Signature and Date)

Review: Regional Compatibility Coordinator: _____
(Signature and Date)

Review: Refuge Supervisor: _____
(Signature and Date)

Concurrence: Regional Chief: _____
(Signature and Date)

Mandatory 10- or 15-Year Re-Evaluation Date: _____

References

DRAFT

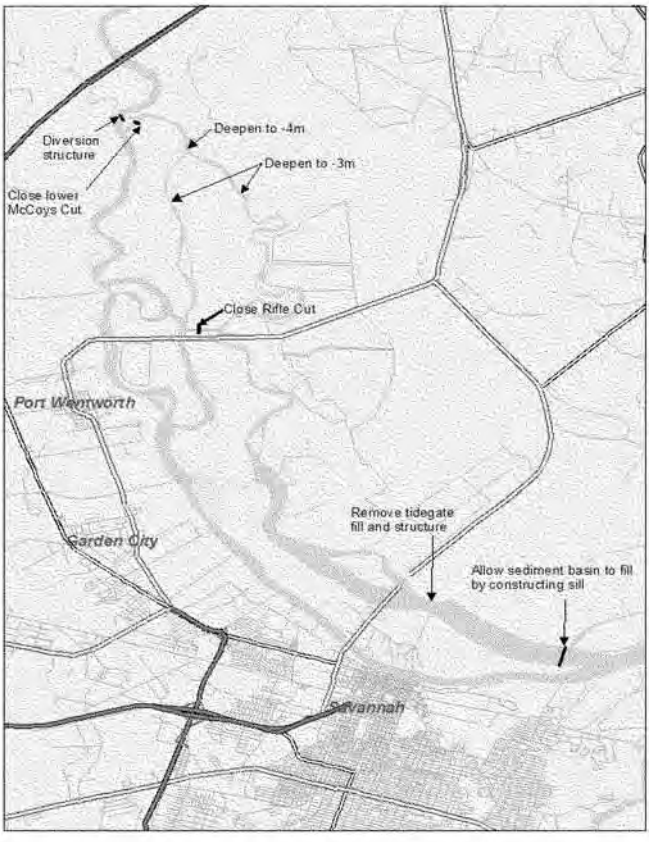


Figure 1. Proposed hydrological modifications for on the Front, Middle and Back Rivers.

Figure 2. Proposed salt marsh mitigation site, Onslow Island, Savannah National Wildlife Refuge.

ENVIRONMENTAL IMPACT STATEMENT APPENDIX U: Independent Technical Review of Use of Regulatory Standard Operating Procedures

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

US Army Corps
of Engineers
Savannah District
South Atlantic Division

Completion of Independent Technical Review (ITR)
Deep Draft Navigation Planning Center of Expertise
Ecosystem Planning Center of Expertise

Application of Savannah Districts Regulatory Standard Operating Procedure for Development of Mitigation, Savannah Harbor Channel Improvements

1. BACKGROUND

The Savannah River navigation channel is currently maintained at a depth of 42 feet (12.8 meters) MLW. The U.S. Congress, in the 1999 Water Resources Development Act (WRDA), conditionally authorized deepening the channel to a maximum depth of 48 feet (14.6 meters) contingent upon the completion of a General Reevaluation Report (GRR) and Tier II Environmental Impact Study (EIS), a final mitigation plan and an incremental analysis of the channel depths from 42 to 48 feet.

A major environmental consideration in this study is increased salinities caused by the deeper channel and resulting impacts to fresh water marsh within the Savannah National Wildlife Refuge located immediately upstream of the harbor project. This refuge is managed by the U.S. Fish and Wildlife Service. In order to assess the salinity changes caused by the deeper channel increments, the Corps conducted hydrodynamic/salinity model studies. Results of the model studies show substantial impacts to the fresh water marsh with any increment of deepening. As such, the Corps conducted additional model studies to assess the effectiveness of various engineered features that could possibly offset the impacts from the deeper channel. Results of the mitigation feature analysis reveal that additional mitigation would be required beyond implementation of the offsetting hydraulic features.

Neither the Corps, the natural resources agencies, the Stakeholders Evaluation Group, or the NGOs that were consulted could identify other sites in the Savannah River estuary that could potentially be used for restoration or creation of tidal freshwater marsh.

The USFWS confirmed that mitigation actions must be performed within the basin for those actions to be acceptable for the impacts caused to wetlands residing within the Savannah National Wildlife Refuge. The Service also confirmed that restoration, enhancement or creation of salt marsh would not be acceptable as mitigation for those losses. However, they suggested preservation of lands as a possible solution and provided desired locations which are a part of their long term lands acquisition strategy to compliment the Wildlife Refuge.

In order to determine the number of acres appropriate for the preservation feature of the mitigation, the Corps used the Standard Operating Procedures (SOP) used by natural resources agencies in Georgia to evaluate impacts and mitigation on projects requiring Section 404 permits. The Standard Operating Procedure used by Savannah District's Regulatory Division was developed by the interagency Mitigation Banking Review Team (MBRT). That team consists of representatives of EPA Region 4, US Fish and Wildlife

Service, National Marine Fisheries Service, US Army Corps of Engineers, and the Georgia Department of Natural Resources. The agencies use the SOP to quantify impacts to wetlands from actions described in Section 404 permit applications and determine the type and extent of actions that would provide acceptable mitigation. The SOP has been in existence for several years and is periodically revised when determined necessary by the MBRT.

Although the SOP was developed by the interagency Mitigation Banking Review Team for actions permitted through the Corps' Regulatory Division, it could also serve as a framework to quantify impacts from civil works projects such as this. EPA Region 4 suggested the Corps consider use of the SOP for this project.

The purpose of this ITR is to determine if the SOP is an appropriate method to determine the preservation acreage for impacts from the Savannah Harbor expansion project and comment on the reasonableness of the assumptions and calculations used in applying the SOP. The ITR was lead by the National Deep Draft Navigation Planning Center of Expertise with assistance from the Ecosystem Planning Center of Expertise for selection of appropriate ITR team members.

2. CHARGE TO ITR TEAM

The charge for this Peer review was to review and comment on the use of the Savannah Districts Regulatory Standard Operating Procedure (SOP) to determine preservation acreage necessary to complete mitigation requirements for the Savannah Harbor Expansion Project. There are other elements of mitigation in this study including minimization, and avoidance of impacts along with restoration features. The SOP was used only to determine the amount of preservation acres necessary to offset the remaining acreage impacted after development of alternatives that included the minimization, avoidance and restoration features. The purpose of this peer review was to assess only the use of the SOP. Other elements of the study and mitigation analysis will be assessed by additional ITRs and EPRs. As such the charge for the peer review team was as follows:

Comment on the appropriateness of using the Savannah Districts Regulatory Standard Operating Procedure (SOP) to determine the amount of preservation acreage necessary to complete mitigation requirements for wetland mitigation related to the Savannah Harbor Expansion Project (SHEP).

Comment on the reasonableness of the assumptions and calculations that Savannah District used in applying the SOP for the SHEP.

3. CONCLUSION

All comments in Dr. Checks have been closed out. The ITR team concurs with the use of the SOP to determine the amount of preservation acreage and consider Savannah District's application of the SOP to be reasonable. However, the ITR team has forwarded

several comments to be considered during ITR of the overall mitigation documentation. These comments relate to mitigation plan development and not use of the SOP. All comments are contained in the enclosed review report.

Independent Technical Review Team

Jeffry L. Trulick — Date
Economic and Environmental Team Leader
Baltimore District

Catherine Rogers — Date
Ecologist, Environmental Resources Section
New England District

Martin P. Wargo — Date
Chief, Environmental Analysis
Buffalo District

Michele Gomez — Date
Biologist, Civil Project Development Branch
Baltimore District

Independent Technical Review Certification
Application of Savannah Districts Regulatory Standard Operating Procedure for Development of Mitigation, Savannah Harbor Channel Improvements

I certify that the project review process required under my responsibility has been completed in accordance with all Corps regulations, requirements, and customer expectations.

_____ _____
Bernard Moseby Date
Acting Deputy Director
Deep Draft Navigation Planning Center of Expertise
Mobile District

_____ _____
David A. Vigh Date
Ecosystem Planning Center of Expertise
Vicksburg District

several comments to be considered during ITR of the overall mitigation documentation. These comments relate to mitigation plan development and not use of the SOP. All comments are contained in the enclosed review report.

Independent Technical Review Team

Jeffrey J. Trunck
Economic and Environmental Team Leader
Baltimore District

5-6-08
Date

Catherine Rogers
Ecologist, Environmental Resources Section
New England District

May 7, 2008
Date

Martin P. Wargo
Chief, Environmental Analysis
Buffalo District

MAY 8, 2008
Date

Michele Gomez
Biologist, Civil Project Development Branch
Baltimore District

30 April 2008
Date

Independent Technical Review Certification
Application of Savannah Districts Regulatory Standard Operating Procedure for Development of Mitigation, Savannah Harbor Channel Improvements

I certify that the project review process required under my responsibility has been completed in accordance with all Corps regulations, requirements, and customer expectations.

Bernard Mosby
Acting Deputy Director
Deep Draft Navigation Planning Center of Expertise
Mobile District

6/11/2008
Date

David A. Vigh
Ecosystem Planning Center of Expertise
Vicksburg District

5/21/08
Date

Charge to the Peer Reviewers
for
Savannah Harbor Expansion Project, Wetlands Mitigation, Use of SOP for Wetlands Preservation Determination

CHARGE

The charge is to review and comment on the use of the Savannah District's Regulatory Standard Operating Procedure (SOP) to determine preservation acreage necessary to complete mitigation requirements for the Savannah Harbor Expansion Project. There are other elements of mitigation in this study including minimization, and avoidance of impacts along with restoration features. The SOP was used only to determine the amount of preservation acres necessary to offset the remaining acreage impacted after development of alternatives that included the minimization, avoidance and restoration features. The purpose of this peer review is to assess only the use of the SOP. Other elements of the study and mitigation analysis will be assessed by other ITRs and EPRs. As such the charge for the peer review team is as follows:

Comment on the appropriateness of using the SOP to determine the amount of preservation acreage necessary to complete mitigation requirements for wetland mitigation related to the Savannah Harbor Expansion Project (SHEP).

Comment on the reasonableness of the assumptions and calculations that Savannah District used in applying the SOP for the SHEP.

BACKGROUND

The Savannah River navigation channel is currently maintained at a depth of 42 feet (12.8 meters) MLW. The U.S. Congress, in the 1999 Water Resources Development Act (WRDA), conditionally authorized deepening the channel to a maximum depth of 48 feet (14.6 meters) contingent upon the completion of a General Reevaluation Report (GRR) and Tier II Environmental Impact Study (EIS), a final mitigation plan and an incremental analysis of the channel depths from 42 to 48 feet.

A major environmental consideration in this study is increased salinities caused by the deeper channel and resulting impacts to fresh water marsh within the Savannah National Wildlife Refuge located immediately upstream of the harbor project. This refuge is managed by the U.S. Fish and Wildlife Service. In order to assess the salinity changes caused by the deeper channel increments, the Corps conducted hydrodynamic/salinity model studies. Results of the model studies show substantial impacts to the fresh water marsh with any increment of deepening. As such, the Corps conducted additional model studies to assess the effectiveness of various engineered features that could possibly offset the impacts from the deeper channel. The specific features and location are shown on figure 1 and table 1 show s the combinations that were modeled. As shown in table 2, results of the mitigation feature analysis reveal that additional mitigation would be required beyond implementation of the offsetting hydraulic features.

FIGURE 1
SAVANNAH HARBOR EXPANSION PROJECT
COMPONENTS OF WETLAND MITIGATION PLANS

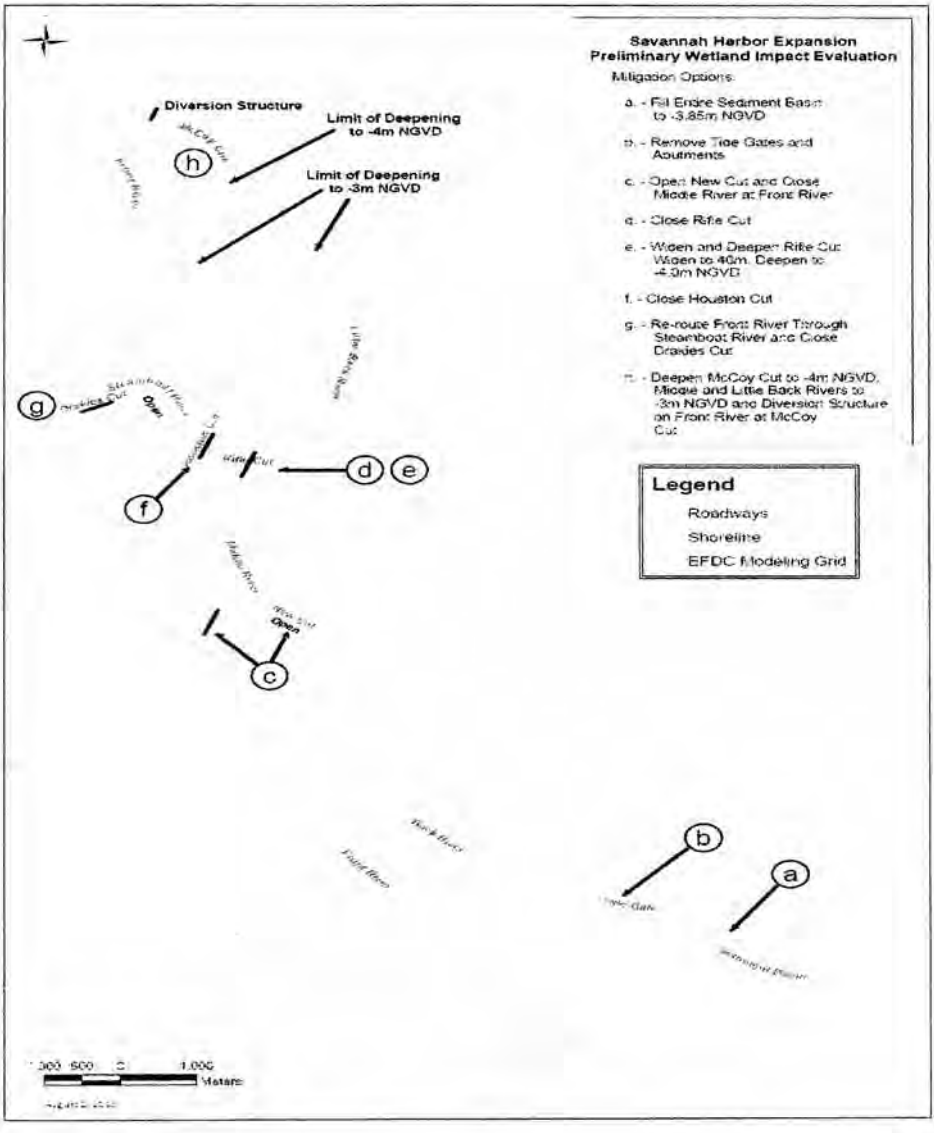


TABLE 1

Charge to the Peer Reviewers
for
Savannah Harbor Expansion Project, Wetlands Mitigation, Use of SOP for Wetlands Preservation Determination

CHARGE

The charge is to review and comment on the use of the Savannah District's Regulatory Standard Operating Procedure (SOP) to determine preservation acreage necessary to complete mitigation requirements for the Savannah Harbor Expansion Project. There are other elements of mitigation in this study including minimization, and avoidance of impacts along with restoration features. The SOP was used only to determine the amount of preservation acres necessary to offset the remaining acreage impacted after development of alternatives that included the minimization, avoidance and restoration features. The purpose of this peer review is to assess only the use of the SOP. Other elements of the study and mitigation analysis will be assessed by other ITRs and EPRs. As such the charge for the peer review team is as follows:

Comment on the appropriateness of using the SOP to determine the amount of preservation acreage necessary to complete mitigation requirements for wetland mitigation related to the Savannah Harbor Expansion Project (SHEP).

Comment on the reasonableness of the assumptions and calculations that Savannah District used in applying the SOP for the SHEP.

BACKGROUND

The Savannah River navigation channel is currently maintained at a depth of 42 feet (12.8 meters) MLW. The U.S. Congress, in the 1999 Water Resources Development Act (WRDA), conditionally authorized deepening the channel to a maximum depth of 48 feet (14.6 meters) contingent upon the completion of a General Reevaluation Report (GRR) and Tier II Environmental Impact Study (EIS), a final mitigation plan and an incremental analysis of the channel depths from 42 to 48 feet.

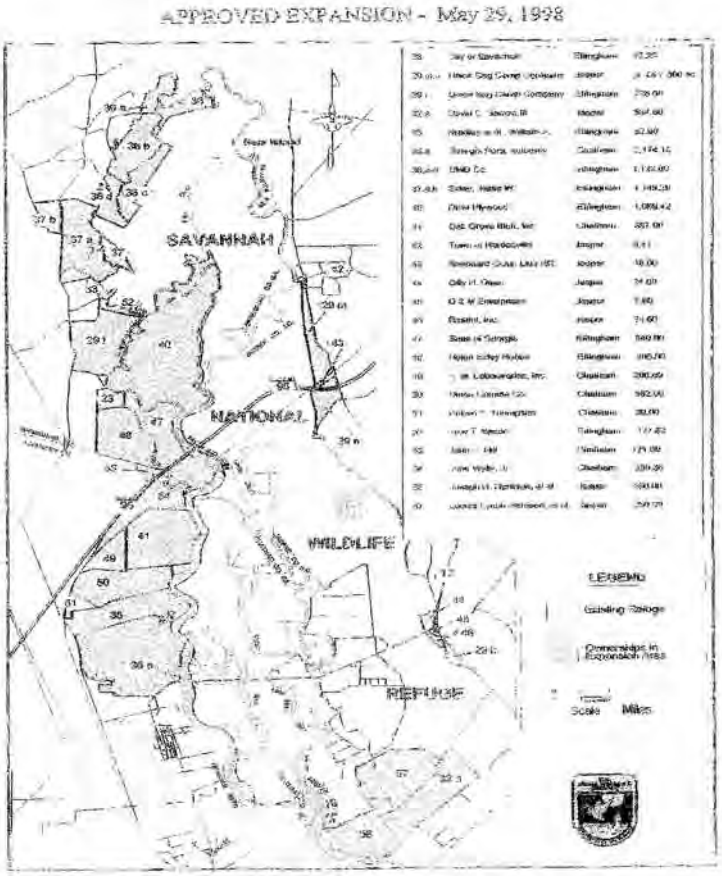
A major environmental consideration in this study is increased salinities caused by the deeper channel and resulting impacts to fresh water marsh within the Savannah National Wildlife Refuge located immediately upstream of the harbor project. This refuge is managed by the U.S. Fish and Wildlife Service. In order to assess the salinity changes caused by the deeper channel increments, the Corps conducted hydrodynamic/salinity model studies. Results of the model studies show substantial impacts to the fresh water marsh with any increment of deepening. As such, the Corps conducted additional model studies to assess the effectiveness of various engineered features that could possibly offset the impacts from the deeper channel. The specific features and location are shown on figure 1 and table 1 show s the combinations that were modeled. As shown in table 2, results of the mitigation feature analysis reveal that additional mitigation would be required beyond implementation of the offsetting hydraulic features.

44-FOO
45-FOO
46-FOO
48-FOO

Neithe
the NC
that co

The USFWS confirmed that mitigation actions must be performed within the basin for those actions to be acceptable for the impacts caused to wetlands residing within the Savannah National Wildlife Refuge. The Service also confirmed that restoration, enhancement or creation of salt marsh would not be acceptable as mitigation for those losses. However, they suggested preservation of lands as a possible solution and provided desired locations which are a part of their long term lands acquisition strategy to compliment the Wildlife Refuge. The location of these lands are shown on figure 2.

Figure 2
SAVANNAH NATIONAL WILDLIFE REFUGE
ACQUISITION MAP



In order to determine the number of acres appropriate for the preservation feature of the mitigation, the Corps used the Standard Operating Procedures (SOP) used by natural resources agencies in Georgia to evaluate impacts and mitigation on projects requiring Section 404 permits. The Standard Operating Procedure used by Savannah District's Regulatory Division was developed by the interagency Mitigation Banking Review Team (MBRT). That team consists of representatives of EPA Region 4, US Fish and Wildlife Service, National Marine Fisheries Service, US Army Corps of Engineers, and the Georgia Department of Natural Resources. The agencies use the SOP to quantify impacts to wetlands from actions described in Section 404 permit applications and determine the type and extent of actions that would provide acceptable mitigation. The SOP has been in existence for several years and is periodically revised when determined necessary by the MBRT.

Although the SOP was developed by the interagency Mitigation Banking Review Team for actions permitted through the Corps' Regulatory Division, it can also serve as a framework to quantify impacts from civil works projects such as this. EPA Region 4 suggested the Corps consider use of the SOP for this project. The SOP uses several factors to quantify the ecological impacts and benefits expected from various project actions. For impacts, those factors include the type of impact, the duration of the impact, the type of vegetation being impacted, and the preventability of the impact. For restoration, the factors include the improvement in hydrology and vegetation, timing of the restoration, maintenance that is expected to be needed, monitoring which would be performed, and control over the land to reduce future impacts. For preservation, the factors include the degree of threat to the identified lands, the type of vegetation occurring on the lands, and the control over the land to control future impacts.

The Corps took the impact data produced by the approved hydrodynamic model as the starting point for the SOP. The output included acreage for wetlands at different levels of salinity. They evaluated the output after the flow-altering features had been included. They decided to consider wetlands that would experience a loss in net acreage as ones that would experience an adverse impact. In a similar manner, wetlands that would experience an increase in net acreage as ones that would benefit from and be restored by the project. They grouped the output into 3 classifications of wetlands – Freshwater (<0.5 ppt), Brackish (0.5 to 4.0 ppt), and Saltmarsh (>4.0 ppt).

Using that approach, adverse impacts could be experienced to wetlands classified as Freshwater, Brackish and/or Saltmarsh, while restoration could occur in either Freshwater or Brackish marsh. The flow-altering features were the primary means through which the net acreage in Freshwater and Brackish marsh would increase. In the 44-foot depth alternative, the flow-altering features of Plan 6B would result in net increases in both Freshwater and Brackish marsh acreage, with a corresponding decrease in Saltmarsh acreage. Since the Freshwater and Brackish marshes had been determined to be more valuable than Saltmarsh for this project, the flow-altering features fully mitigated for the

effects on wetlands for the 44-foot depth alternative. Therefore, the Corps did not apply the SOP for that alternative.

The SOP considers many factors in its calculations of the ecological extent of a project's impact, and the value of the restoration and/or preservation features. Those factors are summarized as follows:

	FACTORS INCLUDED		
FACTORS	ADVERSE IMPACTS	RESTORATION	PRESERVATION
Type of Impact	X		
Duration of Impact	X		
Existing Condition	X		
Type of Habitat	X		
Preventability	X		
Rarity of Habitat	X		
Improvement in Vegetation		X	
Improvement in Hydrology		X	
Timing of Restoration		X	
In-Kind Vs Out-Of-Kind Mitigation		X	X
Maintenance Requirements		X	
Monitoring Plan		X	
Type of Control		X	X
Degree of Threat			X

One of the factors considered in the SOP is the degree of protection one would have over the lands to be acquired and preserved. That is the issue addressed in the factor titled "Control". Lands that are owned in fee or by a government agency are considered more protected from future adverse impacts than are lands protected only by a restrictive covenant or conservation easement. A conservation easement can sometimes be obtained from a private owner without the government needing to resort to condemnation. However, additional lands with an easement would be needed to provide the same total habitat value as would fewer lands provided under government ownership. The Corps consulted the natural resource agencies to determine the type of real estate interest the agencies that they believed would be most appropriate in this situation. The USFWS stated it believed that fee ownership would be required.

The Corps applied the SOP to this project, using the acreages output from the hydrodynamic model at various salinity levels. It also evaluated the extent of the impact that would occur to existing marshes -- conversion of one intertidal marsh type to another, and the benefit that would occur to marshes as a result of the flow-altering

features. We also considered development pressures that are on waterfront properties in this estuary. Using the SOP, the 48-foot alternative would result in 7,368 units of adverse impacts to wetlands. Those must be mitigated by at least an equal number of restoration and preservation units. In Georgia, the agencies' policy is that acceptable mitigation should consist of at least 50 percent restoration. For this project, restoration through the flow-altering features would comprise 66 percent of the total wetland mitigation for the 48-foot alternative, 80 percent for the 46-foot alternative, and 100 percent for the 44-foot alternative. The SOP calculations determine the minimum number of acres that need to be acquired and preserved to acceptably mitigate for wetland impacts. For the project, those numbers are shown in Table 3.

Table 3

PRESERVATION NEEDS
AS DETERMINED BY SOP CALCULATIONS
FOR WETLAND IMPACTS

DEPTH ALTERNATIVE	MINIMUM ACRES NEEDED
44-FOOT	0
45-FOOT	993
46-FOOT	1083
48-FOOT	2094

The following table summarizes the results of the SOP calculations for the 48-foot alternative. The details of the SOP application for each depth are shown with the supplemental reference materials provided with this charge.

Table 4
SUMMARY OF SOP CALCULATIONS
48-FOOT ALTERNATIVE

ADVERSE IMPACT	FRESHWATER	BRACKISH	SALTMARSH	TOTAL
Acres	337		730	
Units	2696		4672	7368
RESTORATION				
Acres		1156		
Units		4855.2		4855.2 (66%)
PRESERVATION				
Acres		2094		
Units		2512.8		2512.8 (34%)

DOCUMENTS PROVIDED
The following documents have been provided to the peer reviewers:

Briefing package provided to reviewers and discussed on 19 November telephone conference.

Web site for Standard Operating Procedure.

SCHEDULE

- Peer Review Team Briefing 19 November, 2007
- Review Charge to Peer Reviewers 6 December, 2007
- Peer Reviewers submit comments to PCX 14 December, 2007

GENERAL CHARGE GUIDANCE
1. If desired, ITR panel members can contact each other or Savannah District POC William (Bill) Bailey.

2. Please contact the Planning Center for Deep Draft Navigation project manager (Paul Bradley) for requests of additional information.

3. In case of media contact, notify the project manager immediately.

4. Your name will appear as one of the panelists in the peer review. Your comments will be included in the peer report. Attributed comments
will be shared with the U.S. Army Corps of Engineers, Savannah District staff.

Please submit your comments in Dr. Checks, no later than Friday, 14 December , 2007

POINT OF CONTACT
The point of contact for this review is Paul Bradley at the Planning Center of Expertise for Deep Draft Navigation, Mobile, Alabama at e-mail address [illegible] or phone number 251-694-4101

DrChecks / Select Project / Select Editing Task / Project Comment Status Report

Use the form below to select criteria for the report

a. Comment Type (req.) Any Critical

b. Evaluation Status (opt.)

c. Discipline (opt.)

d. Keyword(s) (opt.)

e. Start Date (opt.)

f. End Date (opt.)

Review of Standard Operating Procedure

Displaying 26 comments for the criteria specified in this report.

Id	Spec	Sheet	Detail
1729457	n/a'	n/a	n/a

[This item is flagged as a critical issue.]

A(ppropriateness)1. Regarding the appropriateness of using the Savannah District's Regulatory SOP for Compensatory Mitigation to assess the amount of preservation acreage 1. Was the SOP developed jointly with all of the review and resource agencies? In other words, is there an interagency team with representatives from each agency that has concurred on the development and implementation of the SOP for use in dertemining compensatory mitigation? And have they agreed that the use of the SOP can also apply to Civil Works projects as well as Regulatory projects?

Submitted By: Michele Gomez (410-962-5175). Submitted On: 11-Dec-07

Revised 19-Dec-07.

1-0 Evaluation Potential Scope Impact Potential Cost Impact Potential Time Impact **For Information Only**
The SOP was developed jointly with the Federal and State natural resource agencies that evaluate Corps regulatory permits in Georgia. They have approved of its use to determine compensatory mitigation on regulatory projects. EPA, one of those agencies, suggested we use the SOP for that purpose on this project. We have not yet asked all the agencies if they agree with its use on this civil works project.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Open Comment**
With the size and scope of the impact and the mitigation planning, it would have been beneficial to coordinate the use of the SOP with the resource agencies prior to developing a plan. At least one agency was involved as EPA was the proponent of using the SOP, so why not coordinate with the rest? You will either have to coordinate with the agencies prior to developing the mitigation plan or after when they read about it in the report. If they were coordinated with in the beginning, you would have buy in from the agencies with the mitigation plan that was developed. It seems like this is risk not to have coordinated on this in advance.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 23-Jan-08

1-2 Backcheck Recommendation **Close Comment**
Anticipate resolution during ITR and public review of the Draft GRR/SEIS

Submitted By: Michele Gomez (410-962-5175) Submitted On: 03-Mar-08

2-0 Evaluation **Concurred**
There is risk either way. If we coordinated with the agencies first, the Corps could later determine it unsuitable. If we conduct the ITR first to see if the Corps believes it is acceptable, the agencies could disagree. There is risk in either approach. We have informed the agencies that we intend to use the SOP to determine the acreage to be acquired. We have not received any responses saying that such an approach would be unacceptable. The USFWS has verbally said that use of the SOP is a reasonable approach. They

Submitted By: Michele Gomez (410-962-5175) Submitted On: 03-Mar-08

2-0 Evaluation **Concurred**

The project would result in the loss of roughly 10 acres of saltmarsh. Half of those are within the National Wildlife Refuge. The USFWS has stated that they would like us to mitigate by either providing additional freshwater tidal marsh or acquiring and preserving lands adjacent to the Refuge. No sites acceptable tot he USFWS were identified where tidal freshwater marsh could be created or restored. Additional wetlands would be impacted (converted), but not lost. The ecological values of the lands that would be acquired would be enhanced by their acquisition and preservation. Responses to other comments by this reviewer list the 4 avenues through which ecological values would be enhanced by the preservation. The SOP calculates how many acres would need to be acquired to equal the ecological loss of the impacted acreage. We have coordinated with the natural resource agencies extensively during the course of this project and would coordinate with them on this application of the SOP if the Corps believes the SOP is a reasonable approach.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1740235	n/a'	n/a	n/a

A 5.The mitigation plan needs to be consistent with the President's Wetland Initiative (Conserving America's Wetlands 2007, CEQ, April 2007). The preservation of the lands may be consistent with the President's goal to preserve National Wildlife Refuge System. If it is this should be stated clearly in the GRR and EIS to facilitate HQTRS, ASA and OMB review.

Submitted By: Michele Gomez (410-962-5175). Submitted On: 19-Dec-07

1-0 Evaluation **Concurred**

We believe the plan would be consistent with the President's 2004 goal by preserving valuable existing wetlands. The USFWS previously identified those properties as being sites whose wildlife habitat values could be increased by Federal ownership. We will

have questions about how we intend to apply it -- what specific values we would use, but those are details that we would work through when we coordiante with all the agencies.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1729471	n/a'	n/a	n/a

A2. Most Regulatory branches have developed an SOP or guidance paper on compensatory mitigation in coordination with the resource agencies. And as these resource agencies also review Civil Works projects, it seems appropriate that the same tool would be used to assess compensatory mitigation required for these projects.

Submitted By: Michele Gomez (410-962-5175). Submitted On: 11-Dec-07

1-0 Evaluation **Concurred**

This SOP was developed in coordination with the natural resource agencies. Most of the technical specialists in those agencies are the same reviewers on this civil works project, so they would be familiar with this approach.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Close Comment**

Closed without comment.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 23-Jan-08

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1740194	n/a'	n/a	n/a

[This item is flagged as a critical issue.]
Coordinating Discipline(s): Environmental,Environmental

A 3.The overall goal of compensatory mitigation is to replace the functions being lost (functional equivalency) by the impact. Was a functional assessment conducted for each wetlands system to be impacted? Was a functional assessment conducted on the wetlands acreage that is being preserved? Is the entire area to be preserved wetlands? If not, what is the break down of habitat type: wetlands (pristine condition, disturbed/manipulated), uplands (natural: forested, grasslands or disturbed: developed, pervious surfaces, agricultural), open water or waterways? Are the functions of these areas comparable with the functions that are to be impacted by the project? What functional assessment protocol was used to determine the functions of these areas?

Submitted By: Michele Gomez (410-962-5175). Submitted On: 19-Dec-07

Revised 19-Dec-07.

1-0 Evaluation Potential Scope Impact Potential Cost Impact Potential Time Impact **For Information Only**
The SOP includes a limited functional assessment of the lands to be impacted, those that would be restored, and those that would be protected. The "Rarity Ranking" in the impact calculation considers whether the wetland is Rare (possessing some special quality), Uncommon (not ordinarily encountered, or Common (frequently occurring). The areas to be preserved are predominantly wetlands, but the bottomland hardwood forests may contain high ground areas. The SOP includes a factor titled "Kind" to differentiate In-kind and Out-of-kind mitigation. We proposed the bottomland hardwoods be considered midway between those two, therefore receiving less credit and requiring additional mitigation acreage and In-kind mitigation.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Open Comment**
A limited functional assessment does not properly address mitigation planning for a project of this magnitude. To determine if you are actually replacing the functional value of the wetlands lost, a more detailed functional assessment should be conducted on both the wetlands to be impacted, to determine what you are losing, and on the wetlands to be preserved, to determine the functions that remain. However, that being said, what are we gaining overall? Wetlands and their functions are still being lost because we are not replacing them.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 23-Jan-08

1-2 Backcheck Recommendation **Close Comment**
Anticipate resolution during ITR and public review of the Draft GRR/SEIS.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 03-Mar-08

2-0 Evaluation **Concurred**
I agree that detailed functional assessments are usually conducted for large projects. However, in this case the natural resource agencies have indicated that those evaluations may not be warranted. The net ecological effect of converting one type of marsh to another would be somewhat subjective. We can identify the wetland functions that would be affected, but weighing a loss in one function against a gain in another to develop the net ecological effect would likely result in different answers from different experts. Roughly 10 acres of wetlands would be excavated and lost with the project. The extent of those impacts do not warrant detailed functional assessments.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 08-Feb-08

Backcheck not conducted
Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1740231	n/a'	n/a	n/a

[This item is flagged as a critical issue.]

A 4.The charge that we were given is so narrow in focus and only addresses if it is appropriate to use preservation and were the assumptions reasonable. It does not allow us to consider whether proper mitigation sequencing was used. Part of determining if it is appropriate to go to preservation for mitigation of the impacts is understanding the entire mitigation sequencing that has occurred for this project. Aside from avoidance and minimization, assumed to have been conducted, what has occurred to address compensation? Is no net loss being accomplished and how? Are other compensatory mitigation options being required? Does the plan address both direct and indirect impacts to wetlands? Functional capacity of the wetlands to be impacted needs to be replaced in the mitigation plan. It needs to be explained how the preservation proposed provides the replacement of the functional capacity. Does the preservation protect the wetlands in the refuge system? Does the preservation of these parcels protect wetlands and their

functions?

Submitted By: Michele Gomez (410-962-5175). Submitted On: 19-Dec-07

1-0 Evaluation Potential Scope Impact Potential Cost Impact Potential Time Impact **For Information Only**
The mitigation plans would include flow-altering features that would reduce salinity levels from those that would occur with just a channel deepening. These features reduce the adverse effects of deepening the harbor. The flow-altering plans target areas that the agencies identified as being particularly valuable. The impact analysis addresses impacts from direct excavation of wetlands (turning basin expansion and bend wideners) and impacts from salinity intrusion further into the estuary. The SOP includes a limited functional assessment, so the functional values of the impacted wetlands are being considered. The areas being considered for preservation are adjacent to the National Wildlife Refuge and its wetlands. The USFWS has stated that existing laws are insufficient to prevent significant degradation of the sites' wildlife resource values. Preserving these areas would fulfill many of the Refuge's wildlife habitat management needs. Protection of these adjacent areas would decrease expected secondary impacts on marshes and tidal creeks from development of private high ground lands.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Open Comment**
The response does not address the comment. Was no net loss achieved? How? A functional assessment shoud have been conducted. Coordination with the agencies is crucial. Preservation of one wetladns or upland does not replace the functions that will be lost from the impacted wetland. Preservation of the lands will fulfill the Refuge's habitat needs, but how does it address the loss of the impacted wetlands and its functions and values?

Submitted By: Michele Gomez (410-962-5175) Submitted On: 28-Jan-08

1-2 Backcheck Recommendation **Close Comment**
Anticipate resolution during ITR and public review of the Draft GRR/SEIS.

include this information in the EIS.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 15-Jan-08

1-1 Backcheck Recommendation **Close Comment**
In the discussion in the EIS regarding the mitigation plan being consistent with the President's Wetland Initiative, you need to discuss more than the wildlife habitat values. The mitigation plan should properly address that there is no net loss and you are replacing all lost wetland functions due to the impact.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 28-Jan-08

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1740236	n/a'	n/a	n/a

[This item is flagged as a critical issue.]

R(easonableness)1.Regarding Figure 2, the Refuge Acquisition Map, dated May 29, 1998, why are the properties highlighted in yellow? Explain why these properties were highlighted to be included in future expansion of the refuge. What documentation has the USFWS provided that demonstrates that these lands will protect the long term ecological productivity of the marsh system?

Submitted By: Michele Gomez (410-962-5175). Submitted On: 19-Dec-07

1-0 Evaluation **For Information Only**
The areas highlighted in yellow are the lands which the Refuge has identified as its proposed and desired expansion. The Refuge prepared an EA and Land Protection Plan when they proposed acquisition of those properties. Those documents describe why and how the USFWS believes acquiring and preserving those sites would be beneficial to the goals for which Congress authorized that particular Refuge. The documents received public review prior to the Service obtaining approval to add those sites to their acquisition plan.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Open Comment**
This answer does not address whether the preserved lands will be protected to ensure the long term ecological productivity of the marsh system. If you cannot document this, then how do we know if the "loss" of acreage and functions of the wetlands impacted from the project are being replaced and protected?

Submitted By: Michele Gomez (410-962-5175) Submitted On: 28-Jan-08

1-2 Backcheck Recommendation **Close Comment**
Anticipate resolution during ITR and public review of the Draft GRR/SEIS.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 03-Mar-08

2-0 Evaluation **Concurred**
The preserved lands will be protected. The USFWS has stated that such protection would allow improvements / enhancements in the wildlife functions they provide. The preservation would also protect the ecological productivity of the adjacent estuarine marshes, by removing the potential for those sites to be developed in the future.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted
Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1740238	n/a'	n/a	n/a

[This item is flagged as a critical issue.]

R 2. When selecting a mitigation site, one must take into account the surrounding land use and future plans for the land. Mitigation sites should be, and continue to be, resistant to disturbance from the surrounding landscape. While preservation of lands adjacent to other large wetlands systems will protect the existing adjacent wetlands systems, how are we compensating for the loss of the impacted wetlands' functions?

Submitted By: Michele Gomez (410-962-5175). Submitted On: 19-Dec-07

1-0 Evaluation Potential Scope Impact Potential Cost Impact Potential

Time Impact **For Information Only**
The sites proposed for acquisition are predominantly wetlands (bottomland hardwoods), so they would directly provide some of the wetland functions now provided by the marshes. Some tradeoffs will occur. The additional quantity of bottomland hardwoods that would be acquired over those that would be impacted makes up for those values that would not be directly replaced. The impacted areas would convert from freshwater marsh to brackish marsh. That conversion would not result in a total loss of many of the functional values of those existing marshes.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Open Comment**
What amount of acreage of the freshwater marsh would be converted? Caution must be employeed if making these statements in any NEPA/Planning document, especially when you only have best professional judgement to back them up. Using the logic that impacting 337 acres is offset by the preservation of 2,094 acres simply because the preservation acreage is bigger than the impact acreage is not appropriate. Not that these assumptions are necessarily wrong, but only that they may prove difficult to defend under challenge. If not all of the functions/values have been identified and quantified, how then can we claim what is and isn't being lost/replaced? Best professional judgement would better be applied in determining the likelihood of someone challenging these assertions. The level of rigor in the science should be commensurate with the level of risk.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 28-Jan-08

1-2 Backcheck Recommendation **Close Comment**
Anticipate resolution during ITR and public review of the Draft GRR/SEIS.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 03-Mar-08

2-0 Evaluation **Concurred**
The amount of acreage converted to brackish marsh would depend on the depth alternative selected. It would range from a net of 337 acres with the 48-foot alternative to 0 with the 44-foot alternative. The preservation of a certain tract is not being judged as being beneficial just because it is larger than the impacted acreage. The

SOP provides a procedure to evaluate the ecological value of both the impacted site and the site that would be preserved. Sufficient lands must be preserved to provide at least the level of ecological functions that would be adversely impacted. I agree that a quantification of all the functions and values that would be adversely impacted and potentially gained may be of value, but even such detailed quantification is dependent upon the use of professional judgement. I believe wetland experts would arrive at different answers if they were tasked to quantify the ecological loss of converting freshwater marsh to brackish marsh. Some judgement is involved in applying any evaluation procedure. The interagency nature of the civil works review and approval process provides some degree of assurance that values used in the final evaluation of a project will be reasonable and not an unreasonable assumption made by a single individual within an agency. I believe the issue at hand is whether this tool that was developed by an interagency team for this general area and is applied by them on a daily basis can reasonably be used on this project.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1740240	n/a'	n/a	n/a

[This item is flagged as a critical issue.]

R3. What systems are currently within the existing Refuge? Is there mapping that shows wetlands/uplands/waters? What documentation do we have on the condition of the refuge lands? Are there vehicles in place for protecting the lands from any future development there regardless of whether they are waters of the U.S. or not?

Submitted By: Michele Gomez (410-962-5175). Submitted On: 19-Dec-07

1-0 Evaluation **For Information Only**

We have maps and aerial photos which show the wetlands, creeks, and uplands. The Refuge lands were included in fishery inventories conducted as part of this study. Two sets of wetland montoring programs (USFWS and consultant) document the condition across the various portions of the estaury that is

potentially impacted by this project. Acquisition of the sites and inclusion of them into the Refuge would provide them with much more protection than their present private ownership. Most of the sites are used in timber production, where the wildlife values drop substantially when the site is logged. Such use would stop if they were included into the Refuge.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Open Comment**
If most of the sites being acquired are currently in timber production, these sites cannot possibly have the same functions and values of the freshwater tidal wetlands to be impacted by the project. While taking these areas out of production will eliminate continual degradation of the land, what will be done to assure that these areas will actually be restored to wetlands? Simply preserving them will not replace the loss from the impact or restore their wetland functions nor will it replace the loss of the impacted area. You do not state what type of lands are currently in the refuge adjacent to where the preservation is proposed.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 28-Jan-08

1-2 Backcheck Recommendation **Close Comment**
Anticipate resolution during ITR and public review of the Draft GRR/SEIS.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 03-Mar-08

2-0 Evaluation **Concurred**
Refuge lands adjacent to the sites proposed for preservation are wetlands, primarily bottomland hardwoods and some small areas of tidal marsh. As you state, wetland functions would improve when the lands to be acquired are removed from timber production. The USFWS stated they would manage the lands for wildlife purposes, thereby enhancing those ecological values of the sites. Thsse two processes would be the primary means through which ecological values would be gained by preservation of the sites. The other processes would be through protection of the sites from future development and providing additional protection of adjacent Refuge lands. We are not proposing any physical actions on these sites to restore high ground to wetlands. Our experience on nearby lands indicates that property in this part of the estuary receives sufficient hydrology to enable the growth of wetland

vegetation on sites with sufficiently low elevation. So additional water is not needed to restore previously-drained lands.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted
Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1740242	n/a'	n/a	n/a

[**This item is flagged as a critical issue.**]

R 4.What types of wetlands are being impacted? Freshwater tidal marsh: does it include both hardwoods and emergent vegetation? Is there a break down of the different types of wetlands being impacted? In the Baltimore District, when preservation is used, replacement of the impacted wetland is generally required at a 1:1 ratio with preservation being done at a 10:1 ratio. The SOP also states that preservation in the form of "...permanent perpetual protection of existing wetlands, or other water aquatic resources may be an acceptable form of mitigation when these areas are preserved in conjunction with establishment (creation), restoration, and enhancement activities." The areas that are preserved should augment those wetlands being created or restored as well as protect the functional value of the preserved wetlands. Protection in itself does not provide a gain in wetlands acreage or replacement of functional value of wetlands lost. To determine if the use of preservation on this project is appropriate, it is important to understand all other mitigation that is being conducted in conjunction with the preservation of the lands adjacent to the refuge, as well as an inventory of what is being preserved in these parcels. Purchasing uplands, including disturbed uplands, does not replace the acreage or functionality of the wetlands to be impacted.

Submitted By: Michele Gomez (410-962-5175). Submitted On: 19-Dec-07

1-0 Evaluation Potential Scope Impact Potential Cost Impact Potential Time Impact **For Information Only**
These freshwater tidal marshes are dominated by emergent marshes, but they also include some upland thickets and larger hardwoods (cypress). Preservation is the last of the mitigation steps that were considered. The project avoided impacts as much as possible by limiting the width of the channel to be deepened. The mitigation plans also include flow-altering features that would reduce the salinity levels in specific areas, restoring and enhancing some limited areas. No separate restoration or enhancement sites

oculd be identified by the resource agencies, NGOs, or consulted public that met the agencies' critieria -- freshwater wetlands within the Savannah River Basin. The specific sites proposed for acquisition and preservation have been evaluated by the USFWS and identified as being valuable additions to the National Wildlife Refuge.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Open Comment**
No net loss is still not addressed. There will still be a permanent net loss of freshwater wetlands and its ecological functions that never will be accounted for. If you are proposing to mitigate for the loss of the wetlands acreage and the functions of the weltands, you will need to demonstate the replacement of the acreage along wil the replacement of the functional value of the impacted wetlands. The response above does not provide this information. If there is no way to replace the wetlands and their functions, you need to identify this as an "irretrieveable loss" in th3 report adn EIS as per the Planning Guidance.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 28-Jan-08

1-2 Backcheck Recommendation **Close Comment**
Anticipate resolution during ITR and public review of the Draft GRR/SEIS.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 03-Mar-08

2-0 Evaluation **Concurred**
The ecological value of the wetlands would be replaced. Increases in salinity will not result in any loss of wetlands, but instead the conversion of one wetland type to another. The actual loss of wetlands from the project would occur when the turning basin is enlarged (and marshes are excavated) and similar excavation of the riverbank. Those losses would occur to saltmarsh and are in the range of 10 acres with each depth alternative. Roughly half of such losses would occur on Refuge lands. The USFWS has stated that it desires that the project replace the ecological values of their lands that would be excavated by either providing additional tidal freshwater marsh or acquiring and preserving lands adjacent to the Refuge. No sites could be identified to provide additional tidal freshwater marsh or improve existing mershes, so preservation is the remaining option. The SOP is a procedure that determines that

the ecological value of impacted wetlands is replaced by the same or similar ecological values elsewhere.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1740256	n/a'	n/a	n/a

[**This item is flagged as a critical issue.**]

R 5. Have all of the Resource agencies provided documentaiton supporting the decision to use these areas as preservation?

Submitted By: Michele Gomez (410-962-5175). Submitted On: 19-Dec-07

1-0 Evaluation **For Information Only**

No. We wanted to obtain concurrence within the Corps that this is a technically sound approach before asking the agencies for their opinion.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Open Comment**

For a project with impacts of this scale, it is surprising that there has not been any coordination or documentation from any agency regarding the mitigation plan. From looking at other comments/responses there must have been some coordination and mitigaiton discussions with other agencies. When looking at mitigation plans, especially at this magnitude of impact and need for mitigation sites, it would seem that the resource agencies should be involved early on.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 23-Jan-08

1-2 Backcheck Recommendation **Close Comment**

Anticipate resolution during ITR and public review of the Draft GRR/SEIS.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 03-Mar-08

2-0 Evaluation **Concurred**

The resource agencies have been involved in the impact evaluation and mitigation process for about 8 years. However, we have not yet proposed preservation of specific sites to the agencies. We had wanted to obtain Corps agreement and approval first that we are following a reasonable approach to determine how much land would need to be perserved.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1740346	n/a'	n/a	n/a

[This item is flagged as a critical issue.]
Coordinating Discipline(s): Environmental

R 6. A breakdown of wetlands impacts by type along with a explanation of the mitigation sequencing and a table explaining how much and what type of mitigation is to be done as well as an explanation of how and where the impacted wetlands functions are being replaced would be helpful in determining if the end result of the preservation of adjacent refuge lands is a reasonable mitigation decision for this project.

Submitted By: Michele Gomez (410-962-5175). Submitted On: 19-Dec-07

1-0 Evaluation **For Information Only**

Direct losses from enlargement of a turning basin and bend wideners is roughly 10 acres. Conversion of freshwater marshes to brackish marsh would vary by project depth. The wetlands that would be impacted (converted) is shown in the attachment. The lands would be acquired during the construction period -- concurrent with the impact. The wetland functions would be replaced by the functional value preserved in the lands that would be acquired.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08 (Attachment:

EXPANWetlandImpactsandMitJan08.ppt)

1-1 Backcheck Recommendation **Open Comment**
Again it is not clear that you are ensuring that there is no net loss of wetlands and that you are replacing the impacted wetlands functions.The functional value of the preserved lands that are acquired is different from that of the impacted wetland. Preservation protects the functional value of those lands but it does not address how you will replace the functions lost by the wetand to be impacted. There is still a long term loss of the tidal freshwater wetlands and their functional value. WIll there be temporal loss due to the deepening, over how many years will this occur or will it be instant? Has this been factored into the the mitigation plan? In the future, in assessing the appropriateness and reasonableness of using a specific mitigation SOP for the development of a mitigation plan, it would be more beneficial to have the report or EIS availabe, as it would facilitate and focus our review of the given charge.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 28-Jan-08

1-2 Backcheck Recommendation **Close Comment**
Anticipate resolution during ITR and public review of the Draft GRR/SEIS.

Submitted By: Michele Gomez (410-962-5175) Submitted On: 03-Mar-08

2-0 Evaluation **Concurred**
Concur that we would not be replacing the exact wetland functions that the freshwater marshes provide with the enhancements proposed to the bottomland hardwoods. The sites to be acquired and preserved would be enhanced through the following four mechanisms: (1) Removal of the bottomland hardwood sites from timber production and the accompanying periodic drastic loss in wildlife habitat values when the land is cleared and the timber is harvested; (2) Removal of the bottomland hardwood sites from the threat of development by removing them from private ownership and making them part of a National Wildlife Refuge; (3) Enhancement of the wildlife functions of the bottomland hardwood sites through better management by the USFWS when they become part of a National Wildlife Refuge; and (4) Preservation of the bottomland hardwood sites would remove the threat of impacts to adjacent Refuge properties (mostly bottomland hardwoods but also some freshwater marsh) when those private lands are logged and if they were developed in the future. The SOP allows such

enhancements as these to be considered as replacement for functional values that would be lost as a result of the project. The impacts to the freshwater and salt marshes would occur during the time of construction and be permanent. This timing has been factored into the SOP and mitigation plan.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 08-Feb-08

Backcheck not conducted

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1741440	n/a'	n/a	n/a

See attached Word Document.

(Attachment: SOPcomments.doc)

Submitted By: Martin Wargo (716-879-). Submitted On: 20-Dec-07

1-0 Evaluation **For Information Only**

A detailed functional assessment was not conducted to develop the factor scores and ranges applied in the Regulatory SOP. Ranges were established by the interagency Mitigation Banking Review Team when the SOP was developed. The factor scores selected for this project within those ranges are based primarily on the professional judgement of the biologist. Therefore, the determination of acres to be preserved depend heavily on the professional judgement of the staff of the Federal and State reviewers and the SOP protocol that they or their counterparts developed and apply on a daily basis to assess projects proposed by private interests.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 15-Jan-08

1-1 Backcheck Recommendation **Close Comment**

Understood. Whether or not any quantitative assessments are done in the future to support factor scores/ranges will itself ultimately need to be someone's "judgement call." I would strongly recommend this if the SOP will be applied much to non-Regulatory projects in the future. In the case of this particular project (Savannah Hbr Expansion), there appears to be agreement

between all the state and federal agencies involved, so the risk (i.e. likelihood of being challenged on mitigation) of not doing quantitative assessment at this point is likely low...but that's your call.

Submitted By: Martin Wargo (716-879-) Submitted On: 07-Feb-08

2-0 Evaluation **Concurred**

We believe that the SOP is a reasonable tool to quantify the amount of acreage to be acquired and preserved. We intend to use this approach only if it is supported by the other agencies that are making their own evaluations of this project.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1741453	n/a'	n/a	n/a

The interim national goal in 1993 of no overall net loss of the Nation's remaining wetlands was accompanied by the long-term goal of increasing the quality (e.g. function) and quantity of the Nation's wetlands. This policy presupposes the existence of an appropriate way to measure quality. With respect to the Savannah Harbor Expansion Project, if the assumption is made that mitigation of aquatic function has been adequately addressed through the proposed restoration component (66%), then the remaining 34% of the mitigation (i.e. preservation) need not provide any added function for the mitigation plan to adequately assist in meeting the national long-term goals. The Savannah District requirement that only 50% of the mitigation units need result in a net gain in acres and/or aquatic function (Section 5.7) suggests the intent by the Savannah District to allow flexibility in its Regulatory decision making process. This is important since there may be instances where a mitigation plan (or component thereof) does not mitigate aquatic function but yet may having high ecological importance to a region. Accordingly, this regional importance should be established for the proposed preservation of 2,094 acres (34% of mitigation plan). Since freshwater and brackish marsh have already been given highest rating of marsh types in the region by the agencies, it may be more difficult to argue that some other type of ecosystem (e.g. bottomland hardwood forest) is of high enough importance to a region to justify out-of-kind preservation. It would thus be important to demonstrate how the out-of-kind preservation compliments the functions and values of adjacent freshwater and brackish marsh. As indicated in Appendix A of the SOP, "preserved resources should augment the functions of ...restored...aquatic resources."

Submitted By: Martin Wargo (716-879-). Submitted On: 20-Dec-07

1-0 Evaluation **For Information Only**
The bottomland hardwoods provide some of the wetland functions that marshes provide. These sites would also serve as a protective buffer to the adjacent freshwater marshes. Acquisition and protection of those sites was not the preferred method of mitigation, but the resouce agencies or NGOs were not able to identify sites for separable restoration of enhancement that met all the requirements. The SOP -- which the natural resource agencies developed cooperatively -- does allow such Out-of-kind tradeoffs to be made and accounts for their lower ecological value by requiring a larger number of acreas to be preserved. We will include information in the EIS that describes how the bottomland hardwoods compliments the adjacent marshes.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 15-Jan-08

1-1 Backcheck Recommendation **Close Comment**
OK. The documentation was my main concern. The appropriateness of the documentation is a discussion better handled within the EIS.

Submitted By: Martin Wargo (716-879-) Submitted On: 07-Feb-08

2-0 Evaluation **Concurred**
We intend to include that type of information in the EIS.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted
Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1741458	n/a'	n/a	n/a

Aside: For the areas of potential preservation, have the owners already expressed a willingness to sell?

Submitted By: Martin Wargo (716-879-). Submitted On: 20-Dec-07

1-0 Evaluation **For Information Only**
We have not yet approached the owners. If the owners strongly oppose acquisition of their lands, they should have had opportunity to make those views known, as the USFWS previously identified those properties in a document circulated for public comment as sites they would like to acquire and add to the National Wildlife Refuge.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Close Comment**
Interesting. Thanks

Submitted By: Martin Wargo (716-879-) Submitted On: 07-Feb-08

2-0 Evaluation **Concurred**
One of the owners has just expressed an interest in allowing his land to be acquired and added to the Refuge.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted
Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1741461	n/a'	n/a	n/a

Several of the discussion/emails refer to the SOP being used to determine the amount of preservation needed to compensate for the impact to 337 acres of freshwater marsh. However, based on the calculations on the impact worksheet, the impacts to both freshwater and saltwater marsh are combined to produce a total of 7,368 impact units. Accordingly, the proposed preservation is, in reality, partially mitigating for both freshwater and saltwater marsh impacts. It should not be stated that the preservation is the mitigation for the 337 acres of freshwater marsh, since this is neither accurate nor appropriate.

Submitted By: Martin Wargo (716-879-). Submitted On: 20-Dec-07

1-0 Evaluation **For Information Only**
The natural resource agencies have stated they expect mitigation

for impacts to freshwater marshes. They have not viewed increasing salinity at brackish marsh or saltmarsh as an adverse impact. We included it in the SOP in the Adverse Impacts worksheet because the project would have made a physical change (increasing salinity) to those marshes.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Open Comment**
Since there are no recognized impacts to saltwater or brackish marsh that require mitigation, do I correctly understand then that both the restoration and preservation (not just preservation) are mitigating for the impacts to freshwater marsh? If true, then Table 4 of the "Charge to the Peer Reviewers" is misleading since it shows 4,672 impact units to saltmarsh that are included in the calculation for determining how much mitigation is needed. If mitigation is only needed for the Freshwater Marsh impacts, then should the mitigation requirement be based on 2696 impact units instead of 7368 impact units? I suggest modifying the statement to indicate that "The proposed restoration and preservation is the mitigation for 337 acres of freshwater marsh," and then annotate the "Saltmarsh Impacts" column of the Adverse Impacts Table to indicate that these "impacts" did not require mitigation (and explain why in the EIS). Better yet, perhaps the "Saltmarsh Impacts" column could just be removed altogether to avoid confusion.

Submitted By: Martin Wargo (716-879-) Submitted On: 07-Feb-08

2-0 Evaluation **Concurred**
We included the saltmarsh acreage in the SOP calculations to be complete and include all marshes that would be affected by the project. Under the "Dominant Effect" factor, we used 0 for the extent of impacts to saltmarsh to represent our belief that the saltmarsh would not be adversely impacted. We will consider your suggestion further and discuss it with the natural resource agencies when we coordinate our application of the SOP with them. At this time, we do not believe that changing the "Charge to the Peer Reviewers" is necessary.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

2-1 Backcheck Recommendation **Open Comment**
OK. My only concern is that leaving it the way it is may lead one

to believe that we are doing more mitigation than necessary. In other words, we are basing our mitigation requirements off of 7368 impact units, even though only 2696 of those units (freshwater) are from true impacts needing mitigation. I understand that you have made the "dominant effect" factor a zero for saltmarsh to account for there being no saltmarsh impacts. However, there were still five other variables used for saltmarsh that, when added together, create an impact coefficient of 6.4. When multiplied by 730 acres of impacted saltmarsh (that really will not be impacted), you produce 4672 impact units. These were then added to the freshwater impact units to determine how much mitigation is required (i.e. 7368 units worth of mitigation). If there truly are no saltmarsh impacts expected, then the impact coefficient for saltmarsh should be zero, not 6.4. Accordingly, mitigation would only be required for the 2696 impact units from freshwater marsh which would already be well accounted for by the proposed restoration, let alone the preservation. Am I misreading this?

Submitted By: Martin Wargo (716-879-) Submitted On: 07-Feb-08

3-0 Evaluation **Concurred**

You correctly understand how the SOP works. Without consulting the Interagency Team, we did not believe it would be proper to exclude one of the 3 dominant marsh types in the area that could be affected by the proposed project. You are correct that a major portion of the requirement for preservation stems from the way the SOP numbers work out on saltmarsh. We would certainly point that out to the Interagency Team during our discussions about the application of the SOP on this project.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 03-Mar-08

3-1 Backcheck Recommendation **Close Comment**

OK. Got it. I still wonder that we are doing too much mitigation, but that's not in the purview of the ITR. Almost would seem that we are inventing fictitious impacts (i.e. saltmarsh) to justify doing extra mitigation (i.e. preservation) so that USFWS can expand their refuge, as condition for them to have buy-in on the project. Good luck!

Submitted By: Martin Wargo (716-879-) Submitted On: 05-Mar-08

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail

1741465	n/a'	n/a	n/a

If not done already regarding the proposed preservation, consideration should be given to the management strategy of the USFWS for these potential preservation areas and how it may either contribute or detract from the intent of their being preserved. For example, if portions of the land are eventually developed by the USFWS for refuge roadway, buildings, or even opened to waterfowl hunting, this may detract from some of the functions and/or values warranting their preservation.

Submitted By: Martin Wargo (716-879-). Submitted On: 20-Dec-07

1-0 Evaluation **For Information Only**
We have reviewed the Land Protection Plan under which the Service would manage these lands. They would use these sites for wildlife habitat. They expect to include hunting, which would further one of the goals for which the Refuge was created.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Close Comment**
OK. Thanks

Submitted By: Martin Wargo (716-879-) Submitted On: 07-Feb-08

2-0 Evaluation **Concurred**
Concur

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted
Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1741468	n/a'	n/a	n/a

Aside: Will the restoration areas be provided with any upland buffer, as generally required in Section 5.6.1? If yes, did this buffer area contribute toward the mitigation units?

Submitted By: Martin Wargo (716-879-). Submitted On: 20-Dec-07

1-0 Evaluation **For Information Only**
We are not proposing to acquire any additional buffer lands. We intend to acquire entire properties whenever possible, so acquisition of small tracts bordering these sites would probably not be easy or necessarily beneficial.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Martin Wargo (716-879-) Submitted On: 07-Feb-08

2-0 Evaluation **Concurred**
Comment closed

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted
Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1741472	n/a'	n/a	n/a

The "Kind" factor must be based on of a functional assessment. If this were not done, theoretically mitigating impacts to an invasive species-dominated scrub-shrub wetland by the preservation of native forested wetlands would result in a low (0.2) coefficient, even though this would likely be appropriate out-of-kind mitigation.

Submitted By: Martin Wargo (716-879-). Submitted On: 20-Dec-07

1-0 Evaluation **For Information Only**
Theoretically, that is possible. However, the SOP relys on professional judgement when selecting appropriate factor scores. We applied such judgement when we selected the values we propose to use. That selection was based on years of environmental experience working on projects in Savannah Harbor, as well as detailed wetland field studies performed for this project. Those studies documented the diversity, abundance and seasonal variability of wetland vegetation across the range of the

estuarine marsh communities. The interagency review will provide a collective professional judgement that is broader and deeper than that of any single individual. That multi-agency review should result in a final decision that is science and experience-based, rather than the theoretical application of a rigid procedure.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 15-Jan-08

1-1 Backcheck Recommendation **Close Comment**
OK. Your call. Reference my previous comments. There is no doubt that BPJ is more flexible, especially when assessment tools have not yet been adapted to a particular region.

Submitted By: Martin Wargo (716-879-) Submitted On: 07-Feb-08

2-0 Evaluation **Concurred**
OK

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted
Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1741475	n/a'	n/a	n/a

Aside: Since two major concerns of the natural resource agencies are impacts to the habitat of shortnose sturgeon and striped bass, was the Habitat Evaluation Procedure (HEP) used in evaluating the existing habitat quality for these species for comparison against the ability of the restored areas to provide the same habitat quality?

Submitted By: Martin Wargo (716-879-). Submitted On: 20-Dec-07

1-0 Evaluation **For Information Only**
HEP was not used in this project to evaluate fishery habitats. instead, the interagency Fisheries Coordination Team developed procedures to identify and quantify acceptable habitat for selected species (including these 2) in the Savannah River estuary. We are using the hydrodynamic and water quality models to identify changes expected to specific aquatic parameters (velocity, D.O.,etc.). We then apply the definitions of acceptable habitat to

identify areas that will change as a result of the channel deepening and flow-alterng features. The goal is to end with no reduction in the volume of acceptable habitat for these important species.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 15-Jan-08

1-1 Backcheck Recommendation **Close Comment**
OK. Thanks

Submitted By: Martin Wargo (716-879-) Submitted On: 07-Feb-08

2-0 Evaluation **Concurred**
Comment closed

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

Backcheck not conducted
Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1741773	n/a'	n/a	n/a

Regarding the first charge, appropriateness of using the SOP for the SHEP: it would seem reasonable to use a SOP used by Regulatory as a guideline for Civil Works projects. Although some differences between regulatory and civil works projects can exist such as the complexity and policy differences (i.e. length of monitoring currently allowed for civil work projects) between regulatory and civil works projects.

Submitted By: Catherine Rogers (978-318-8231). Submitted On: 20-Dec-07

Revised 20-Dec-07.

1-0 Evaluation **Concurred**
EPA suggested we use it on this project to quantify the remaining preservation needs.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Catherine Rogers (978-318-8231) Submitted On: 22-Jan-08

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1741905	n/a'	n/a	n/a

Some statements appear to be contradictory in the Charge to the Peer Reviewers. For example, on the 1st page, 3rd para. it is stated that a major consideration of this study is that increased salinities caused by the deeper channel would result in impacts to freshwater wetlands. Yet on the bottom of the 5th page, it states that adverse impacts could be experienced to not only freshwater wetlands but brackish wetlands and salt marsh. How would increasing salinity impact salt marshes? If saltmarshes are adversely impacted than why would they not be mitigated for in-kind? We are not given back-up on the decision to value freshwater and brackish wetlands higher than saltmarsh.

Submitted By: Catherine Rogers (978-318-8231). Submitted On: 20-Dec-07

1-0 Evaluation **For Information Only**

The section on page 5 is speaking more on a theoretical basis. Actual identifiable impacts to saltmarsh from increased salinity would be difficult to identify and quantify. The Georgia/South Carolina coast has experienced some areas of saltmarsh die-off during recent droughts as a result of a number of factors, including high salinity levels. Such an occurrence is not expected at this site because of the large tidal exchange that occurs each day. We showed adverse impacts to saltmarsh when applying the SOP to this project because we did not want to include this important vegetative community. Actual impacts to that community are expected to be minimal. We reflected that in the SOP quantification by including 0 as the "Dominant Effect" on saltmarsh. The main impact of concern to natural resource agencies is a potential loss of freshwater marsh. The EIS will contain further documentation of this collective interagency decision which was made early in the study process.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 15-Jan-08

1-1 Backcheck Recommendation **Open Comment**

The meaning behind the 5th sentence above is not clear. It would appear that to follow the SOP then the impacts (functions/values

lost) to saltmarsh would need to be described as accurately as possible either through an approved method and/or professional judgement. If minimal impacts are expected to salt marsh then it would seem more accurate to provide the back-up that the impacts are minimal. The information provided to us indicates that 682 acres of saltmarsh would be impacted by the 48' alternative. And an additional 48 acres if the "mitigation plan" is implemented for a total of 730 acres. I doubt any agency would describe that as a minimal impact! Also, a description in the EIS of why (functional assessment) converting saltmarsh to freshwater wetlands is preferable is suggested. While the agencies maybe more concerned about the loss of freshwater wetlands over saltmarsh wetlands, this conversion would not appear to follow the SOP/national policy in providing in-kind mitigation first where possible/practicable.

Submitted By: Catherine Rogers (978-318-8231) Submitted On: 30-Jan-08

2-0 Evaluation **Concurred**

The 5th sentence is confusing. It should have read "We showed adverse impacts to saltmarsh when applying the SOP to this project because we did not want to EXCLUDE this important vegetative community." Approximately 10 acres of saltmarsh would be lost as a result of the project. This would occur as a result of enlarging a turning basin and excavating small areas along the riverbank. We included all the saltmarsh that would be impacted by increases in salinity in the SOP calculations. It is impacts from those increases in salinity that I meant when I stated that the impacts to saltmarsh would be minimal. Under the "Dominant Effect" factor in the SOP calculations, we included a value of "0" for the expected impacts to saltmarsh as a result of the expected increase in salinity. The salinity would increase over a large acreage of saltmarsh, but we do not believe that those increases would reduce their ecological value. Roughly half of the impacts to saltmarsh would occur on lands within the Refuge. The USFWS has stated that it does not want us to provide in-kind mitigation (provide or enhance other saltmarsh) to compensate for those losses. They prefer either additional tidal freshwater marsh or bottomland hardwoods adjacent to the Refuge. We could not identify any other acceptable site to create or restore tidal freshwater marsh, so we moved to preservation.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

2-1 Backcheck Recommendation **Close Comment**

The reason given above for assigning a value of "0" to the

"Dominant Effect" factor in the SOP calculations appears to differ from the reason given in the Adverse Impact Worksheet. The worksheet states that the saltmarsh is being converted to more valuable brackish marsh vs. the discussion above which states that the impact from the expected increase in salinity to salt marsh is minor and not expected to effect the salt marsh's ecological value. If the explanation given above (insignificant increases in salinity) is the reason for assigning "0" to the "Dominant Effect" factor for salt marsh, then it is not clear that there is a need for salt marsh mitigation. However, based on the worksheet calculations, 730 acres of salt marsh would be converted to brackish marsh if Mitigation Plan 6A is used. Assigning a value of "0" to the "Dominant Effect" for the adverse impact worksheet and the values assigned for the Restoration Worksheet gives brackish marshes a higher value than salt marshes, yet an explaination is not given for assigning a higher value to brackish marshes. If the district wishes to use the Regulatory SOP for Preservation Determinations, then it would seem reasonable to use the remaining Regulatory guidelines in conjunction with the SOP. For example, in the Memorandum to the Field "Model Compensatory Mitigation Plan Checklist for Aquatic Resource Impacts under the Corps Regulatory Program Pusuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act" it states under section 3(b) that the description of how the mitigation project will compensate for the functions identified in the Mitigation Goals section 1(c). Also, if the proposed mitigation is off-site and/or out-of-kind, explain why on-site on in-kind options are not practicable or environmentally preferable (section 3(f)). And, under "Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pusuant to Section 404...and Section 10..." that districts will determine what level of mitigation is "appropriate" based upon the functions lost or adversely affected as a result of impacts to aquatic resources..., districts are encouraged to increase their reliance on functional assessment methods (pg. 2). However it states on pg. 3 that "in the absence of more definitive information on the functions of a specific wetland site, a minimum one-to-one acreage replacement may be used as a reasonable surrogate for no net loss of functions (I assume that they would be referring to in-kind replacement). These 404 concepts would seem to place a burden on the agencies to justify why freshwater wetlands should replace salt marsh without a functional assessement or a one-to-one acreage replacement. This might increase the available mitigation options and/or more accurately mitigate the appropriate impacts.

Submitted By: Catherine Rogers (978-318-8231) Submitted On:

19-Feb-08

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1741985	n/a'	n/a	n/a

It is stated in the "Charge to the Peer Reviewers" and in the "Position of Agencies on Mitigation Measures" that agencies have not been able to identify any sites where tidal freshwater marsh could be restored. This gives additional importance to preservation of freshwater wetlands in the project area. However, it is unclear if the calculations take into account the possibility that restoration may need to occur outside the impact watershed area and how that would "reasonably offset authorizied impacts" (5.9.2 of the SOP).

Submitted By: Catherine Rogers (978-318-8231). Submitted On: 20-Dec-07

Revised 20-Dec-07.

1-0 Evaluation **For Information Only**

The USFWS has stated it will not accept mitigation outside the basin for this project. They are of the 4 Federal agencies that must approve this conditionally-authorized project.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Open Comment**

See response to comment #1742170.

Submitted By: Catherine Rogers (978-318-8231) Submitted On: 30-Jan-08

2-0 Evaluation **Concurred**

The USFWS has provided guidance on what they would consider acceptable mitigation for this project. That guidance does limit the options from which we can develop an acceptble mitigation plan. Although such specific limitations may not be typical, it is common for an agency to find some proposed mitigation action to be unacceptable. Since the Dept of Interior must approve this project for it to proceed, the USFWS has more input to the final results of this project than in most. From Comment #1742170 ..... The USFWS has stated that mitigation outside the basin is unacceptable for this project. I believe this is at least partially based on their feeling that since it is Refuge lands that are impacted, that the mitigation should be within or adjacent to the

Refuge. Their procedures (Refuge Compatibility Determination) require they conclude that a proposed use of Refuge lands supports the purpose for which Congress created that Refuge. Out-of-basin mitigation would make such a determination more difficult, as that Refuge would not benefit from mitigation in another basin. We did follow the normal steps of mitigation. We first looked at avoidance, then minimization, then restoration and enhancement, and finally preservation. We were unable to identify an acceptable site to further restore or enhance freshwater marshes in the basin. That entire process may not have been in the information you received, but it will be in the EIS.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

2-1 Backcheck Recommendation **Close Comment**
See comment 1741905.

Submitted By: Catherine Rogers (978-318-8231) Submitted On: 19-Feb-08

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1742089	n/a'	n/a	n/a

Without the backup, it is not possible to determine if the number selected for each factor is reasonable. Assuming the numbers selected are accurate, then the calculations seem reasonable.

Submitted By: Catherine Rogers (978-318-8231). Submitted On: 20-Dec-07

1-0 Evaluation **Concurred**
We intend to provide some additional explanations when we describe this approach in the EIS.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Catherine Rogers (978-318-8231) Submitted On: 22-Jan-08

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1742103	n/a'	n/a	n/a

Recheck the restored brackish marsh acreage number. I believe it should be 1068 instead of 1156. The change would be due to the slight decrease of acreage in the 2.1 to 4.0 salinity range under Plan 6A.

Submitted By: Catherine Rogers (978-318-8231). Submitted On: 20-Dec-07

1-0 Evaluation **Concurred**
Correct. I will revise the spreadsheet accordingly. Thank you for catching that.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 15-Jan-08

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Catherine Rogers (978-318-8231) Submitted On: 22-Jan-08
Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1742111	n/a'	n/a	n/a

A statement is made in the "Charge to the Peer Reviewers" that "additional lands with an easement would be needed to provide the same total habitat value as would fewer lands provided under government ownership." Is there evidence for this distinction?

Submitted By: Catherine Rogers (978-318-8231). Submitted On: 20-Dec-07

1-0 Evaluation **For Information Only**
That statement is based on the content of the SOP, particularly how the agencies chose to quantify the effects of various levels of "Control" over a property. For this project, the USFWS has stated it would not consider habitat preserved through easements as being acceptable mitigation. Since they are one of the 4 Federal agencies that need to approve this project, we would acquire all lands in fee,

not through easements.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 15-Jan-08

1-1 Backcheck Recommendation **Open Comment**
See response to comment #1742170

Submitted By: Catherine Rogers (978-318-8231) Submitted On: 30-Jan-08

2-0 Evaluation **Concurred**
The USFWS has provided guidance on what they would consider acceptable mitigation for this project. That guidance does limit the options from which we can develop an acceptble mitigation plan. Although such specific limitations may not be typical, it is common for an agency to find some proposed mitigation action to be unacceptable. Since the Dept of Interior must approve this project for it to proceed, the USFWS has more input to the final results of this project than in most. From Comment #1742170 ..... The USFWS has stated that mitigation outside the basin is unacceptable for this project. I believe this is at least partially based on their feeling that since it is Refuge lands that are impacted, that the mitigation should be within or adjacent to the Refuge. Their procedures (Refuge Compatibility Determination) require they conclude that a proposed use of Refuge lands supports the purpose for which Congress created that Refuge. Out-of-basin mitigation would make such a determination more difficult, as that Refuge would not benefit from mitigation in another basin. We did follow the normal steps of mitigation. We first looked at avoidance, then minimization, then restoration and enhancement, and finally preservation. We were unable to identify an acceptable site to further restore or enhance freshwater marshes in the basin. That entire process may not have been in the information you received, but it will be in the EIS.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

2-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Catherine Rogers (978-318-8231) Submitted On: 19-Feb-08

Current Comment Status: **Comment Closed**

Id	Spec	Sheet	Detail
1742170	n/a'	n/a	n/a

As the agencies could not identify potential sites for restoration or creation of tidal freshwater marsh, then it would seem reasonable to mitigate for in-kind saltmarsh, if sites are available.

Submitted By: Catherine Rogers (978-318-8231). Submitted On: 20-Dec-07

1-0 Evaluation Potential Scope Impact Potential Cost Impact Potential Time Impact **For Information Only**
The USFWS stated that restoration or enhancement of saltmarsh would not be acceptable mitigation for loss of freshwater marsh. The USFWS is one of 4 Federal agencies that must approve the project.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 14-Jan-08

1-1 Backcheck Recommendation **Open Comment**
This comment is also relevant for comment numbers 1742111 and 1741985. The responses to these three comments center on the USFWS position regarding mitigation. It would appear that they have skipped to preservation of freshwater wetlands without giving consideration to out-of-kind mitigation or mitigation outside the Savannah basin. According to the SOP, creation, enhancement or restoration is to be given higher priority than preservation. Creation, enhancement and restoration mitigation are to complement preservation of wetlands. Preservation is to be an exception.

Submitted By: Catherine Rogers (978-318-8231) Submitted On: 30-Jan-08

2-0 Evaluation **Concurred**
The USFWS has stated that mitigation outside the basin is unacceptable for this project. I believe this is at least partially based on their feeling that since it is Refuge lands that are impacted, that the mitigation should be within or adjacent to the Refuge. Their procedures (Refuge Compatibility Determination) require they conclude that a proposed use of Refuge lands supports the purpose for which Congress created that Refuge. Out-of-basin mitigation would make such a determination more difficult, as that

Refuge would not benefit from mitigation in another basin. We did follow the normal steps of mitigation. We first looked at avoidance, then minimization, then restoration and enhancement, and finally preservation. We were unable to identify an acceptable site to further restore or enhance freshwater marshes in the basin. That entire process may not have been in the information you received, but it will be in the EIS.

Submitted By: William G. Bailey (912-652-5781) Submitted On: 06-Feb-08

2-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Catherine Rogers (978-318-8231) Submitted On: 19-Feb-08

Current Comment Status: **Comment Closed**

There are currently a total of 230 users online as of 12:34 PM 22-May-08.
SM property of ERDC since 2004.

Questions and comments to Call Center staff@rcesupport.com, 217-367-3273 or 800-428-HELP (4357)

Classified information is NOT permitted on this site. Do NOT share your ProjNet password.

ENVIRONMENTAL IMPACT STATEMENT
APPENDIX V: List of Preparers

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

US Army Corps
of Engineers
Savannah District
South Atlantic Division

LIST OF PREPARERS

Name	Title	USACE Division/ Organization	USACE Discipline	Experience Level
William G. Bailey, PE	Physical Scientist	Planning	Environmental	32 years
K. Paul Bradley, PE	Environmental Engineer	Planning	Environmental	37 years
J. Steven Calver	Biologist	Planning	Environmental	24 years
Hugh E. Heine	Biologist	Planning	Environmental	26 years
Jeffrey K. King, Ph.D, PE	Environmental Engineer	Planning	Environmental	8 years
Margarett G. McIntosh, PG	Physical Scientist	Planning	Environmental	9 years
Jennifer L. Owens	Environmental Scientist	Planning	Environmental	20 years
Judy L. Wood	Archeologist	Planning	Plan Formulation	31 years
G. Frank Yelverton, MPH	Marine Biologist	Regulatory	Environmental	35 Years
Joseph T. Hoke, PE	Civil Engineer	Engineering	Hydrology & Hydraulics	34 years
L. Elizabeth Williams, PE	Civil Engineer	Engineering	Hydrology & Hydraulics	11 years
David Coleman	Physical Scientist	Tetra Tech	N/A	35 years
Edwin Eudaly	Biologist	US Fish & Wildlife Service	N/A	36 years
Jane Greiss	Refuge Manager	Savannah National Wildlife Refuge	N/A	21 years
Gerald Miller, Ph.D	Coastal Ecologist	Tetra Tech	N/A	35 years

ENVIRONMENTAL IMPACT STATEMENT
APPENDIX W: Index

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

US Army Corps of Engineers
Savannah District
South Atlantic Division

INDEX

WORD/SUBJECT PAGE(S)

Advisory Council on Historic Preservation (ACHP).....1-iv; 4-73; 5-164, 167; 7-9
Aesthetic.....1-ii, iv; 4-80; 5-180
agitation dredging.....1-6
air quality.....1-ii, iii, 1-ix; 4-19, 20; 5-132, 133, 136-138, 174, 181, 190-194; 6-6; 8-1
alternatives
No Action Alternative (Without Project Condition).....1-i; 3-3, 4; 5-137, 138
-44-Foot Alternative (2 Feet Deeper).....1-i; 3-14; 5-52
-45-Foot Alternative (3 Feet Deeper).....1-i; 3-15; 5-37
-46-Foot Alternative (4 Feet Deeper).....1-i; 3-16; 5-36
-47-Foot Alternative (5 Feet Deeper).....1-i; 3-16; 5-37, 205
-48-Foot Alternative (6 Feet Deeper).....1-i; 3-17; 5-36
anadromous.....1-v, 5; 2-3; 4-20, 21, 38; 5-114,118, 140, 179, 209; 6-3
aquatic life.....3-11; 4-14; 5-143, 207
Argyle Island..... 1; 3-7, 9, 10, 13
arsenic.....5-128
Atlantic Intracoastal Waterway (AIWW).....3-6; 4-83; 5-187
authorized channel.....3-6, 9
authorized depths.....3-4

Back River.....1-8; 3-6, 11-13; 4-21, 22, 49, 50, 75, 76, 78-80; 5-12, 42, 43, 48-52, 139, 153, 160, 165, 166, 170, 172, 173, 175, 180, 206, 209; 6-8
bald eagle.....4-69, 70
bank protection.....1-x; 3-7, 30; 5-150, 164
Base Plan.....1-12
Beach...1-6, 8; 2-3; 3-20, 21, 23-25; 4-17, 24, 44, 50, 51, 62, 80, 83; 5-143, 144, 149, 151, 169, 179, 199; 6-8; 7-2
beneficial use.....1-ii, 6; 3-11, 23, 24; 7-5
benthic resources.....5-142
benthic survey.....5-145
berthing areas.....4-43
Biological Assessment (BATES, BA).....1-xi; 4-67; 5-153; 6-4; 7-8
bird habitat.....1-vii; 4-61, 62; 5-148
bird island.....3-12, 23; 4-54

CSS Georgia.....1-1, 7; 3-6, 10; 4-74, 76, 77; 5-159, 162, 164, 167, 168, 204, 208, 209; 6-5, 6
CESAD (see South Atlantic Division)
Chatham County.....1; 1-i, vii, x, 1, 12; 2-1; 4-19, 68-70, 78-79, 83-85; 5-132-136, 141, 148, 152, 177, 182, 183, 187, 196; 7-10, 11;
City of Savannah.....1-ii, ix, x, 4, 5; 2-1, 3; 3-6; 4-17, 18, 67, 83-84; 5-2, 58-61, 64, 67-71, 73, 74, 79, 82, 130, 153, 182, 190, 193, 204, 206; 6-4; 7-1, 2, 6, 10
Coast Guard.....4-44-46; 5-143, 200-202; 7-9
Coastal Barrier Resources Act.....1-iv, 9; 4-50; 5-202, 203
Coastal Barrier Resources System.....4-50; 5-202, 203

Coastal Zone Management Act.....1-v, 9; 6-7; 7-7, 8
confined disposal facility.....2; 1-iv, vii, 12; 3-11
costs.....1; 2-2, 3; 3-1-3, 9, 24, 30; 5-34, 59, 68, 70, 72, 73, 121, 169; 7-5
cultural resources.....1-ii, iv, v, xi; 4-73-74; 5-155-157, 159, 161, 168, 171, 199, 208; 6-1; 7-7
cumulative impacts.....1-iv, 6; 5-1, 171, 179

Daufuskie Island.....3-24
DHEC (see SC Department of Health and Environmental Control)
Dikes.....2-1; 3-11, 30; 4-52, 57; 5-34, 147, 161, 166; 6-7,8
dike raising.....3-11, 23
disposal area.....1-ix, 8, 12; 3-4, 11; 4-11, 15-16, 19, 51, 53, 56, 57, 60; 5-3, 8, 141, 151, 156, 161, 165, 172, 174, 205, 209
Disposal Area 14A.....3-11; 4-55
Disposal Area 1N.....3-11
Disposal Area 1S..... 5-3, 7, 8, 161, 165, 174, 205
Disposal Area 2A.....3-11
dissolved oxygen (D.O.)...2; 1-iii, viii, x, xii, 4, 5; 3-18-20; 4-1, 13-16, 26, 27; 5-42, 93, 120, 141, 169, 171, 174-176, 178, 195, 200, 201, 205, 206
DNR (see Georgia Department of Natural Resources)
DOT (see Georgia Department of Transportation)

easements.....5-5, 36, 174
economics.....1-4, 6; 3-2, 4, 7; 5-190, 194; 7-3, 7
effluent.....3-11; 4-14-17, 19, 46; 5-79, 124, 126-128, 141, 144; 7-5
elutriate.....5-124,125
endangered species.....1-ii, iv, v, vii, xi, 9; 2-3; 3-22; 4-67-68, 70; 5-153, 170, 171, 177, 178, 205; 6-2, 3; 7-4, 8
Endangered Species Act.....1-9; 4-67; 5-153; 6-4; 7-8
environmental impacts.....1; 1-3; 2-4, 5; 3-3, 6, 13, 18, 21; 4-9; 5-29, 72, 123, 125, 160, 171, 201, 209; 7-1, 3, 5; 8-1
Environmental Protection Agency (EPA)...1, 2; 1-xii, 1-3; 2-4; 3-4; 4-10, 14; 5-1, 3, 31, 40, 67-69, 124, 132, 165, 206; 6- 1; 7-1, 4, 8, 9
erosion.....1-6, 12; 3-17, 19-20, 22; 4-62, 76-80; 5-147, 149-151, 160, 161, 165, 166, 179, 199, 203; 6-5
estuarine.....1-ii, iii; 3-4; 4-20, 26, 28, 39-41, 62-64; 5-2, 10, 11, 29, 30, 40, 59, 82, 138-140, 146, 154, 165, 180, 202, 205; 6-3, 7, 8

Federal Standard (see Base Plan)
feeder berm.....3-8, 12, 23, 26
Fig Island channel.....4-78, 79
fisheries...1; 1-iii, xiii, 4; 3-19, 20; 4-28, 38, 40, 81; 5-1, 53, 82-85, 114, 169, 171, 175, 178; 6-3; 7-1, 9
Fort Pulaski.....1-1, 6-7; 3-6, 8; 4-13, 14, 50, 70, 76, 83; 5-42, 43, 150, 176, 208; 6-5; 7-1, 9
freshwater...2; 1-4, 6; 2-3; 3-13, 14, 18, 20, 21; 4-1, 3, 10, 12, 13, 20-22, 26, 43, 48-50, 83; 5-9-13, 17, 27, 29-32, 34, 35, 37, 38, 40, 71, 72, 92, 114, 131, 139, 146, 170-175, 177, 204-207; 6-3, 9; 7-5
Front River.....3-6, 13, 20; 4-21; 5-3, 42, 43, 48-52
functional value.....5-32

Fish and Wildlife Service (FWS)...1; 1-xiv; 4-49-50, 54-55, 63, 65, 67; 5-3, 7, 9, 11, 12, 17, 32-34, 36, 38, 71, 77, 153, 165, 173, 200, 206; 6-4, 7; 7-1, 8, 9

Georgia Department of Natural Resources (GADNR)...3-23; 4-14, 16-19, 24, 44, 69-70; 5-72, 120, 165, 168; 6-5; 7-4, 8
Georgia Department of Transportation (GDOT).....2-1; 3-11; 5-34, 148, 191
Georgia Ports Authority (GPA).....1; 1-xii, 1-3, 12, 13; 2-2; 3-7, 27; 4-19, 20; 5-3, 9, 34, 60, 74, 128, 132, 134, 159, 181, 190-194; 7-1, 6, 9

habitat loss.....5-121
hazardous.....1-iv, xiii; 5-203, 204; 6-9
hopper dredge.....2; 3-9, 12, 22-24, 29; 4-15; 5-140, 142, 143, 199

in-kind mitigation.....5-174; 6-3
intertidal.....4-42, 63, 64; 5-36, 180; 6-8

jetty.....3-12; 5-160
Jones/Oysterbed Island.....2-1; 3-7, 11; 5-146, 147, 150

Kings Island Turning Basin...1, 2; 1-ix; 3-1, 3, 14-16, 21; 4-3, 9, 74, 75; 5-1, 2, 4, 6, 120, 123, 146, 159, 174; 6-8

land use.....1-iv; 4-67, 83; 5-40, 57, 180, 206; 6-5
landowner.....3-14; 4-48, 50; 5-172
larval fish.....4-27, 38; 5-143
littoral.....3-28; 4-14; 5-202

magnetometer.....5-150, 155-157, 166
maintenance dredging..1-ii, vii; 3-8, 9, 11, 14-17, 21, 25, 28-30; 4-8, 77, 83; 5-122, 125, 128, 133, 136, 141, 142, 169
management plan.....1-6, 7, 12; 4-38-40, 45, 47, 50; 5-40, 169, 171, 180, 202; 6-7-9; 7-1, 4, 5
management strategy.....1-12; 3-11, 12; 4-15, 16; 5-139
management technique.....3-9
manatee.....4-68, 69; 5-153; 6-4
McCoombs Cut.....3-13
Migratory Bird Treaty Act.....1-v, 1-10; 6-7
migratory birds.....1-iv, v, 11; 4-50, 51; 5-148; 6-7
mitigation plan...1, xi, 13; 2-4-5; 3-17, 18; 4-17, 41; 5-1, 10, 16, 17, 38, 53, 60, 84, 92, 93, 118, 151, 165, 170, 176, 178, 180, 195, 201, 202, 206, 207, 209; 6-2, 3; 7-2
mixing zone.....3-28; 4-12
Memorandum of Agreement (MOA).....4-74, 77, 79
monitoring.....1-iii, x, xi; 4-16, 17, 46, 48, 49, 76; 5-7, 35, 36, 40, 41, 72, 119, 120, 122, 126, 127, 131, 132, 137, 161, 166, 171, 202; 6-3, 5; 7-1, 4, 5
mosquito control.....5-148
MPRSA.....3-12; 6-2

National Economic Development Plan (NED).....2; 3-18, 2; 5-64, 65, 67
National Environmental Policy Act (NEPA).....1, 2, 3; 1-4, 13; 5-53, 128, 168,181; 6-1, 2; 7-1
National Marine Fisheries Service (NMFS).....1; 1-viii; 4-38, 40, 67; 5-9, 83, 143, 145, 153, 154, 171, 175, 205, 206; 6-1, 3, 4; 7-1, 9
nesting.....3-22; 4-51-59, 61, 62; 5-143, 148, 153; 6-4, 7
New Cut.....1-8; 3-13; 4-21, 49, 74-76, 78-80, 81; 5-14, 16, 160, 161, 166
nursery.....1-5; 2-3; 4-22, 23, 39; 5-121, 140, 169

Ocean Dredged Material Disposal Site (ODMDS).....2; 1-viii, 8; 3-4, 8, 12, 22, 23, 25, 26, 29; 4-1, 6; 5-123, 142, 153, 169, 180; 6-2, 3, 6, 8; 7-6, 8
OCRM (see South Carolina DHEC-OCRM)
Old Fort Jackson.....1-x; 5-163, 164; 6-5
operation and maintenance.....1-12; 3-4; 4-77-78; 5-73, 82, 162, 170, 205; 6-2; 7-5
ordnance.....4-78; 5-164

permits.....4-14; 5-35, 177
Pilots Association.....7-6, 10
piping plover.....4-68; 5-153; 6-4
plume.....5-139-141, 143, 144
project life.....5-135, 150
project sponsor.....3-13
public review.....6-5

recreation.....1-4, 9; 3-24; 4-13, 14, 24, 26, 46, 80, 83; 5-114, 141, 144,169, 175, 180, 187, 199, 200
rotational program.....3-11

Savannah National Wildlife Refuge (SNWR)...1-iii, xi, 4, 5; 2-3; 3-11, 13; 4-1, 4-48, 66, 67, 83; 5-1, 3, 6, 10, 32, 34, 38, 71, 77, 146, 161, 170, 171, 173, 195, 200, 206
sea turtle.....4-16, 17, 68; 5-143, 206; 6-4
Section 103.....1-v, xi, 10; 3-12; 4-6; 6-2, 3; 7-8
Section 401.....1-11; 4-15, 16; 5-78, 141; 6-1, 2; 7-8
Section 404.....3-12, 23; 4-17, 79; 5-35, 159, 174, 203; 6-1, 2; 7-8
Section 7.....4-67; 5-153; 6-4; 7-8
Sediment Basin.....1-8; 3-12, 13; 4-3, 4, 5, 75, 76; 5-14, 16, 42, 160, 161, 165, 166, 172, 175; 6-8
sediment control features.....3-13; 4-49
sediment deposition.....3-9; 4-51; 5-147, 186
sediment quality.....4-3, 8; 5-122, 123, 125, 126; 6-3, 8; 8-1
sedimentation.....3-4, 12; 5-79, 140-142
selected plan.....1, 2; 2-4; 3-21, 27; 4-8
shipping.....1; 1-1; 2-2, 3; 3-24, 3-29; 4-27, 43, 47, 67, 83; 5-121, 144, 145, 149; 5-150, 180, 182, 187, 200
shoaling.....1; 3-4, 13-17, 19-20, 28-29; 4-12, 83; 5-142
shoaling rates.....3-14-17, 29; 4-83
shorebird.....3-22; 4-50, 52, 59, 62; 5-148

shortnose sturgeon.....2; 1-4; 3-19, 20; 4-28-30, 39, 68, 70; 5-83, 179, 201, 204, 205, 207; 6-1, 3, 4, 9; 7-4, 5
side scan sonar.....5-124, 156, 157, 160, 165, 166
side slopes.....3-4, 8, 12-14, 21, 28; 4-8, 52, 74, 75; 5-141, 159
silt.....3-8; 4-3-6, 12, 52; 5-140, 142-144
South Atlantic Division (CESAD).....3-14; 5-63
South Carolina Department of Health and Environmental Control (DHEC).....4-13, 19; 5-165; 6-1, 8; 7-7, 8
Spartina.....4-53, 63, 64, 66; 5-3, 7, 30
special resources of concern.....5-146
State Historic Preservation Officer (SHPO).....4-74; 5-164; 6-5; 7-7, 9, 10
stormwater.....5-147
striped bass...2; 1-4, 5, 8; 3-13, 19, 20; 4-15, 20-22, 26, 28, 31-33, 39; 5-83-85, 87-89, 92, 93, 99-107, 114, 118, 120-122, 138, 139, 161, 169, 170, 175, 176, 200, 201, 204, 205, 207, 209; 6-3, 9
submerged berms.....3-8, 12; 5-142
suspended solids.....3-11; 5-53, 143, 144

threatened and endangered species.....3-22; 4-67, 68; 5-153; 6-4
tidal currents.....5-141
tidal marsh.....1-4; 3-4, 22; 4-49, 66; 5-10, 11, 13, 34, 36, 173
Tidegate.....1-8; 3-12, 13; 4-49, 50, 63, 74-76; 5-1, 2, 6, 14, 16, 165, 166, 172, 174, 175, 180; 6-8
toxicity.....4-6; 6-2
turbidity.....3-22; 5-120, 125, 139, 140, 141,143-145
turning basins.....3-10; 4-75; 5-42, 155
Turtle Island.....3-12; 4-48, 50, 57; 5-146, 147, 202, 203
Tybee Island...1-1, 8, 13; 2-1; 3-8, 12, 21, 23-26; 4-3, 14, 44, 48, 62, 70, 80, 81, 83; 5-143-145, 149- 151, 153, 169, 171, 179, 186, 199, 200, 202, 203, 208; 7-2, 5, 6
Tybee National Wildlife Refuge (TNWR).....4-50, 51, 83; 5-146, 187
underdrains.....3-11

Water Quality Certification.....1-11; 4-15, 16; 5-1, 78, 131, 132, 141, 170; 6-1, 2, 9; 7-8
waterfowl.....3-14; 4-48-51, 60, 62; 5-148, 170, 172, 206
Waters of the United States.....6-2
waves.....3-8; 5-179
weir.....3-11; 5-115-117
wetland creation/restoration.....5-33, 174
wetland vegetation.....4-10; 5-10, 11, 29, 32, 173
whales.....4-16, 45; 5-153; 6-4
wildlife habitat.....3-11, 22; 5-31, 40
wildlife management area.....4-48, 50; 5-146, 147, 202
wildlife resources.....5-38, 120, 205
Without Project.....3-3, 4; 4-20; 5-132, 133, 137, 150, 194, 208
wood stork.....4-61, 68, 70; 5-148, 153; 6-4
wrecks/shipwrecks.....4-46, 77, 78; 5-156, 161, 166, 161, 137
Wright River.....4-17, 52

ENVIRONMENTAL IMPACT STATEMENT APPENDIX X: 1999 Report of the Chief of Engineers and Record of Decision

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

US Army Corps of Engineers
Savannah District
South Atlantic Division

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

21 OCT 1999

CECW-PE (10-1-7a)

SUBJECT: Savannah Harbor, Georgia and South Carolina

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on the Savannah Harbor, Georgia and South Carolina navigation improvements. It is accompanied by the report prepared by the Georgia Ports Authority (GPA) under Section 203 of the Water Resources Development Act of 1986 (WRDA 1986), Public Law 99-662. The report was prepared by the GPA (non-Federal sponsor) under the authority of Section 203 of the Water Resources Development Act of 1986 to evaluate the advisability of increasing the depth and making other improvements to Savannah Harbor in the interest of navigation and related purposes.

2. Section 101 (b) (9) of the Water Resources Development Act of 1999 (WRDA 1999), Public Law 106-53, authorized construction of the Savannah Harbor Expansion, Georgia project for navigation subject to completion of a final report of the Chief of Engineers on or before 31 December 1999. This report constitutes the final report of the Corps of Engineers in response to this legislation. Section 101 (b) (9) specified that the project may only be carried out after (i) the Secretary in consultation with other agencies reviews and approves an environmental impact statement that includes:

> (I) an impact analysis of project depths ranging from 42 feet through 48 feet; and
> (II) a selected plan for navigation and an associated selected plan as required under Section 906(a) of the Water resources development Act of 1986:

and (ii) the Secretary of the Interior, the Secretary of Commerce, the Administrator of the Environmental Protection Agency, and the Secretary approve the selected plan and determine that the associated mitigation plan adequately addresses the potential environmental impacts of the project.

3. The non-Federal sponsor recommends a plan to modify the existing Federal navigation project for Savannah Harbor. The plan of improvement consists of the following:

a. Deepening the existing entrance channel up to -50 feet Mean Low Water (MLW) from the ocean to Station –14B+000, up to -48 feet MLW from Station –14B+000 to Station 0+000 and, the inner harbor up to -48 feet MLW from Station 0+000 to Station 103+000;

b. Widening bends in the entrance channel at 2 locations and in the inner harbor channel at 10 locations;

c. Enlarging the Kings Island Turning Basin to a width of 1,676 feet.

d. Raising the dikes from 2.6 feet up to 5.5 feet in disposal areas 12A, 14B and Jones/Oysterbed Island; and

e. A mitigation plan which includes a cultural resource mitigation plan, a natural resources mitigation plan and an impact avoidance plan.

4. The proposed recommended plan of improvement would require dredging and subsequent placement of a maximum of up to 27 million cubic yards of sediments. Sediments excavated from the inner harbor would be deposited in confined disposal facilities (CDFs) presently used by the existing federal navigation project. Dike raising would be performed to accommodate the sediments deposited in those CDFs to regain lost disposal capacity. Sediments excavated from the entrance channel would be deposited in the approved ocean dredged material disposal site. Further consideration of nearshore and/or beach placement of excavated sediments would be made during the engineering and design phase of the project.

5. In the July 1998 GPA report, project costs are allocated to the commercial navigation purpose. Based on October 1997 prices from this report, the estimated cost of the general navigation features (GNF) of the recommended plan is $127, 000,000. The GNF costs include dredging of the channel, debris removal and disposal area improvements. Lands, easements and rights-of-way are estimated as $2,200,000. Mitigation costs are estimated to be $94,000,000. As identified in the report, total project costs are $224,000,000 for the –48 foot project, which include $800,000 for aids to navigation and $454,000 dredging and disposal costs for private facilities. According to the July 1998 report the Federal and non-Federal share of the GNF are estimated to be $141,500,000 and $82,500,000 with all of the estimated mitigation costs assigned to the minus 45-foot depth. However, in response to comments in the July 1998 report GPA provided supplemental information with a revised total project first cost of $229,527,000, of which $144,302,184 is the estimated Federal share and $85,225,101 is the estimated non-Federal share.

6. Included in the mitigation costs that are assigned to the minus 45-foot depth the minimum depth of a "deep draft" harbor is a chloride mitigation cost of $46 million for relocation of a city of Savannah water intake pipe. It has not as yet been confirmed that this chloride mitigation will be required. Following completion of the Tier II EIS study, a determination will be made as to the appropriate amount and the allocation of mitigation costs for each

alternative depth evaluated and a decision made as to whether the chloride mitigation is necessary and an appropriately cost shared item. If relocation of the city of Savannah water intake pipe or other chloride mitigation feature involving modifications of the city of Savannah water supply system remains a part of the project, the costs of operation, maintenance, repair, replacement, and rehabilitation of the modified city of Savannah water system will remain a city of Savannah responsibility and will not be operated and maintained as project GNF. Other project mitigation features to address the adverse impacts of the project will be operated and maintained in the same manner other GNF are operated and maintained.

7. The cost sharing for the mitigation features has been revised using the most current project costs of $229,527,000 and allocating the mitigation costs to project depth zones in proportion to dredging zones. Based on the assignment of mitigation costs for non-depth related features to depth zones in the same proportion as dredging costs, the estimated Federal share of the project cost is $135,249,000 or 59 percent of total project costs and the non-Federal share is $94,278,000 or 41 percent of total project costs. The July 1998 GPA report estimates average annual benefits at a 7-1/8 percent discount rate and 50 year project life to be $52,740,000 and average annual construction costs estimated to be $17,580,000. Net benefits are $35,160,000 and the benefit-to-cost ratio is 3.0 to 1. According to the revised estimates provided by GPA in June 1999, the annual benefits are $52,743,000 and the annual costs including operation and maintenance are estimated as $17,997,000. The net benefits are $34,745,000 and the benefit-to-cost ratio is 2.93 to 1. According to the report prepared by GPA the recommended plan is both the national economic development plan and the locally preferred plan.

8. The mitigation and impact avoidance plan included in the GPA report Tier I EIS consists of five components: (1) Purchase of 3,000 acres of freshwater wetlands to compensate for salinity increases to 1,170 acres of tidal freshwater wetlands; (2) Creation of 81 acres of saltmarsh wetlands to compensate for loss of 40 acres of saltmarsh; (3) A 3-year behavioral study of endangered shortnose sturgeon in the Savannah River estuary, and deepening of the Port Wentworth Turning Basin by 8 feet to provide more suitable habitat for the sturgeon; (4) measures to eliminate the potential project impacts on dissolved oxygen and chloride levels in the estuary; and (5) for striped bass impact avoidance, closure of the mouth of the Middle River at the confluence with Savannah/Front River, closure of two channels from Steamboat Cut to Middle River and opening of a new channel near New Cut from Middle River to Back River. The mitigation plan in the Tier I EIS has been designed to address decreased dissolved oxygen levels in the upper harbor and increased chloride levels at the city of Savannah's industrial water supply intake, potential impacts to the Savannah National Wildlife Refuge, tidal freshwater wetlands, tidal saltmarsh, striped bass spawning and nursery area, endangered shortnose sturgeon habitat, water quality, contaminated sediments, and modifications to flow patterns in the estuary.

9. Cultural resource mitigation plans are included for the two sites listed on the National Register of Historic Places: Old Fort Jackson and the CSS Georgia. Old Fort Jackson is a brick fortification constructed for the War of 1812. A steel sheetpile wall would be constructed to

protect the shoreline adjacent to the fort structure. The CSS Georgia is a confederate ironclad that rests on the bottom of the river adjacent to the navigation channel. In recognition of the project's impacts on the vessel, a plan was developed to recover, document, and curate the items of historic significance.

10. The Washington level review determined that the proposed project was not formulated in accordance with applicable U.S. Army Corps of Engineers planning procedures and regulations and that an acceptable mitigation plan has not been determined at this time. Analyses provided in the Tier I EIS only evaluated the potential impacts for a 50-foot project. Additional analyses must be performed to more completely identify and evaluate the potential impacts of alternative depths, develop an acceptable mitigation plan, and conclusively determine the NED plan and the cost sharing for the mitigation features. These include refinement of the hydrodynamic model and concurrence by the U.S. Army Corps of Engineers and the natural resource agencies in the model's ability to reasonably predict the impacts of the proposed project alternatives, including mitigation features. These additional studies will be performed during the engineering and design phase. The GPA plans to provide documentation, including a consensus mitigation plan developed through a Stakeholders Evaluation Group issue resolution process that could be used for the development of a Federal Tier II EIS. When the findings and conclusions of these additional evaluations are complete, a special report and Tier II environmental impact statement will be prepared and receive full public review. Review of the Tier II EIS and the GRR documents would serve as the basis for obtaining the required approvals, certifications, and permits, as appropriate, from the natural resource agencies for the channel improvement that would be implemented. As a requirement of WRDA 99 Authorization, the Secretary of the Interior, Secretary of Commerce and Administrator of the Environmental Protection Agency, with the Secretary of the Army, must approve the selected plan and determine that the associated mitigation plan adequately addresses the potential environmental impacts.

11. I understand that critics of the subject project could allege that the signing of a favorable Chief of Engineers' report for the project at this time would violate a number of environmental laws, including the Endangered Species Act (ESA), the Fish and Wildlife Co-ordination Act (FWCA), and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). In my opinion, such an allegation clearly would be incorrect, and would fail to recognize the highly conditional and limited nature of this project's statutory authorization. It is true that the signing of a favorable Chief of Engineers' report by 31 December 1999 would complete the congressional authorization process for the project. Consequently, it is possible that the project could eventually be constructed pursuant to that congressional authorization without another authorization action. However, the signing of a favorable Chief's report decidedly would <u>not</u> allow the project to be constructed. The project could only be constructed if and when a number of statutorily specified conditions were to occur, as described above. Among those conditions would be the successful completion of the NEPA process, including any necessary consultation under the ESA, the FWCA, and the MSFCMA, and the demonstration of compliance with those and other relevant environmental laws. Only if and when the

Secretaries of the Army, Interior, and Commerce, and the Administrator of the EPA, have all concluded that all relevant environmental laws have been fully complied with and that all substantial environmental problems have been adequately addressed, could the subject project be approved for construction. In a sense, the signing of a favorable Chief of Engineers' report for this project only authorizes further planning and design work for the project, while all parties work to achieve eventual compliance with all of the relevant environmental laws.

12. I find that, although the project was not formulated in accordance with all applicable U.S. Army Corps of Engineers policies, procedures, and regulations, does not yet have the final EIS that would be necessary to initiate construction, and a fully developed, acceptable mitigation plan has not been identified, the conditions placed on the project by the Congress in Section 101 (b)(9) of Public Law 106-53 provide sufficient safeguards to ensure that implementation will not proceed until the Chief of Engineers determines it to be in accordance with all applicable U.S. Army Corps of Engineers policies, procedures, and regulations and that it includes an acceptable mitigation plan. Accordingly, in recognition of the conditional Congressional authorization, I recommend implementation of the authorized project in accordance with GPA's plan: (a) as modified by Section 101 (b)(9), including additional review by the Corps of Engineers and approval by the Chief of Engineers to ensure that construction of the project will comply with all applicable laws and policies, (b), according to the cost-sharing for mitigation features specified in paragraph 7 above, and (c) as modified by any modifications as in the discretion of the Chief of Engineers may be advisable.

13. Federal implementation of the authorized project would be subject to the non-Federal sponsor agreeing with applicable Federal laws and policies. The non-Federal sponsor would be responsible for the following items of local cooperation:

a. Provide, during construction, any additional funds needed to cover the non-Federal share of design costs;

b. Provide, during the period of construction, a cash contribution equal to the following percentages of the total cost of construction of the general navigation features (which include the construction or improvement of land-based and aquatic dredged material disposal facilities that are necessary for the disposal of dredged material required for project construction, operation, or maintenance and for which a contract for the Federal facility's construction or improvement was not awarded on or before October 12, 1996): 25 percent of the costs attributable to dredging to a depth in excess of 20 feet but not in excess of 45 feet, and 50 percent of the costs attributable to dredging to a depth over 45 feet;

c. In the case of project features greater than -45 feet below MLLW in depth, provide 50 percent of the excess cost of operation and maintenance of the project over that cost which the Secretary determines would be incurred for operation and maintenance if the project had a depth of -45 feet below MLLW.

d. Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the project, up to an additional 10 percent of the total cost of construction of general navigation features. The value of lands, easements, rights-of-way, and relocations provided by the non-Federal sponsor for the general navigation features, described below, may be credited toward this required payment. If the amount of credit exceeds 10 percent of the total cost of construction of the general navigation features, the non-Federal sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of lands, easements, rights-of-way, and relocations in excess of 10 percent of the total cost of construction of the general navigation features;

e. Provide all lands, easements, and rights-of-way, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features (including all lands, easements, and rights-of-way, and relocations necessary for dredged material disposal facilities);

f. Provide, operate, maintain, repair, replace, and rehabilitate, at its own expense, the local service facilities, i.e., berthing areas, local access channels, etc., 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;

g. Pay the proportional cost of construction of any dredged material disposal facilities and maintenance thereof, necessary to dispose of dredged or excavated material for the local service facilities during the initial construction of the local service facilities and the operation, maintenance, repair, replacement and rehabilitation of the local service facilities;

h. Accomplish all removals determined necessary by the Federal Government other than those removals specifically assigned to the Federal Government;

i. Grant the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the general navigation features for the purpose of inspection, and, if necessary, for the purpose of operating, maintaining, repairing, replacing, and rehabilitating the general navigation features;

j. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation 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;

k. 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 general navigation features, 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;

l. Perform, or cause to be performed, 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 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, maintenance, repair, replacement, or rehabilitation of the general navigation features. However, for lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigation unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

m. Assume complete financial responsibility, as between the Federal Government and the non-Federal sponsor, for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features;

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

o. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987, and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

p. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964 (42 U.S.C. 2000d), 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";

q. Provide a cash contribution equal to the non-Federal cost share of the project's total historic preservation mitigation and data recovery costs attributable to commercial navigation that are in excess of 1 percent of the total amount authorized to be appropriated for commercial navigation; and

CECW-PE (10-1-7a)
SUBJECT: Savannah Harbor, Georgia and South Carolina

r. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

JOE N. BALLARD
Lieutenant General, U.S. Army
Chief of Engineers

RECORD OF DECISION
SAVANNAH HARBOR EXPANSION PROJECT
Georgia and South Carolina

1. I have reviewed the Savannah Harbor Expansion Project Feasibility Report and Tier 1 Final Environmental Impact Statement (FR/EIS) dated July 1998. These documents address the need for navigation improvements in Savannah Harbor, Georgia and South Carolina, and were initially prepared by the Georgia Ports Authority (GPA) under the authority of Section 203 of the Water Resources Development Act of 1986 (Public Law 99-662).

2. The harbor improvement would deepen the existing –42 feet Mean Low Water (MLW) deep-draft navigation channels a maximum of six feet to –48 feet MLW. This improvement would increase the efficiency of cargo movements by larger vessels. The improvement plan consists of the following features:

- Deepening the entrance channel to a depth of up to -50 feet MLW from its present terminus to Station –14B+000, to a depth of up to -48 feet MLW from Station –14B+000 to Station 0+000, and in the inner harbor to a depth of up to -48 feet MLW from Station 0+000 to Station 103+000;

- Extending the entrance channel oceanward until it meets the natural depth of –50 feet MLW;

- Widening bends in the entrance channel at 2 locations and in the inner harbor channel at 10 locations;

- Enlarging the Kings Island Turning Basin to a width of 1,676 feet;

- Raising the dikes up to 5.5 feet in upland Confined Disposal Facilities 12A, 14B and Jones/Oysterbed Island; and

- A mitigation plan which includes a cultural resources mitigation plan, a natural resources mitigation plan and an impact avoidance plan.

3. The improvement project would require dredging and subsequent placement of a maximum of up to 27 million cubic yards of sediments. Sediments excavated from the inner harbor would be deposited in Confined Disposal Facilities (CDFs) presently used by the existing federal navigation project. Dike raising would be performed to accommodate the sediments deposited in those CDFs and to replace storage capacity used by this improvement. Sediments excavated from the entrance channel would be deposited in the approved ocean dredged material disposal site. Further consideration of

nearshore and/or beach placement of excavated sediments would be made during the engineering and design phase of the project.

4. The environmental effects of two alternatives were considered; the No Action plan and a deepening of the navigation channel to a –50-foot MLW depth. Based upon the findings of the Tier I EIS, the No Action plan is considered to be the environmentally preferable alternative. Future increases in the tonnage of cargo moved through the port are expected due to increases in economic growth and domestic production within each of several countries that export or import cargo through Savannah Harbor. Growth in the size of vessels calling at the port is projected to occur in response to the trend toward larger vessel size in the world fleet. The proposed harbor deepening would allow the larger vessels to transport more cargo during each transit through the harbor, thereby reducing transportation costs for those cargoes. The EIS assessed the impacts expected to endangered species, fisheries, benthic communities, birds, marine mammals, water quality, cultural resources, historic properties, wetlands, and other environmental factors resulting from the two alternatives. After review of the comments received during the public review of the Draft EIS, deepening the navigation channel to –50 feet MLW was deleted and deepening of the channel up to a maximum authorized depth of –48 feet MLW was identified as the Selected Plan.

5. Means to avoid and/or minimize adverse impacts to environmental resources were analyzed and have been incorporated into the recommended plan. Where adverse impacts to natural resources could not be avoided, mitigation of significant adverse impacts was included. The natural resource mitigation and impact avoidance plan included in the Tier I EIS consists of the following components; details of the mitigation measures are found in the EIS:

- Purchase of 3,000 acres of freshwater wetlands to compensate for salinity increases to 1,170 acres of tidal freshwater wetlands;

- Creation of 81 acres of saltmarsh wetlands to compensate for loss of 40 acres of saltmarsh;

- A 3-year behavioral study of endangered shortnose sturgeon in the Savannah River estuary, and deepening of the Port Wentworth Turning Basin by 8 feet to provide more suitable habitat for the sturgeon;

- Measures to eliminate the potential project impacts on dissolved oxygen and chloride levels in the estuary; and

- To avoid impacts to striped bass, closure of the mouth of the Middle River at the confluence with Savannah/Front River, closure of two channels from Steamboat Cut to Middle River and opening of a new channel near New Cut from Middle River to Back River.

The mitigation plan in the Tier I EIS was designed to address decreased dissolved oxygen levels in the upper harbor, increased chloride levels at the city of Savannah's industrial water supply intake, potential impacts to the Savannah National Wildlife Refuge, tidal freshwater wetlands, tidal saltmarsh, striped bass spawning and nursery areas, endangered shortnose sturgeon habitat, water quality, contaminated sediments, and modifications to flow patterns in the estuary.

6. Cultural resource mitigation plans are included for the two sites listed on the National Register of Historic Places: Old Fort Jackson and the CSS Georgia. Old Fort Jackson is a brick fortification constructed for the War of 1812. A steel sheetpile wall would be constructed to protect the shoreline adjacent to the fort structure. The CSS Georgia is a Confederate ironclad that rests on the bottom of the river adjacent to the navigation channel. In recognition of the project's impacts on the vessel, a plan was developed and included as a project feature to recover, document, and curate the items of historic significance. A Programmatic Agreement was included in the EIS that describes how cultural and historic resources will be addressed from authorization of the project through its implementation. Execution of the Agreement is a feature of the project and will ensure its compliance with the Federal laws protecting these resources.

7. The Corps Washington level review determined that the proposed project was not formulated in accordance with applicable U.S. Army Corps of Engineers planning procedures and regulations and that an acceptable mitigation plan has not been determined. Analyses provided in the Tier I EIS only evaluated the potential impacts for a -50-foot MLW channel depth. Additional analyses must be performed to more completely identify and evaluate the potential impacts of alternative depths, develop an acceptable mitigation plan, and conclusively determine the NED plan and the cost sharing for the mitigation features. These include refinement of the hydrodynamic model and concurrence by the U.S. Army Corps of Engineers and the natural resource agencies in the model's ability to reasonably predict the impacts of the proposed project alternatives, including mitigation features. These additional studies will be performed during the engineering and design phase. The GPA plans to provide documentation, including a consensus mitigation plan developed through a Stakeholders Evaluation Group issue resolution process that could be used for the development of a Federal Tier II EIS. When the findings and conclusions of these additional evaluations are complete, a special report and Tier II environmental impact statement will be prepared and receive full public review. Review of the Tier II EIS and the engineering and design phase documents would serve as the basis for obtaining the required approvals, certifications, and permits, as appropriate, for any recommended channel improvement. Results from the Tier II EIS will be documented in a new Record of Decision.

8. Section 101(b)(9) of Water Resources Development Act of 1999 (WRDA 99), Public Law 106-53 specified a number of conditions that must be met before a project can be constructed. Among those conditions is the successful completion of the NEPA process, including any necessary consultation under the Endangered Species Act, the Fish and Wildlife Coordination Act, and the Magnuson-Stevens Fishery Conservation and

Management Act, and the demonstration of compliance with these and other relevant environmental laws. Also, the Secretaries of the Army, Interior, and Commerce, and the Administrator of the Environmental Protection Agency must all approve the selected plan and determine that the associated mitigation plan adequately addresses the environmental impacts of the project before the project can be approved for construction.

9. Technical and economic criteria specified in the Water Resource Council's *Principles and Guidelines* were used in the formulation of alternative plans. I find that, although the project was not formulated in accordance with all applicable U.S. Army Corps of Engineers policies, procedures, and regulations, does not yet have the final EIS that will be necessary to initiate construction, and a fully developed, acceptable mitigation plan has not been identified, the conditions placed on the project by the Congress in Section 101 (b)(9) of WRDA 99 provide sufficient safeguards to ensure that implementation will not proceed until the Chief of Engineers determines it to be in accordance with all applicable U.S. Army Corps of Engineers policies, procedures, and regulations and that it includes an acceptable mitigation plan. Accordingly, I recommend implementation of the authorized project in accordance with the selected plan (a) as modified by Section 101 (b)(9) of WRDA 1999, including additional review by the Corps of Engineers and approval by the Chief of Engineers to ensure that construction of the project will comply with all applicable laws and policies, (b), according to the cost-sharing for mitigation features determined to be appropriate by the Chief of Engineers, and (c) as modified by any modifications as in the discretion of the Chief of Engineers may be advisable. This Record of Decision completes the National Environmental Policy Act compliance process for authorization of the project.

22 DEC 1999

Date

Hans A. Van Winkle
Major General, U.S. Army
Deputy Commander of Civil Works

ENVIRONMENTAL IMPACT STATEMENT
APPENDIX Y: Stakeholders Evaluation Group Summary Report

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

US Army Corps
of Engineers
Savannah District
South Atlantic Division

Stakeholders Evaluation Group Summary Report
June 24, 2011

The Stakeholders Evaluation Group (SEG) for the proposed deepening of the Savannah River, known as the Savannah Harbor Expansion Project (SHEP), was created to meet a Congressional directive included in the conditional authorization of the project under section 101 of WRDA 1999 *(see Appendix A)*. The SEG, as detailed in the Tier I EIS, was formed to help (1) identify all potential environmental impacts at each incremental depth, (2) define the scope of scientific analysis and environmental evaluation for the Tier II EIS and (3) to develop a consensus mitigation plan *(see Appendix B)*. The SEG also determined it should examine the economics analysis for the project. The SEG has held 68 full meetings and numerous committee meetings during its 12 years of existence. Initially, the meetings of the full membership were held monthly for about the first year, then bi-monthly, decreasing to its current process of holding meetings when relevant based on information available for discussion. An average of about 40 people attend each meeting. The SEG is submitting this report to the Corps of Engineers to serve as a record of the activities and accomplishments of the group, to discuss lessons learned during the process and to hopefully improve the effectiveness of stakeholder groups participating in future Corps of Engineers Civil Works projects.

The SEG initially took time working through several challenging issues, including defining the nature of its membership, determining a mutually agreed upon definition of "consensus" and establishing and maintaining a public record of the proceedings. The adoption of an independent facilitator and a court reporter after the first few meetings assisted in this effort. The group eventually adopted the "SEG Operating Guidelines" *(see Appendix C)* defining the group's mission, operating principles and tasks to be completed. The membership of the group has remained open, a practice which, over time, has resulted in a fairly stable body encompassing a broad representation of community, commercial and environmental interests, and federal and state agency representatives *(see Appendix D)*. The effort to keep a public record of the group's proceedings has expanded beyond the use of the court reporter to include a website with links to items including meeting transcripts, committee reports, presentation materials and supporting documentation.

SEG BENEFITS:

Congress saw the SEG's early and consistent involvement in the project as an integral and essential component of the project. This involvement has benefited the proposed project and its participants as follows:

- Allowed the project sponsor to reach stakeholders in a more organized, timely, and responsive fashion and address problems constructively;
- Fostered working relationships with disparate parties;
- Encouraged inquiry and a more complete discussion of issues;
- Enabled the basic education of diverse stakeholders of the scientific studies, body of knowledge, Corps of Engineers principles/guidelines, and federal regulations providing for more informed public comments for this and other Savannah River related projects;
- Enabled the Corps and project sponsor to receive and integrate into the project more timely input and feedback along the way rather than -- and hopefully avoiding -- the difficulty of fixing problems at the end of the process;
- Incorporated independent external peer review, which the Corps agreed to use for three project issues/studies – the modeling, economics and aquifer – to the SEG and subsequently conducted on the entire Draft General Evaluation Report and Draft Environmental Impact Statement; and
- Identified 11 studies that were completed for the SHEP analysis (*see Appendix E*).

SEG CHALLENGES:

The SEG process has not been trouble-free over its 12 years. Since a stakeholder group had not previously been implemented on a Corps deep draft navigation project, the SEG grappled with several components of its operations:

- A significant challenge existed in how to incorporate a stakeholders group into the existing Corps and agency processes. The federal agencies have a formal coordination process established and any advisory committee can subject the functions of the project to the Federal Advisory Committee Act (FACA), which is extensive and complicated. Since the SEG was established to be advisory to the Georgia Ports Authority, the process was determined not to be subject to FACA. Throughout the process, all self-identified parties were welcome at the table with full rights of participation. SEG meetings and processes were conducted to facilitate free, diverse and transparent discussion. The group does not believe this would have been possible under the highly formal and structured requirements of FACA. However, since the SEG was advisory to only the GPA, some of the membership believes that its

influence over the study process was lessened when the Corps became the lead agency for the production of the GRR and Tier II EIS.

- In order for the Federal and State agencies to participate in the SEG, it was made clear that the representatives in attendance for each of the agencies were not necessarily authorized to represent the official position of their agencies on any particular issue. This condition of the agencies made it difficult to get decisions or recommendations from the agencies in a timely manner and seemed to lessen the discussion by the agency representatives at times.
- A similar challenge existed for the representatives of the non-governmental organizations (NGO). In the spirit of cooperation, the NGO representatives participated in consensus decisions but maintained their ability to make official comments on the documents.
- Another dilemma unresolved is the future of the SEG. The membership of the SEG needs to determine if it would like to be self-sustaining for continued involvement in future harbor and watershed projects/issues. The SEG also needs to find a repository for the meeting records and information gathered through the SEG process after its conclusion. The SEG desires that the information produced and knowledge gained throughout the process is available in the future.
- The definition of consensus was a continual struggle with the disparate interests and open participation of the SEG. The basis for using consensus determinations originated with the Congressional language which charged the SEG to achieve a consensus mitigation plan. The Operating Guidelines, Revision F, defined consensus as "the mutual feeling that all concerns have been addressed and that all parties can live with the proposed course of action." Not only did consensus apply to the mitigation plan, but also applied to the scope of studies and all other determinations of the SEG.
- The technical complexity of evaluating all possible categories of impact exceeded the abilities and training of many SEG members. As a result, the SEG decided to accept assignments and scientific studies as complete, without endorsing by consensus the study particulars, recommendations or conclusions. The SEG did reach a consensus on the scope of committee and scientific studies that should be completed for the project.
- In an effort to deal with difficulties of achieving consensus whether because of technical competence or because of the apprehension of accuracy and completeness, a committee of the SEG (on Operating Guidelines) proposed a set of standards to be used in managing,

evaluating, and controlling the project and its impacts, including mitigation. These procedures were adopted by the SEG in May 2008 (See Appendix F) and later recommended to the Corps by GPA. Soon thereafter, the SEG learned that, under the Water Resources Development Act of 2007, the Corps was being required to use principles of adaptive management in developing project implementation procedures. In concept, the adaptive management approach paralleled the procedures described in the guidelines adopted by the SEG in May 2008. However, the SEG never took a position providing more details on the interpretation and use of adaptive management, nor did Corps headquarters provide similar guidance by the time the draft EIS for the project was issued in November 2010. Some members of the SEG remain concerned about substantive inconsistencies between the SEG guidance memo and the proposed adaptive management approach presented by the Corps in the draft EIS.

- Throughout the process, there have been and continue to be instances where it was/is difficult for SEG members to understand the detailed practices and procedures used by the Corps in project evaluation, potentially causing unnecessary controversy at times. Among procedural matters that were not well understood or uniformly accepted was an analytical methodology, revealed late in the process, that some members believed to be adding to disputes over Corps findings about project economic benefits, both within the SEG and among the general public.

SEG ACCOMPLISHMENTS:

- The SEG membership advocated for independent external peer review and adaptive management prior to the requirement of these processes within Corps projects as required by the Water Resources Development Act of 2007.
- Serving on the SEG provided unprecedented opportunities for individuals affiliated with diverse professional and interest groups to engage in extensive dialogue and become more familiar with the project and each other. This experience is expected to improve communications between and among these groups in addressing future issues.
- The SEG considered and attempted to address all issues raised by membership during the development of the project.

SEG LESSONS LEARNED:

- The membership of the SEG was intentionally left open to anyone who wanted to attend the meetings and participate in the discussion. While this was inclusive, the openness created issues with consensus agreements and with the knowledge base of the attendees. The SEG had to revisit many issues to educate new attendees on work that had been previously completed. Consideration should be given to providing educational materials for new participant orientation.
- While the membership should not be limited, expectations and authority of stakeholder groups should be tailored to the skills, education, and experience of its members, or to the field of candidates from which members will come. Ground rules for conducting group meetings should be prepared in advance to the extent possible, but allowances for the group amending or refining these ground rules should be afforded so that members gain a sense of process ownership and meetings are conducted with as few operational disruptions as possible.
- Future groups should have a well-defined purpose, continually revisit that purpose and adapt as necessary throughout the process.
- It is recommended that Operating Guidelines be established for the organization and function of the group, including procedures for amending them as needed. A subset of the stakeholder group should be established to track the management and adherence to the Operating Guidelines.
- With respect to the idea of achieving an overall consensus, the varied and open membership can make it difficult to reach consensus at times. Depending on the purpose of the stakeholder group, another methodology of approval or acceptance of ideas may be necessary. The group has to decide what works best for the purpose for which it is established.
- Participants in the stakeholder process must be provided clear understanding about the limits of analysis applicable to the study at hand and orientation about the legal aspects of the state and federal authorities engaged in both the project assessment and its implementation. To the maximum extent possible, the process should be made adaptive so that new issues can be explored, enabling comprehensive evaluation that produces outcomes incorporating evolving realities that are essential to ensuring that decisions are made in the public interest.

Accommodations for accountability and adaptive project management must be central, which means high priority must be given to monitoring, assessment and implementation. Process participants must be given corresponding orientation that supports their comprehension of these factors to support their full realization.

Appendices

A. WRDA 1999 Section 101, Savannah Harbor Expansion Excerpt
B. Tier I EIS language establishing the SEG, pages 221-222
C. Operating Guidelines (version accepted in 2000; version updated in 2009)
D. SEG Participants (list)
E. SEG Recommended Studies (list)
F. Operating Guidelines memo of 2008, adopted by consensus in May 2008

Appendix A

WRDA 1999

Savannah Harbor Expansion Project Excerpt

AUTHENTICATED U.S. GOVERNMENT INFORMATION GPO

Public Law 106–53
106th Congress

An Act

To provide for the conservation and development of water and related resources, to authorize the United States Army Corps of Engineers to construct various projects for improvements to rivers and harbors of the United States, and for other purposes.

Aug. 17, 1999
[S. 507]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Water Resources Development Act of 1999.
Inter-governmental relations.
33 USC 2201 note.

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the "Water Resources Development Act of 1999".

(b) TABLE OF CONTENTS.—The table of contents of this Act is as follows:

Sec. 1. Short title; table of contents.

TITLE I—WATER RESOURCES PROJECTS

Sec. 101. Project authorizations.
Sec. 102. Small flood control projects.
Sec. 103. Small bank stabilization projects.
Sec. 104. Small navigation projects.
Sec. 105. Small projects for improvement of the quality of the environment.
Sec. 106. Small aquatic ecosystem restoration projects.

TITLE II—GENERAL PROVISIONS

Sec. 201. Small flood control authority.
Sec. 202. Use of non-Federal funds for compiling and disseminating information on floods and flood damage.
Sec. 203. Contributions by States and political subdivisions.
Sec. 204. Sediment decontamination technology.
Sec. 205. Control of aquatic plants.
Sec. 206. Use of continuing contracts for construction of certain projects.
Sec. 207. Water resources development studies for the Pacific region.
Sec. 208. Everglades and south Florida ecosystem restoration.
Sec. 209. Beneficial uses of dredged material.
Sec. 210. Aquatic ecosystem restoration.
Sec. 211. Watershed management, restoration, and development.
Sec. 212. Flood mitigation and riverine restoration program.
Sec. 213. Shore management program.
Sec. 214. Shore damage prevention or mitigation.
Sec. 215. Shore protection.
Sec. 216. Flood prevention coordination.
Sec. 217. Disposal of dredged material on beaches.
Sec. 218. Annual passes for recreation.
Sec. 219. Nonstructural flood control projects.
Sec. 220. Lakes program.
Sec. 221. Enhancement of fish and wildlife resources.
Sec. 222. Purchase of American-made equipment and products.
Sec. 223. Construction of flood control projects by non-Federal interests.
Sec. 224. Environmental dredging.
Sec. 225. Recreation user fees.
Sec. 226. Small storm damage reduction projects.

Graham, Texas: Report of the Chief of Engineers dated October 6, 1998, at a total cost of $10,080,000, with an estimated Federal cost of $6,560,000 and an estimated non-Federal cost of $3,520,000.

(b) PROJECTS SUBJECT TO A FINAL REPORT.—The following projects for water resources development and conservation and other purposes are authorized to be carried out by the Secretary substantially in accordance with the plans, and subject to the conditions, recommended in a final report of the Chief of Engineers if a favorable report of the Chief is completed not later than December 31, 1999:

(1) HERITAGE HARBOR, WRANGELL, ALASKA.—The project for navigation, Heritage Harbor, Wrangell, Alaska, at a total cost of $24,556,000, with an estimated Federal cost of $14,447,000 and estimated non-Federal cost of $10,109,000.

(2) ARROYO PASAJERO, CALIFORNIA.—The project for flood damage reduction, Arroyo Pasajero, California, at a total cost of $260,700,000, with an estimated Federal cost of $170,100,000 and an estimated non-Federal cost of $90,600,000.

(3) HAMILTON AIRFIELD, CALIFORNIA.—The project for environmental restoration, Hamilton Airfield, California, at a total cost of $55,200,000, with an estimated Federal cost of $41,400,000 and an estimated non-Federal cost of $13,800,000.

(4) SUCCESS DAM, TULE RIVER BASIN, CALIFORNIA.—The project for flood damage reduction and water supply, Success Dam, Tule River basin, California, at a total cost of $17,900,000, with an estimated Federal cost of $11,635,000 and an estimated non-Federal cost of $6,265,000.

(5) DELAWARE BAY COASTLINE, DELAWARE AND NEW JERSEY: OAKWOOD BEACH, NEW JERSEY.—The project for shore protection, Delaware Bay coastline, Delaware and New Jersey: Oakwood Beach, New Jersey, at a total cost of $3,360,000, with an estimated Federal cost of $2,184,000 and an estimated non-Federal cost of $1,176,000, and at an estimated average annual cost of $81,000 for periodic nourishment over the 50-year life of the project, with an estimated annual Federal cost of $53,000 and an estimated annual non-Federal cost of $28,000.

(6) DELAWARE BAY COASTLINE, DELAWARE AND NEW JERSEY: REEDS BEACH AND PIERCES POINT, NEW JERSEY.—The project for shore protection and ecosystem restoration, Delaware Bay coastline, Delaware and New Jersey: Reeds Beach and Pierces Point, New Jersey, at a total cost of $4,057,000, with an estimated Federal cost of $2,637,000 and an estimated non-Federal cost of $1,420,000.

(7) LITTLE TALBOT ISLAND, DUVAL COUNTY, FLORIDA.—The project for hurricane and storm damage prevention and shore protection, Little Talbot Island, Duval County, Florida, at a total cost of $5,915,000, with an estimated Federal cost of $3,839,000 and an estimated non-Federal cost of $2,076,000.

(8) PONCE DE LEON INLET, FLORIDA.—The project for navigation and related purposes, Ponce de Leon Inlet, Volusia County, Florida, at a total cost of $5,454,000, with an estimated Federal cost of $2,988,000 and an estimated non-Federal cost of $2,466,000.

(9) SAVANNAH HARBOR EXPANSION, GEORGIA.—

(A) IN GENERAL.—Subject to subparagraph (B), the project for navigation, Savannah Harbor expansion,

Georgia, including implementation of the mitigation plan, with such modifications as the Secretary considers appropriate, at a total cost of $230,174,000 (of which amount a portion is authorized for implementation of the mitigation plan), with an estimated Federal cost of $145,160,000 and an estimated non-Federal cost of $85,014,000.

(B) CONDITIONS.—The project authorized by subparagraph (A) may be carried out only after—

(i) the Secretary, in consultation with affected Federal, State of Georgia, State of South Carolina, regional, and local entities, reviews and approves an environmental impact statement for the project that includes—

(I) an analysis of the impacts of project depth alternatives ranging from 42 feet through 48 feet; and

(II) a selected plan for navigation and an associated mitigation plan as required under section 906(a) of the Water Resources Development Act of 1986 (33 U.S.C. 2283(a)); and

(ii) the Secretary of the Interior, the Secretary of Commerce, the Administrator of the Environmental Protection Agency, and the Secretary approve the selected plan and determine that the associated mitigation plan adequately addresses the potential environmental impacts of the project.

(C) MITIGATION REQUIREMENTS.—The mitigation plan shall be implemented before or concurrently with construction of the project.

(10) DES PLAINES RIVER, ILLINOIS.—The project for flood control, Des Plaines River, Illinois, at a total cost of $48,800,000 with an estimated Federal cost of $31,700,000 and an estimated non-Federal cost of $17,100,000.

(11) REELFOOT LAKE, KENTUCKY AND TENNESSEE.—The project for ecosystem restoration, Reelfoot Lake, Kentucky and Tennessee, at a total cost of $35,287,000, with an estimated Federal cost of $23,601,000 and an estimated non-Federal cost of $11,686,000.

(12) BRIGANTINE INLET TO GREAT EGG HARBOR, BRIGANTINE ISLAND, NEW JERSEY.—The project for hurricane and storm damage reduction and shore protection, Brigantine Inlet to Great Egg Harbor, Brigantine Island, New Jersey, at a total cost of $4,970,000, with an estimated Federal cost of $3,230,000 and an estimated non-Federal cost of $1,740,000, and at an estimated average annual cost of $465,000 for periodic nourishment over the 50-year life of the project, with an estimated annual Federal cost of $302,000 and an estimated annual non-Federal cost of $163,000.

(13) COLUMBIA RIVER CHANNEL, OREGON AND WASHINGTON.—The project for navigation, Columbia River Channel, Oregon and Washington, at a total cost of $183,623,000, with an estimated Federal cost of $106,132,000 and an estimated non-Federal cost of $77,491,000.

(14) JOHNSON CREEK, ARLINGTON, TEXAS.—The project for flood damage reduction, environmental restoration, and recreation, Johnson Creek, Arlington, Texas, at a total cost of

Appendix B

Tier I EIS language establishing the SEG

Subject to authorization in the Water Resources Development Act of 1998, additional environmental scientific analyses are required during the design phase of the project in order to provide information necessary for the natural resource agencies, the City of Savannah, and affected manufacturing interests to complete their respective evaluations of potential impacts resulting from proposed expansion of the Savannah Harbor channel up to a depth of 48 feet and to participate fully in the development of modifications to the proposed mitigation plan in conjunction with identification of the appropriate channel depth. The additional scientific analyses and the resulting modifications to the mitigation plan will be subject to a Tier II Environmental Impact Statement.

This Tier I Environmental Impact Statement supporting the potential engineering and economic feasibility of a channel up to 48 feet deep requires a Tier II environmental analysis including a Tier II Environmental Impact Statement which will, through appropriate scientific analysis, identify the depth which results in an acceptable level of environmental impacts, and then identifies mitigation necessary to avoid, minimize, or compensate for those impacts.

The scientific analyses will be developed by a Stakeholders Evaluation Group (SEG) comprised of the Georgia Ports Authority, the Army Corps of Engineers, the U. S. Fish and Wildlife Service, the U. S. National Marine Fisheries Service, the Environmental Protection Agency, the U. S. Department of Transportation, the Georgia Department of Natural Resources, the South Carolina Department of Natural Resources, the South Carolina Department of Health and Environmental Control, the City of Savannah, and the Savannah Manufacturers Council. Other interested parties will be welcome to participate in the evaluation process as well. The SEG will identify all potential environmental impacts at each incremental depth from 42 feet to and including 48 feet. If channel deepening is environmental feasible, the SEG will recommend whether and to what extent to modify the mitigation plan to fully address salinity impacts on the Savannah National Wildlife Refuge, salinity and dissolved oxygen impacts on the endangered shortnose sturgeon, salinity and other impacts on striped bass spawning and nursery habitat, chloride impacts on the city's water intake, and dissolved oxygen impacts on existing manufacturing discharges. The SEG recommendation will define the scope of scientific analysis and environmental evaluations for the Tier II EIS, including the need to establish along term monitoring program to continue scientific analyses, evaluate the efficacy of the mitigation plan, and identify further adjustments to the mitigation plan during operation of the project. A flow chart depicting the SEG process is attached.

If the SEG is unable to develop a consensus on the scope of additional scientific analyses within a period of six months from the date of project authorization, the

group will furnish a report to the Secretary of the Army, the Secretary of the Interior, the Secretary of Commerce, the Administrator of the Environmental Protection Agency, Commissioner of the Georgia Department of Natural Resources, the Director of the South Carolina Department of Natural Resources and the Commissioner of the South Carolina Department of Health and Environmental Control, describing the unresolved issues and the respective stakeholders' views on the issues. Neither the Secretary of the Army nor the Georgia Ports Authority will proceed with further work on the scientific analyses for development of the mitigation plan or complete selection of the optimum channel depth until the respective department heads concur in an appropriate scope of work for the additional scientific analyses.

The final channel deepening plan and its associated mitigation plan will support and be consistent with, and in no way preclude, any proposed restoration of degraded Back River striped bass spawning habitats from previous harbor improvement projects. Back River restoration measures will be identified through an ongoing Georgia Department of Natural Resources/Corps of Engineers Section 1135 feasibility study partnership.

The deepening alternatives and the associated mitigation plans will be evaluated in the Tier II EIS which will be subject to further compliance with the National Environmental Policy Act, the Fish and Wildlife Coordination Act, Endangered Species Act, Coastal Zone Management Act, the Clean Water Act, and the Ocean Dumping Act. The Tier II EIS will serve as a decision making tool for the alternatives and the mitigation plan.

If the stakeholders evaluation group determines that a final channel deepening plan, including the mitigation plan, cannot be reached in a reasonable time, the group will furnish a report to the Secretary of the Army, the Secretary of the Interior, the Secretary of Commerce, the Administrator of the Environmental Protection Agency, the Commissioner of the Georgia Department of Natural Resources, the Director of the South Carolina Department of Natural Resources and the Commissioner of the South Carolina Department of Health and Environmental Control, describing the unresolved issues and the respective stakeholders' views on the issues. Neither the Secretary of the Army nor the Georgia Ports Authority will proceed with the final design or construction of the project until the respective department heads concur in an appropriate implementation plan and mitigation plan.

Implementation of the selected mitigation plan will be concurrent with and an integral part of execution of the project.

Notwithstanding a consensus, each individual stakeholder will retain and reserve its individual rights and options to oppose the resultant project.

Appendix C

Operating Guidelines

Version accepted in 2000

Table of Contents

I. Introduction and Mission.
II. Principles.
III. Principal Functions
IV. Implementation
V. Defining Tasks
VI. SEG Organization and Support
VII. Public Information
VIII. Appendix A List of Issues and Recommended Studies
IX. Appendix B List of Tentative or Proposed Issues for Possible Study
X. Appendix C Membership of the SEG
XI. Appendix D SEG Committees

I. Introduction and Mission.

A. The Stakeholders Evaluation Group (SEG) is formed to provide a public forum and assist the Georgia Ports Authority (GPA) to develop scientific studies and analyses necessary to identify impacts on specific environmental concerns that may result from proposed deepening of the harbor channel. The SEG process has as its principal deliverables consensus amongst the participants regarding:
   1. the scope and content of the scientific investigations and analyses to be performed pursuant to the development of a Tier II EIS
   2. the impacts of the project and the resulting appropriate mitigation actions

The SEG will use these scientific studies and analyses to provide input to a mitigation plan alternative which will specify the mitigation necessary to avoid, minimize, and compensate for the impacts. The SEG recognizes that the federal and state regulatory agencies must retain their respective independence to ensure any proposed plan meets agency requirements. The SEG also recognizes that the outcome of the process may result in a determination by the SEG that there is no feasible mitigation plan. Deliberations of the SEG will be based on the Stakeholders Evaluation Group Agreement reached among some of the responsible agencies as stated in the Tier I Environmental Impact Statement filed with GPA's report and recommendation to the Secretary of the Army.

Consensus of the SEG scientific analysis analyses will be incorporated into a Tier II Final Environmental Impact Statement which requires approval of the Secretary of the Army, in consultation with the other responsible federal department heads, prior to project construction. Minority views contra to the consensus Tier II Environmental Impact Statement will be submitted simultaneously with the consensus report.

In its capacity as the project sponsor, GPA will facilitate the SEG process and provide funding for studies and administrative support to the SEG. GPA's involvement will be guided by its Charter responsibility to serve Georgia business while maintaining the natural quality of Georgia's coastal and river environment.

While the SEG will focus on environmental impacts and such economic issues as may be related to or derived from the environmental impacts, it is the expectation of the SEG that GPA will provide similar opportunities for public review and input on cultural issues, broader economic issues, design and engineering issues, implementation issues and other issues that may result from the proposed deepening project. SEG members shall be notified of, and may participate in meetings related to such varied issues and all findings and reports shall be made available to SEG members.

A list of the issues and recommended studies, leading to the above principal deliverables shall be maintained in Appendix A. A list of all tentative or proposed issues for possible study shall be maintained as Appendix B. Both shall be updated as appropriate.

Return to Table of Contents

II. Principles.

A. Deliberations of the SEG will be scientific in nature and be based on the best science available.
   1. When impacts or concerns that have been identified or evaluated by the SEG are used in preparation of, or as a basis for, any type of economic analysis or cost projection, GPA shall provide such analysis or projection in its entirety for review and comment by the SEG. The SEG may request that such analysis or projection be submitted for review by an independent economist, accountant or other financial professional chosen by the SEG, and whose findings shall be reported to the SEG.

B. Decisions will be by consensus, not by majority vote.
   1. Consensus is the mutual feeling that all concerns have been addressed and that all parties can live with the proposed course of action. "Consensus does not necessarily mean unanimity or 100 percent agreement on everything by everybody. Consensus is not conformity." (From "Rules for Reaching Consensus, A Modern Approach to Decision Making" by Steven Saint and James R. Lawson.) In the event of a dispute as to whether consensus has been reached, the SEG will revisit the definition of consensus.
   2. Notwithstanding such consensus, any SEG member(s) may submit a differing viewpoint, which shall be attached as an appendix to the meeting transcript with the submitting member(s) identified.
   3. Estimated time allocations for the agenda items will be provided by the facilitator in consultation with the Steering Committee, and approved by the SEG. When an estimated time allocation has been reached, the facilitator will inform the SEG and ask the members for a determination as to whether progress is being made. If the response is affirmative, the SEG will make a decision as to whether to continue the discussion or to defer it. If the response is negative, the discussion will be deferred. In either case, the SEG will designate a time certain for resuming the discussion, which may be either later in the meeting or at a future meeting.

a. If the issue primarily involves only a small number of SEG members, the SEG may request that the concerned parties meet as an ad hoc committee and report back to the SEG with a recommended course of action.
b. If the issue is one which has come from or is appropriate for a specific committee, the SEG may refer the matter back to said committee.

C. The organizational structure of the SEG will be determined by the SEG and may include the use of committees for specific tasks. The SEG will establish guidelines and determine the scope of work for each such committee. All committee work product will be subject to approval and acceptance by the full SEG

D. Work will be accomplished by discrete assignments performed by appropriate individuals, groups, or consultants as agreed by the SEG.

E. Detailed activities required to meet the objectives of the SEG will be developed by the SEG.

F. The SEG is both an advisory group to GPA and a public forum. Its decisions, recommendations, conclusions, or opinions are not binding upon any member. Nothing herein compromises or alters the legally defined responsibilities, authority, or operational procedures imposed on any agency or organization. SEG members function as individuals; their expressions of consensus are not official organizational positions unless specifically designated as such.

G. Tasks to resolve concerns having to do with the Savannah Harbor Expansion Project may be proposed by any member of the SEG for consideration by the Georgia Ports Authority. : Task statements would include (1) type of effort required, (2) responsible party, (3) schedule and funding requirements, (4) intended results and deliverables (5) possible spill over impact affecting other stakeholders, and (6) intended use of the results in developing the mitigation plan. The SEG shall define the content of each task, including as applicable:

1. Model boundaries, critical parameters, data requirements, analysis increments, and modeling scenarios.
2. Effects on species of flora and fauna to be studied.
3. Effects on other issues to be studied
4. Criteria to quantify effects from environmental changes.
5. Criteria to evaluate and rank effects.
6. Deliverable(s) to be provided to the SEG, including interim reports of progress, final reports, data tables, etc.
7. Discussion of alternative scoping designs.

As part of the evaluation of the proposal by the SEG for recommendation to GPA, consideration shall be given to the applicability of the task to the Harbor Deepening Project. Those concerns which do not meet USACE criteria for applicability to the deepening project shall not be dismissed without further consideration. Rather, the SEG shall seek to assist the proponent in identifying the appropriate mechanism to address the concern.

H. All scientific or technical reports, findings, or conclusions of the SEG or its committees shall include a statement which clearly identifies the boundaries and

limitations of such report, finding, or conclusion; and such statement shall be included whenever such reports, findings, or conclusions are cited or quoted.

I. All meetings of the SEG, including any committee or subgroup performing SEG tasks, shall be considered subject to and shall comply with provisions specified in the Georgia Open Meetings Act. All records, findings, data, reports, etc., shall be considered to be public records subject to the provisions of the Georgia Open Records Act.

J. The SEG will integrate work by others in the estuary and basin to leverage information and action opportunities.

Return to Table of Contents

III. Principal Functions

A. SEG

Through scientific analysis, determine by consensus to what extent to modify the current Tier I EIS mitigation plan to formulate a plan that will govern the final design and construction of the authorized project. Activities will include:

1. Recommend studies and other "straw man" documents to be developed that will define impacts to specific environmental concerns that may result from proposed deepening of the harbor channel.
2. Evaluate such studies developed by GPA or others and recommend adoption.
3. Recommend mitigation studies, including the alternatives to be developed, to address unacceptable environmental/economic impacts.
4. Evaluate such mitigation studies developed by GPA or others, including ranking of competing mitigation alternatives, and recommend adoption.
5. Through scientific analysis, determine by consensus to what extent to modify the current Tier I EIS mitigation plan to formulate a plan that will govern the final design and construction of the authorized project.
6. Identify other activities required to meet the objectives of the SEG.
7. Monitor or otherwise participate in all relevant aspects of SEG deliberations.
8. Support communication of SEG consensus decisions within each member's agency.

B. GPA

Through scientific analysis and consensus, agree to what extent to modify the current Tier I EIS mitigation plan to formulate a plan that will govern the final design and construction of the authorized project. Activities will include:

1. Develop task statements and other "straw man" documents in advance of the tasks to be performed in order to allow opportunity for review and comment by the SEG.
2. Develop studies recommended by the SEG, as required to meet the EIS Tier II process.
3. Maintain a master schedule and exert every effort to meet consensus schedules.

4. Issue agendas for SEG meetings, with input from SEG members, well in advance of such meetings; provide a location for such meetings; issue notes summarizing the results and discussion of such meetings in a timely manner.
5. Monitor or otherwise participate in all relevant aspects of SEG deliberations.
6. Assist in preparation of an after action report to be included in the Tier II EIS as an indication of the consensus support for the outcome of SEG efforts.
7. Participate in all relevant aspects of SEG deliberations

Return to Table of Contents

IV. Implementation

A. Focus on scientific and engineering considerations in working toward consensus.
B. Develop a consensus value system for evaluating and comparing study results and alternative mitigation plans.
C. Integrate related work by others in the estuary to leverage information and action opportunities.

Return to Table of Contents

V. Defining Tasks

The SEG is expected to operate by defining and carrying out specific tasks. GPA and other members may propose "straw man" of tasks for SEG consideration and consensus. Each individual straw man will include the following definition as applicable:

A. Model boundaries, critical parameters, data requirements, analysis increments, modeling scenarios,
B. Species of flora and fauna to be studied,
C. Criteria to quantify effects on species from environmental changes,
D. Criteria to evaluate and rank effects

Return to Table of Contents

VI. SEG Organization and Support

A. Membership

SEG Membership shall be listed in Appendix C.

B. Management and administrative support:

GPA will support the work of the SEG under authority of Section 203 and/or Section 204 of the Water Resources Development Act of 1986 (subject to appropriations of state funds).

1. Provide an SEG facilitator, and other administrative support.
2. Conduct scientific and engineering studies and analyses necessary to

complete a satisfactory project analysis under requirements of NEPA and all other relevant federal and state laws.

3. Provide periodic status reports on project studies.
4. Provide coordination with consultants and insure necessary cooperation on work products being developed under this SEG.

C. The organizational structure of the SEG will be determined by the SEG and may include the use of committees for specific tasks. The SEG will establish guidelines and determine the scope of work for each such committee. All committee work products will be subject to approval and acceptance by the full SEG. The SEG will consider a policy committee and various technical committees as needed.

1. Existing committees will be listed in Appendix D, which shall be modified as necessary. Each committee's mission, and membership shall be described.

Return to Table of Contents

VI. Public Information

A. Public participation and information

The SEG meetings will be open to the public. Any documents prepared by the SEG and approved by the SEG membership shall be posted by GPA on their Internet web site. Such postings shall be made without alteration of the SEG provided document. They are intended to provide access to the general public for SEG information.

B. Representation of the SEG

No member shall represent the SEG to the media or any other body unless they have been explicitly approved to do so in advance by the SEG. Any statements to be released to the media shall be approved in advance by the SEG.

Return to Table of Contents

Appendix A List of Issues and Recommended Studies

This listing will be maintained as recommendations are made by the SEG for studies.

A. A hydrodynamic computer model to accurately evaluate the impacts of channel deepening on salinity in the Savannah Harbor and the resulting impacts on the Savannah National Wildlife Refuge, the endangered shortnose sturgeon, striped bass spawning and nursery habitat through use of a hydrodynamic computer model.
B. A study report outlining an evaluation of the impacts of harbor channel deepening on chloride levels, especially at the City of Savannah's water intake through the use of a hydrodynamic computer model optimized for chlorides.
C. A hydrodynamic computer model to accurately predict the impacts of channel deepening on dissolved oxygen deficit in the Savannah Harbor and the resulting

impacts on the endangered shortnose sturgeon through the use of a hydrodynamic computer model optimized for dissolved oxygen.

D. A consensus mitigation plan to address identified impacts to dissolved oxygen, salinity and chloride for an acceptable channel depth
E. A study report on the economic impacts of the deepening and proposed mitigation plan.
F. A report on how the mitigation plan will complement and interface with the Corps of Engineers' concurrent environmental restoration project in the Savannah River Harbor.
G. An evaluation of beach erosion on Tybee Beach.
H. A study of the distribution of shortnose sturgeon in the lower Savannah River.

Return to Table of Contents

Appendix B List of Tentative or Proposed Issues for Possible Study

A. Essential Elements
    1. Impacts on salinity to the Savannah National Wildlife Refuge,
    2. Impacts on salinity and dissolved oxygen to the endangered shortnose sturgeon,
    3. Impacts on salinity and other impacts to striped bass spawning and nursery habitat,
    4. Impacts on chloride levels, especially to the city's water intake.
    5. Impacts on dissolved oxygen deficit caused by harbor deepening.
B. Model Verification
C. Salinity Changes
D. Dissolved Oxygen
E. Chloride Levels
F. Striped Bass
G. Shortnose Sturgeon
H. Fresh Water Wetlands
I. Salt Water Wetlands
J. Tide Gate Restoration
K. Cumulative Impacts from Previous Dredging
L. Closing Middle River
M. Fishery Management Plans
N. Anadromous Fish Populations
O. Other Fish Species; red drum, American shad, Atlantic salmon, river herring
P. Essential Fish Habitat (EFH)
Q. Endangered Species Act Compliance
R. Management of Contaminated Sediments
S. Beach Erosion
T. Channel Slope Erosion
U. Ft. Pulaski Erosion
V. Dissolved Oxygen/Fecal Coliform on Beaches

W. Agitation Dredging
X. Sand as a Resource
Y. Upstream Water Releases
Z. Project Economics
AA. . Corps of Engineers Section 1135 Restoration Study
AB. . Corps of Engineers Savannah River Comprehensive Study
AC. . Bend widener impacts
AD. . Ft. Pulaski impacts
AE. . Dredged Material Disposal Capacity and Impacts
AF. . Impacts on Adjacent South Carolina Properties
AG. . Integration with the COE Savannah River Basin Comprehensive Water Resources Management Study
AH. . Tidal Amplitude
AI. . Ballast Water

Return to Table of Contents

Appendix C Membership of the SEG

This listing will be kept current as changes in membership occur. Listing here in no way precludes participation by any agency, group, or individual.

A. Georgia Ports Authority
B. Army Corps of Engineers
C. U.S. Fish and Wildlife Service
D. National Marine Fisheries Service
E. Environmental Protection Agency
F. U.S. Department of Transportation
G. Georgia Department of Natural Resources
H. Georgia Environmental Protection Division
I. South Carolina Department of Health and Environmental Control
J. South Carolina Department of Natural Resources
K. City of Savannah
L. City of Tybee Island
M. South Atlantic Regional Fishery Management Council
N. Savannah Manufacturers Council
O. Savannah Harbor Committee
P. Chatham Environmental Forum
Q. Coastal Group Sierra Club
R. The Coastal Environmental Organization of Georgia
S. The Georgia Conservancy
T. Georgia Wildlife Federation
U. Georgia Department of Transportation

Return to Table of Contents

Appendix D SEG Committees

A. Operating Guidelines Committee
   1. Mission:

      To refine the draft operating guidelines and recommend a version to the SEG for approval

      To make recommendations to the SEG on operational procedures and to keep the operating guidelines current to reflect the decisions of the SEG on operational matters. Develop and maintain a matrix of issues and the committees considering those issues. The matrix is understood to be an information tool with no operational imperative itself. It is provided to ensure the membership is informed of which committees are considering which issues and to provide a mechanism for committees to coordinate among themselves.

   2. Member organizations:
      a. City of Tybee
      b. Coastal Environmental Organization of Georgia
      c. Savannah Manufacturer's Council Harbor Committee
      d. Georgia Ports Authority
      e. U. S. Fish and Wildlife Service
      f. Army Corps of Engineers
      g. Chatham Environmental Forum
      h. Coastal Group Sierra Club

B. Beach Erosion Committee
   1. Mission:

      To develop the scope of scientific study needed to determine impacts of the project on sand resources/sharing at Tybee Island.

   2. Member organizations:
      a. City of Tybee
      b. Army Corps of Engineers
      c. Chatham Environmental Forum
      d. Georgia Department of Natural Resources
      e. The Georgia Conservancy
      f. Georgia Ports Authority
      g. Unaffiliated individuals

C. Striped Bass Committee
   1. Mission:

      Determine the scientific analyses needed to determine the effect of the project upon the efforts to restore the striped bass fishery in the Back River

   2. Member organizations:
      a. Georgia Department of Natural Resources

b. Army Corps of Engineers
c. Georgia Ports Authority
d. US Fish and Wildlife Service (ex officio)
e. South Carolina Department of Natural Resources
f. Coastal Group Sierra Club
g. National Marine Fisheries Service

D. Modeling Technical Review Group

1. Mission:

Develop the scope of work for field data collection for dissolved oxygen model development, chloride model development, and interstitial marsh salinity model development. Develop the scope of work for a field study of the distribution of shortnose sturgeon in the lower Savannah River. Develop the scopes of work for the chloride model development task (SEGCL1), the dissolved oxygen model development task (SEGD01), and the marsh succession study task (SEGFM1) and other tasks as specified by the SEG.

2. Member organizations:
   a. Environmental Protection Agency
   b. Georgia Ports Authority
   c. Army Corps of Engineers
   d. National Marine Fisheries Service
   e. Georgia Department of Natural Resources
   f. South Carolina Department of Health and Environmental Control
   g. South Carolina Department of Natural Resources
   h. City of Savannah
   i. Savannah Manufacturers Council
   j. Savannah Harbor Committee
   k. The Coastal Environmental Organization of Georgia
   l. US Fish and Wildlife Service (ex officio)
   m. Chatham Environmental Forum
   n. Coastal Group Sierra Club

E. Communications Committee

The functions and membership of the Communications Committee were assumed by the Operating Guidelines Committee by action of the SEG at its meeting on August 5, 2003.

1. Mission:

Determine the needs and desires of the SEG membership for information distribution and event notification

2. Member organizations:
   a. The Coastal Environmental Organization of Georgia
   b. Coastal Group Sierra Club
   c. Georgia Ports Authority
   d. The Georgia Conservancy

e. Coastal Georgia Center for Sustainable Development
f. Chatham Environmental Forum
g. U. S. Fish and Wildlife Service
h. Army Corps of Engineers
i. Office of Congressman Jack Kingston

F. F. Fisheries Committee
1. Mission
2. Member organizations

G. G. Economic Working Group
1. 1. Mission
2. 2. Member organizations

H. H. Dredging and Disposal Committee
1. 1. Mission
2. 2. Member organizations

Return to Table of Contents

Appendix C

Operating Guidelines

Version updated in 2009

OPERATING GUIDELINES STAKEHOLDERS EVALUATION GROUP SAVANNAH HARBOR EXPANSION PROJECT

February 10, 2009

The Stakeholders Evaluation Group (SEG) has as its mission, purpose, and function the providing of advice to the Georgia Ports Authority (GPA) pertaining to the Savannah Harbor Expansion Project to help insure that all issues pertaining to the project are addressed to the fullest extent practicable.

To accomplish this mission, purpose, and function, the SEG shall operate with the following Operating Guidelines:

1. The SEG shall provide the following:
   A. A public forum to permit members of the general public to voice their support or concerns, to become acquainted with the project, and to provide whatever input they wish.
   B. Advice to the GPA regarding:
      a.
      The scope and content of scientific investigations and analyses to be performed.
      b.
      The anticipated and/or perceived impacts of the project, and
      c.

      Suggested mitigation actions.

2. Advice to the GPA may be in any format, including:
   A. Specific data.
   B. Questions
   C. Suggestions
   D. Reports and Studies
   E. Other

3. Advice to the GPA may have any source, including:
   A. SEG consensus opinions
   B. SEG Committee reports received by the SEG
   C. Individual determinations

1. Federal and state regulatory agencies, as well as other participating organizations, must retain their respective independence, and therefore any input from individuals from these entities does not necessarily represent the official positions of the respective organizations, nor is any such input binding upon any SEG participant.

2. The advice provided may not be complete and accurate, especially in technical matters.

3. Funding and administrative support for the SEG to accomplish it mission, purpose, and function shall be provided by the GPA.
4. A website shall be maintained that shall contain the documentation considered by the SEG, including meeting minutes, reports, studies, schedules, etc.

5. Subjects deliberated by the SEG will be scientific in nature and based on the best science available.

6. The organization structure of the SEG shall utilize a Facilitator to coordinate SEG meetings, plus committees to concentrate on specific project subjects or areas of concern.

7. The SEG shall establish standing committees to help the SEG in its work..

8. SEG committee work product will be received by the SEG, or returned to the committee with a request for further work. Committee work product that is received by the SEG shall become part of the formal SEG record and be considered as advice to the GPA.

    1. The SEG shall establish and maintain Appendices to these Operating Guidelines as follows:
    2. A. Appendix A. List of Issues and Recommended Studies
    3. B. Appendix B. List of Tentative or Proposed Issues for Possible Study
    4. C. Appendix C. Participants of the SEG
    5. D. Appendix D. SEG Committees and Their Missions

        1. Advice provided to the GPA shall be as specific as practicable, addressing relevant considerations such as:
        2. A. Type of effort required
        3. B. Responsible party
        4. C. Schedule and funding requirements
        5. D. Possible spill over impact affecting other stakeholders
        6. E. Intended use of results
        7. F. Model boundaries, critical parameters, data requirements, analysis increments, and modeling scenarios
        8. G. Effects on species of flora and fauna to be studied
        9. H. Effects on other issues to be studied
        10. I. Criteria to quantify effects from environmental changes
        11. J. Criteria to evaluate and rank effects
        12. K. Deliverables to be provided
        13. L. Discussion of alternative scoping designs
        14. M. Applicability of the task to the project
        15. N. Boundaries assumptions and limitations
        16. O. Degree of risk and uncertainty
        17. P. Systemic implications
        18. Q. Metrics and methods for evaluation impacts
        19. R. External review considerations

9. All SEG records, findings, data, reports, advice, etc., shall be considered to be public records subject to the provisions of the Georgia Open Records Act.

10. The SEG will integrate work by others in the Savannah River estuary and basin to leverage information and action opportunities.

11. The SEG encourages representatives of SEG participant organizations to keep their respective organizations fully informed of SEG concerns, issues, plans, advice, etc., as well as the activities, plans, studies, and reports, pertaining to the Savannah Harbor Expansion Project.

12. Meetings of the SEG shall be in accordance with meeting agendas approved by those SEG participants present at any SEG meeting, including whatever time limitations may be established for particular agenda items. The focus of the SEG shall be engineering, economic, and scientific considerations in working toward consensus.

13. No participants shall represent the SEG to the media or any other body unless they have been explicitly approved to do so in advance by the SEG. Any "SEG Statements" to be released to the media shall be approved in advance by the SEG.

14. A final report shall be prepared and provided to the GPA that shall include these operating guidelines, as amended, including all Appendices, as well as a summary of important advice provided to the GPA, and an outline of the information contained on the Savannah Harbor Expansion Project Website pertaining to the Savannah Harbor Expansion Project.

APPENDIX A: List of Issues and Recommended Studies

The primary issues and studies for consideration by the Stakeholders Evaluation Group were defined early in the project as follows:

A. A hydrodynamic computer model to accurately evaluate the impacts of channel deepening on salinity in the Savannah Harbor and the resulting impacts on the Savannah National Wildlife Refuge, the endangered shortnose sturgeon, striped bass spawning and nursery habitat through use of a hydrodynamic computer model.
B. A study report outlining an evaluation of the impacts of harbor channel deepening on chloride levels, especially at the City of Savannah's water intake through the use of a hydrodynamic computer model optimized for chlorides.
C. A hydrodynamic computer model to accurately predict the impacts of channel deepening on dissolved oxygen deficit in the Savannah Harbor and the resulting impacts on the endangered shortnose sturgeon through the use of a hydrodynamic computer model optimized for dissolved oxygen.
D. A mitigation plan to address identified impacts to dissolved oxygen, salinity and chlorides for an acceptable channel depth.
E. A study report on the economic impacts of the deepening and proposed mitigation plan.
F. A report on how the mitigation plan will compliment and interface with the Corps of Engineers' concurrent environmental restoration project in the Savannah River Harbor.
G. A study of beach erosion on Tybee Island.
H. A study of potential impacts of the project to the aequifer under the channel.

APPENDIX B: List of Tentative or Proposed Issues for Possible Study

The primary issues and studies listed in Appendix A reflect numerous elements which were defined early in the project, and were allocated to various committees for additional study, as follows:

A B C D E F G H I

SEG STUDIES AND COMMITTEE SUMMARY

Appendix B-1 -Matrix: Issues Versus Committee Consideration List of Study Elements Listing here in no way precludes participation by any agency, group, or individual. "X's" DENOTE ISSUES BEING CONSIDERED BY COMMITTEE(S). A. Essential Elements									
1. Impacts on salinity to the Savannah National				X		X			
Wildlife Refuge,									
2. Impacts on salinity and dissolved oxygen to the endangered shortnose sturgeon,				X		X			
3. Impacts on salinity and other impacts to striped bass spawning and nursery habitat,		-	X	X		X			
4. Impacts on chloride levels, especially to the city's water intake.				X		-			
5. Impacts on dissolved oxygen deficit caused by harbor deepening.				X		X			
B. Model Verification				X		X			
C. Salinity Changes			X	X		X		X	
D. Dissolved Oxygen				X		X			
E. Chloride Levels				X		-			
F. Striped Bass			X			X			
G. Shortnose Sturgeon				-		X			
H. Fresh Water Wetlands						X		X	
I. Salt Water Wetlands						X		X	
J. Tide Gate Restoration			X			X		X	
K. Cumulative Impacts from Previous Dredging		X	X	-		X		X	
L. Closing Middle River			X			X			
M. Fishery Management Plans						X			
N. Anadromous Fish Populations						X			
O. Other Fish Species; red drum, American shad, Atlantic salmon, river herring						X			
P. Essential Fish Habitat (EFH)						X			
Q. Endangered Species Act Compliance						X			
R. Management of Contaminated Sediments						X		X	
S. Beach Erosion		X							
T. Channel Slope Erosion									
U. Ft. Pulaski Erosion									
V. Dissolved Oxygen/Fecal Coliform on Beaches									

W. Agitation Dredging			X			X		X	
X. Sand as a Resource		X				X		X	
Y Upstream Water Releases						X			
Z. Project Economics						X	X		
AA. Corps of Engineers Section 1135 Restoration Study			X			X			
BB. Corps of Engineers Savannah River Comprehensive Study						X			
CC. Bend widener impacts						X		X	
DD. Ft. Pulaski impacts									
EE. Dredged Material Disposal Capacity and Impacts						X		X	
FF. Impacts on Adjacent South Carolina Properties								X	
GG. Integration with the COE Savannah River Basin Comprehensive Water Resources Management Study			X			X			
HH. Tidal Amplitude			X	X		X			
II. Ballast Water									
JJ. Acquifer Impact									X

Appendix B-2 -Matrix: Organizations Versus Committee Participation Listing here in no way precludes participation by any agency, group, or individual. "X's" DENOTE ORGANIZATIONAL REPRESENTATIONS ON COMMITTEE(S).

A. Georgia Ports Authority	X	X	X	X	X	X	X	X	X
B. Army Corps of Engineers	X	X	X	X	X	X	X	X	X
C. U.S. Fish and Wildlife Service	X	X	X	X	X	X			
D. National Marine Fisheries Service			X	X		X			
E. Environmental Protection Agency				X		X			
F. U. S. Department of Transportation									
G. Georgia Department of Natural Resources		X	X	X		X		X	
H. Georgia Environmental Protection Division				X					
I. South Carolina Department of Health and Environmental Control				X		X		X	X
J. South Carolina Department of Natural Resources			X	X		X		X	
K. City of Savannah				X					X
L. City of Tybee Island	X	X					X		X

M. South Atlantic Regional Fishery Management Council						X			
N. Savannah Manufacturers Council	X			X					
O. Savannah Harbor Committee				X					
P. Chatham Environmental Forum	X	X		X	X				X
Q. Coastal Group Sierra Club	X		X	X	X	X	X	X	X
R. The Coastal Environmental Organization of Georgia	X			X	X			X	X
S. The Georgia Conservancy		X			X		X		X
T. Georgia Wildlife Federation									
U. Georgia Department of Transportation								X	
V. Unaffiliated Individuals		X		X				X	X
W. USCOE-WES				X					
X. USGS				X					X
Y. Coastal Georgia Center for Sustainable Development					X	X	X		X
Z. Synergistic Dynamics							X		
AA. Office of Congressman Jack Kingston					X		X		X
BB. Stevens Shipping							X	X	
CC. UGA Fish & Wildlife Coop Unit			X			X			
DD. Skidaway Institute of Oceanography				X					X
EE. Colonial Terminals									X
FF. Sierra Club South Carolina									X
GG. Town of Hilton Head									X
HH. Greater Savannah Chamber of Commerce									X
II. Georgia Southern University -Coastal Research Center									X
JJ. Georgia Southern University									X
KK. Golder Associates									X
LL. Hydrovision									X
MM. S & ME									X
NN. Watson Technical Consulting									X
OO. International Paper Corp.									X

COLUMN CODES: A = Operating Guidelines Committee B = Beach Erosion Committee C = Striped Bass Committee D = Modeling Technical Review Group E = Communications Committee F = Fisheries Committee G = Economics Working Group H = Dredging and Disposal Committee I = Acquifer Committee

APPENDIX C: Participants of the SEG

All meetings of the Stakeholders Evaluation Group are open to the public which includes individuals as well as participants from organizations. Sign-in sheets are available for each meeting of the Stakeholders Evaluation Group. A compilation of participants who noted their attendance on sign-in sheets at one or more SEG meetings through 2008, is as follows:

1.	Adler	Emma	Citizen
2.	Ahern	Chris	Applied Technology & Management
3.	Alexander	Clark	Skidaway Institute of Oceanography
4.	Askins	Lyne	U.S. Fish and Wildlife Service
.	Bailey	William	U.S. Army Corps of Engineers
6.	Baker	James	Colonial Terminals/SACC Manufacturer's Council Harbor Committee
7.	Balsley	David	Tybee Island
8.	Barrett	Tim	Georgia Department of Natural Resources
9.	Barrows	Matthew	The Island Packet
.	Beach	Dana	Coastal Conservation League
11.	Beach	Richard	Weston Solutions
12.	Beard (Leffek)	Teri	Citizen/ Marine Terminals Corp (formerly Stevens Shipping)/ Fife & Clydesdale Plantations/ Coastal Group Sierra Club
13.	Beasley (Vaughn)	Cathy	Georgia Ports Authority
14.	Beason	Carol	Bottom Line Echo Company
.	Beason	Fred	Bottom Line Echo Company
16.	Beckmann	Lee	Georgia Ports Authority
17.	Bergen	Clete	Citizens for Clean Air and Water
18.	Berson	Will	Georgia Conservancy
19.	Biezenbos	Erica	Citizen
.	Birdwell	Billy	U.S. Army Corps of Engineers
21.	Blanton	Jack	Skidaway Institute of Oceanography
22.	Bogatic	Charles	Stone Container Corporation
23.	Boltin	Tripp	S.C. Dept. of Natural Resources Fisheries Division
24.	Booher	Sam	Georgia Wildlife Federation
.	Bossart	John	Applied Technology and Management
26.	Bouchard	Pat	Tybee Island
27.	Bowen-Li	Russell	Engelhard Corp.
28.	Bowers	B. Gail	League of Women Voters
29.	Boyles	Robert	South Carolina Department of Natural Resources
.	Breen	John	Fort Pulaski National Monument
31.	Brewton	Ben	Coastal Environmental Organization of Georgia
32.	Broome	Doug	International Paper Realty Corp.
33.	Browne	Tommy	Savannah Pilots Association
34.	Brownell	Prescott	U.S. Dept. of Commerce, National Marine Fisheries Service
.	Browning	Donny	U.S. Fish and Wildlife Service
36.	Brush	Janell	Florida Cooperative Fish and Wildlife Research Unit

37.	Burke	Roger	U.S. Army Corps of Engineers – Mobile District
38.	Bush	Douglas	Peeples Industries
39.	Buxton	Eddie	General Engineering
.	Cahill	Kevin	Audobon Society
41.	Calhoun	Andy	Colonial Terminals, Inc.
42.	Callahan	Bridget	Applied Technology & Management
43.	Campbell	Leon	Citizen
44.	Cannon	Robert	Citizen
.	Carroll	C. Ron	University of Georgia
46.	Center	Tony	Congressional candidate
47.	Chapman	Kathy	U.S. Fish and Wildlife Service
48.	Chase	Tom	Moffatt & Nichol
49.	Clark	Sabrina	U.S. Fish and Wildlife Service
.	Coburn	Michael	Peeples Industries
51.	Cohen	Juliet	S.C. More than a Port
52.	Collins	Mark	S.C. Dept of Natural Resources
53.	Collins Rahn	Lucille	Coastal Group Sierra Club
54.	Cooley	Martin	U.S. Army Corps of Engineers
55.	Colvin	Elizabeth	Georgia Department of Natural Resources
56.	Conrads	Paul	USGS-WRD-SC
57.	Considine	John	Savannah Resident
58.	Coocy	Robert	Moran / Georgia Pilots
59.	Cousins	Luke	Private
60.	Covington	Ellie	U.S. Army Corps of Engineers
61.	Cox	John	Applied Technology and Management
62.	Crenshaw	Jason	WJCL – TV
63.	Crosby	Leroy	U.S. Army Corps of Engineers
64.	Daily	F.W.	Citizen /Retired Physician
65.	Darby	Jim	Coastal Group Sierra Club
66.	Dark	Ann	Coastal Group Sierra Club
67.	Davie	Steven	Tetra Tech
68.	Davis	Robert	Port Data Systems (Tampa Bay PORTS)
69.	Davis	Jared W.	Sen. Zell Miller
70.	Davy	Kay	NOAA
71.	Dekrone	Steve	Port Data Systems
72.	Derickson	Ken	U.S. Army Corps of Engineers
73.	Desa	Christopher	Jonaro Technomar Services LLC
74.	DeScherer	Chris	Southern Environmental Law Center
75.	Devisfruto	June	National Park Service
76.	Diamantides	Jerry	David Miller & Associates
77.	Dixon	Sonny	WTOC-TV
78.	Donald	David Charles	Savannah Morning News
79.	Donaldson	Bill	El Paso Global LNG

80.	Drake	Sam	Citizen / Fife & Clydesdale Plantations / U.S. Fish & Wildlife Service
81.	DuBeck	Guy	Georgia Department of Natural Resources -WRD
82.	Duberstein	Jamie	Florida Cooperative Fish & Wildlife -University of Florida
83.	Dumas	Kenny	City of Savannah – Water Dept.
84.	Duncan	Ed	S.C. Dept. of Natural Resources Marine Resources Division
85.	Dunlap	Rob	S.C. Dept. of Natural Resources
86.	Durden	Susan	U.S. Army Corps of Engineers
87.	Dysart	Ben	Dysart & Associates
88.	Edleman	S. H.	Savannah Pilots
89.	Edwards	Mark	Georgia DNR
90.	Ellis	Bo	Applied Technology and Management
91.	Eunis	William	Koch Materials Company
92.	Ernst	Andrew	Hunter, Maclean, Exley & Dunn, P.C.
93.	Ernst	Donald	Citizen
94.	EuDaly	Ed	U.S. Fish and Wildlife Service
95.	Fajen	Michael	CITGO Asphalt Refining Company
96.	Farmer	Bill	Citizen / City of Tybee Island
97.	Fenwick	Charlie	National Park Service – Fort Pulaski
98.	Fisher	George	Georgia Department of Transportation
99.	Fleming	Joel	Georgia DNR Wildlife Resources -Fisheries Management
100.	Flock	Alan	U.S. Fish and Wildlife Service
101.	Folker	Julie	Navy League Board of Directors
102.	Foran	Michael	Savannah Pilots Association
103.	Foyle	Tony	Georgia Southern University
104.	Gaddis	Gabe	Georgia Department of Natural Resource
105.	Gale	Jeri	Georgia Conservancy
106.	Galloway	Brandon	Galloway & Associates
107.	Gane	Brad	Georgia Department of Natural Resource
108.	Garrett	Alan	U.S. Army Corps of Engineers
109.	Gay	Dodie	Enviro Assets / Savannah Area Chamber of Commerce
110.	Gebhardt	Angela	Congressman Jack Kingston
111.	Gibbs	Mark	U.S. Coast Guard Marine Safety Office Savannah
112.	Gignilliat	Matt	Savannah Electric
113.	Ginett	Joe	Citizen
114.	Grabill	Bill	U.S. Fish and Wildlife Service
115.	Grainy	Karen	Coastal Group Sierra Club
116.	Grandison	Johnny	U.S. Army Corps of Engineers – Mobile District
117.	Graves	Chris	U.S. Fish and Wildlife Service
118.	Greene	Larry	U.S. Coast Guard Marine Safety Office Savannah
119.	Greenwood	Darrell	Sierra Club, SC
120.	Griess	Jane	U.S. Fish and Wildlife Service
121.	Griffen	Charles	Georgia Ports Authority
122.	Griffin	David	Georgia Department of Transportation

123.	Haas	Kevin	Georgia Tech Savannah
124.	Hair	Billy	Chatham County Commissioners
125.	Haire	David	Georgia Department of Transportation
126.	Hall	Carl	Georgia Wildlife Federation
127.	Hanzalik	James	U.S. Coast Guard Marine Safety Office Savannah
128.	Harmon	David	CITGO Asphalt Refining Company
129.	Harris	Duane	Georgia Department of Natural Resources – CRD
130.	Harris	Maxine	League of Women Voters
131.	Harrison	Joe	Robinson-Humphrey Company, Inc.
132.	Harrison	Robert	Fife & Clydesdale Plantations
133.	Hastie	Kyla	U.S. Fish and Wildlife Service
134.	Hawks	Jodi	Mulberry Grove Foundation
135.	Headrick	Jerry	Blue Circle Cement
136.	Heitzke	Ken	Town of Hilton Head
137.	Held	Mark	U.S. Army Corps of Engineers
138.	Hendricks	Tim	Georgia Steamship Company / Georgia Pacific
139.	Henry	Jim	GSU/ACRL
140.	Hernandez	Debra	S.C. Depart. of Health and Environmental Control
141.	Hiett	Joe	Connect Savannah
142.	Hill	Harvey	U.S. Fish and Wildlife
143.	Hill	Richard	U.S. Army Corps of Engineers
144.	Hines	Dean	Citizen
145.	Hodge	Jeanne	U.S. Army Corps of Engineers
146.	Hoke	Joe	U.S. Army Corps of Engineers
147.	Holman	Blan	Southern Environmental Law Center
148.	Hughes	Vance	Kilpatrick Stockton, LPP
149.	Hurt	Robert	Hurt, Norton & Associates
150.	Jarons	Betty	U.S. Fish and Wildlife Service
151.	Jennings	Cecil	USGS -Georgia Coop.
152.	Jennings	Judy	Coastal Group Sierra Club
153.	Johnson	Bill	Office of Congressman Jack Kingston
154.	Johnson	John	76 Products Company
155.	Johnson	Lisa	Port Data Systems
156.	Johnson	Paul	WTOC-TV
157.	Johnson	Tim	S.C. Beaufort County Citizen
158.	Jordan	Dave	Sierra Club
159.	Joyner	Curtis	S.C. Depart. of Health and Environmental Control -OCRM
160.	Jue	Harry	City of Savannah
161.	Keegan	Larry	Lockwood Greene Engineers / CH2M Hill
162.	Kelly	Sheryl	Southern Environmental Law Center
163.	Kempke	Suzanne	Armstrong Atlantic State University – Dept. of Biology
164.	King	Mitch	U.S. Fish and Wildlife Service
165.	Kitchens	Wiley	University of Florida – WEC

166.	Klonowski	Karl	U.S. Army Corps of Engineers
167.	Knight	Laura	University of Georgia
168.	Knott	David	S.C. Department of Natural Resources
169.	Knowles	Sally	S.C. Depart. of Health and Environmental Control
170.	Krause	Rick	Hydrovision
171.	Kromer	Danny	Office of Congressman Clyburn
172.	Kronquest	Stacey	Savannah Riverkeeper
173.	Krueger	Gail	Savannah Morning News
174.	Kyler	David	Center for A Sustainable Coast
175.	Lamb	Zachary	Georgia Conservancy
176.	Landers	Mary	Savannah Morning News
177.	Landmeyer	Jim	U. S. Geological Survey
178.	Larson	Jeff	Georgia Environmental Protection Division
179.	Liakakis	Pete	Chatham County / Savannah City Council
180.	Liebschner	Martin	Old Fort Jackson
181.	Lin	Guoming	Interested Citizen
182.	Lively	Leland	Savannah Electric & Power Co.
183.	Lloyd	Heath	City of Savannah
184.	Lowry	Steve	Middleton, Mathis, Adams & Tate
185.	Luther	Mark	Port Data Systems
186.	Lyons	Larry	U.S. Army Corps of Engineers
187.	Macbeth	Ben	CITGO
188.	Maier	Phil	South Carolina Department of Natural Resources
189.	Maimone	Mark	CDM
190.	Malloy	Andrea	South Carolina Coastal Conservation League
191.	Marscher	Bill	CWTF
192.	Marscher	Fran	League of Women Voters
193.	Martin	James	U.S. Army Corps of Engineers, WES
194.	Martin	Ramon	Georgia DNR – Wildlife Resources Division
195.	Maulden	Gary	U.S. Army Corps of Engineers
196.	Matyok	Tom	Center For A Sustainable Coast
197.	Mayle	Mary	Savannah Morning News
198.	McAdams	Tom	Engelhard / Harbor Committee
199.	McBride	Eddie	International Longshoremen's Association Local 1414
200.	McCollum	Jerry	Georgia Wildlife Federation
201.	McCurry	Jamie	Georgia Ports Authority
202.	McCutchen	John	Southern LNG
203.	McDonald	Jim	U.S. Coast Guard
204.	McDougal	Art	Colonial Oil Industries, Inc.
205.	McGee	Gwen	Georgia Wildlife Federation
206.	McIntire	James	Carriers Container Council
207.	McIntosh	Margaret	U.S. Army Corps of Engineers
208.	McIntosh	Neff	Coastal Environmental Organization
209.	McIntosh	Patricia	Georgia Conservancy

210.	McKee	Gwen	Georgia Wildlife Federation & CEO
211.	Meronek	Tom	Georgia DNR – Wildlife Resources
212.	Metz	Craig	Office of Congressman Floyd Spence
213.	Michaels	Ron	Georgia DNR – Coastal Resources Div.
214.	Mikell	Robert	S.C. Depart. of Health and Environmental Control
215.	Miklos	Adam	International Paper
216.	Miller	Doug	Savannah Morning News
217.	Miller	Gerald	U. S. Environmental Protection Agency
218.	Missroon	James	Citizen
219.	Modzelewski	Ed	Applied Technology and Management
220.	Moffitt	Pete	South Atlantic Fishery Management Council
221.	Montague	Clay	University of Florida
222.	Moore	Charles	S.C. Department of Natural Resources
223.	Moore	Kelie	Georgia DNR Coastal Resources Division
224.	Moorer	Hope	Georgia Ports Authority
225.	Morekis	Jim	Creative Loafing
226.	Morgan	Henry	Citizen
227.	Mueller	Heinz	US EPA, Region Four, Environmental Accountability Division
228.	Nadelman	Fred	Citizens for Clean Air and Water
229.	Neal	Larry	MACTEC
230.	Nelson	Christie	Lockwood Greene Engineers
231.	Neuhauser	Hans	Georgia Land Trust Center
232.	Njikam	Forpu	U. S. Army Corps of Engineers
233.	O'Co7uner	Andrew	Ferrene & Associates, P.A.
234.	O'Brien	Pam	City of Tybee Island
235.	O'Kelly	Robert	U.S. Army Corps of Engineers
236.	Off	Lou	Tybee Island Beach Task Force
237.	Oliver	James	
238.	Olsen	Erik	Olsen Associates, Inc.
239.	Oosterhoudt	Jim	The Retec Group
240.	Pafford	Julian	Savannah Electric
241.	Parker	James	U.S. Army Corps of Engineers
242.	Parker	Walter	City of Tybee Island
243.	Parrott	Dan	U.S. Army Corps of Engineers
244.	Parsons	Keith	Georgia Department of Natural Resources
245.	Pedrick	James	Blue Circle Cement
246.	Peeples	Frank	Peeples Industries, Inc.
247.	Penberthy	DaWayne	Southern LNG
248.	Perling	Florence	League of Women Voters
249.	Perry	Bob	S.C. Depart. of Natural Resources
250.	Phillips	Darrell	WTOC TV
251.	Phillips	Jack	U.S. Army Corps of Engineers
252.	Phillips	John	Georgia Department of Transportation

253.	Plachy	Douglas	U.S. Army Corps of Engineers
254.	Post	Bill	S.C. Depart. of Natural Resources Marine Resources Research Institute
255.	Poulos	Mike	Citizen
256.	Procopio	Maria	Savannah Riverkeeper
257.	Prusa	Thomas	U.S. Fish & Wildlife Service
258.	Pugliese	Roger	South Atlantic Fisheries Management Council
259.	Quigley	Erin	Interested Student (Ga. Conservancy & Skidaway Island)
260.	Rackley	David	U.S. Dept. of Commerce, National Marine Fisheries Service
261.	Rado	Melissa	S.C. Depart. of Health and Environmental Control -OCRM
262.	Rae	Andrew	Coastal Group Sierra Club
263.	Rees	Ali	Rees Engineering & Environmental Services
264.	Rees	Morgan	Rees Engineering & Environmental Services
265.	Reese	Patricia	Georgia Ports Authority
266.	Reich	Courtney	Metropolitian Planning Commission
267.	Reichard	Jim	Georgia Southern University
268.	Reinert	Tom	University of Florida
269.	Renner	James	Golder Associates, Inc.
270.	Resinger	Jacqueline	Resident, Daufuski Island
271.	Rhett	Brad	Georgia Conservancy
272.	Rhodes	Ray	S.C. Department of Natural Resources
273.	Rich	Fred	Georgia Southern University
274.	Richards	Jimmy	Savannah Sugar Refinery
275.	Richards	Patty	S.C. Coastal Conservation League
276.	Richardson	Lenett	Office of U.S. Congressman Jack Kingston
277.	Roberto	Douglas	Georgia-Pacific Corporation
278.	Robinette	John	U.S. Fish and Wildlife Service
279.	Robinson	Brittany	International Paper / Harbor Committee
280.	Rockwell	Jason	WTOC-TV
281.	Roden	Randy	Domtar Gypsum
282.	Rogers	Larry	Georgia Department of Natural Resources – EPD
283.	Rothschild	Brent	National Park Service – Fort Pulaski
284.	Rothschild	Maury	Savannah Foods
285.	Russom	Kevin	Berlion Ltd. / Georgia Pacific
286.	Rutherford	Frieda	Tybee Island Task Force
287.	Saia	John	U.S. Army Corps of Engineers
288.	Samz	Charles	Coastal Group Sierra Club
289.	San Juan	Lauree	Ogeechee Audubon
290.	Sawyer	John	City of Savannah
291.	Saxon	Ed	Beaufort-Jasper Water & Sewer Authority
292.	Scanlon	Bob	City of Savannah / Manufacturers Council
293.	Scardino	Tom	Candidate Ga. House District 125
294.	Schaller	David	Georgia Ports Authority
295.	Schanze	Thomas	Applied Technology and Management

296.	Schechter	Joe	Intermarine USA
297.	Schilling	Nancy	Friends of the Rivers at Lowcountry Institute / SC Marine Association & AIWA
298.	Schmitt	Col. Joseph	U. S. Army Corps of Engineers
299.	Schuberth	Christopher	Chatham Environmental Forum
300.	Seebald	Ray	U.S. Coast Guard
301.	Seyle	Wade	U.S. Army Corps of Engineers
302.	Shaw	R. Lewis	S.C. Depart. of Health and Environmental Control
303.	Shelby	John	League of Women Voters of Savannah/Chatham
304.	Shipman	Susan	Georgia DNR, Coastal Resources Division
305.	Shortland	Becky	Georgia Conservancy
306.	Sibley	John	Georgia Conservancy
307.	Sikes	Kristy	Armstrong
308.	Simo	Paul	Georgia Trust for Historic Preservation
309.	Simonds	Pete	U.S. Coast Guard – MSO
310.	Smith	Brion	Lockwood Greene Engineers
311.	Smith	Cardwell	U.S. Army Corps of Engineers
312.	Smith	Scott	Coastal Heritage Society
313.	Smyth	James	U.S. Department of the Army, Civil Works
314.	Snedeker	John	Synergistic Dynamics, Inc.
315.	Snyder	Steve	S.C. Depart. of Health and Environmental Control
316.	Sprague	Ronald	RRoy Enterprises, L.L.C.
317.	Stafford	John	Ogeechee Audubon Society
318.	Stevens	Stuart	Georgia Department of Natural Resources
319.	Stringer	Pat	League of Women Voters
320.	Stroup	Rodger	S.C. Historical Association
321.	Sutlive	Charles	Savannah Maritime Association
322.	Tanner	Margaret	MACTEC
323.	Taylor	Christie	Georgia Guardian
324.	Thomas	Marian	Lockwood Greene Engineers
325.	Thomas	Matt	Georgia DNR -Water Resources Division
326.	Thomas	Paul	E.M. Industries
327.	Thomas	Raymond J.	
328.	Thorpe	Dale	U.S. Army Corps of Engineers – Institute for Water Resources (IWR)
329.	Thran	Ann	Georgia DNR – Permitting
330.	Tollison	Trip	Savannah Area Chamber of Commerce / U.S. Rep. Jack Kingston
331.	Toma	Mike	Armstrong Atlantic State University
332.	Tomlinson	Leon	Georgia Sierra Club
333.	Traylor	Mell	Long Island Club Corporation
334.	Tucker	Sandy	U.S. Fish and Wildlife Service
335.	Tyler	Billie L.	City of Pooler
336.	Tyndall	Carr	Stone Container Corporation

337.	Urbine	Wayne	U.S. Army Corps of Engineers
338.	Vacquer	Mike	International Paper
339.	Valente	Ray	Scaray Environmental Consulting
340.	Vermilye	Terry	Citizen
341.	Walker	Laura	City of Savannah
342.	Waters	Wade	Mulberry Grove Foundation
343.	Watson	Charles	KAC/R&D / Watson Technical Consultants
344.	Watus	Wade	Mulberry Grove Foundation
345.	Webb	Robb	U.S. Coast Guard
346.	Webb	Russell	U.S. Fish and Wildlife Service
347.	Webster	Billy	S.C. Depart. of Health and Environmental Control
348.	Welborn	Tom	U.S. Environmental Protection Agency, Region IV
349.	Wendt	Priscilla	S.C. Dept. of Natural Resources
350.	Werner	Ben	Savannah Morning News
351.	Wesley	Rick	Savannah Bar Pilots
352.	Wiggins	Wilbur	U.S. Fish and Wildlife Service
353.	Wilkes	Mark.	Jasper County
354.	Wilkes	Mark	Metropolitan Planning Commission
355.	Will	Ted	Georgia Department of Natural Resources – WRD
356.	Williams	Beth	U.S. Army Corps of Engineers
357.	Williams	Joel	Coastal Conservation Association
358.	Willis	Steve	Citizen
359.	Wills	Caitlin	UGA
360.	Witherington	Mimi	Sen. Max Cleland
361.	Wise	Lloyd	EPA
362.	Wood	Judy	U.S. Army Corps of Engineers
363.	Woodall	Mark	Sierra Club
364.	Woolf	Wesley	National Wildlife Federation
365.	Wright	Tom	Wright Systems and Project Management
366.	Wynne	John	Georgia DNR – Coastal Resources Division
367.	Yandel	Justin	Coastal Environmental Organization
368.	Yuschishin	Myron	U.S. Army Corps of Engineers

APPENDIX D: SEG Committees and Their Missions

The Stakeholders Evaluation Group (SEG) has established a number of Standing Committees, as well as a mission for each committee, as follows:

A. Operating Guidelines Committee Mission Statement: To make recommendations to the SEG on operational procedures, to recommend revisions to the SEG Operating Guidelines and the Appendices thereof, and to draft for SEG consideration an SEG Final Report.

B. Beach Erosion Committee Mission Statement: To make recommendations to the SEG on needed scientific studies addressing the impacts of the harbor deepening project on beach erosion, as well as needed mitigations addressing expected impacts of the project on beach erosion.

C. Striped Bass Committee Mission Statement: To make recommendations to the SEG on needed scientific studies addressing the impacts of the harbor deepening project on the striped bass fishery in the Back River, as well as needed mitigations addressing expected impacts of the project on the striped bass fishery.

D. Modeling Technical Review Group Mission Statement: To assist in the establishment of scopes of work, field data collection, and sufficiency criteria for the following:

1. Dissolved oxygen model development,
2. Chloride model development,
3. Interstitial marsh salinity model development,
4. Shortnose sturgeon distribution field study for the lower Savannah river.
5. Other modeling tasks as specified by the SEG.

E. Communications Committee Mission Statement: To assist the SEG in establishing informational and communication needs for the SEG.

F. Fisheries Committee Mission Statement: To make recommendations to the SEG on needed scientific studies addressing the impacts of the harbor deepening project on fish populations in the Savannah River and adjacent marshes, as well as needed mitigations addressing expected impacts of the project on fish populations in the Savannah River and adjacent marshes.

G. Economic Working Group Mission Statement: To evaluate international, national, regional and local waterborne trade patterns and types of vessels used in order to review and comment on the Corps of Engineers economic analysis, including the validity of assumptions used by the Corps.

H. Dredging and Disposal Committee Mission Statement: To make recommendations to the SEG on needed scientific studies addressing channel dredging and disposal of dredged materials associated with the harbor deepening project, as well as needed mitigations addressing expected impacts of the project associated with dredging and disposal of dredged materials.

I. Acquifer Committee Mission Statement: To make recommendations to the SEG on needed scientific studies addressing the impacts of the harbor deepening project on fresh water acquifers under the Savannah River and adjacent areas, as well as needed mitigations addressing expected impacts of the project on fresh water acquifers under the Savannah River and adjacent areas.

(The Stripped Bass Committee and the Fisheries Committee were combined)

Appendix D

SEG Participants

REGISTERED ATTENDEES OF THE SAVANNAH HARBOR EXPANSION
PROJECT STAKEHOLDERS EVALUATION GROUP MEETINGS

	Last Name	First Name	Company/Affiliation
1	Adler	Emma	Citizen
2	Ahern	Chris	Applied Technology and Management
3	Alexander	Clark	Skidaway Institute of Oceanography
4	Askins	Lyne	U. S. Fish and Wildlife Service
5	Bailey	William	U. S. Army Corps of Engineers
6	Baker	James	Colonial Terminals/SACC Manufacturer's Council Harbor Committee
7	Balsley	David	Tybee Island
8	Barrett	Tim	Georgia Department of Natural Resources
9	Barrows	Matthew	The Island Packet
10	Beach	Dana	Coastal Conservation League
11	Beach	Richard	Weston Solutions
12	Beard (Leffek)	Teri	Citizen/ Marine Terminals Corp (formerly Stevens Shipping)/ Fife & Clydesdale Plantations/ Coastal Group Sierra Club
13	Beasley (Vaughn)	Cathy	Georgia Ports Authority
14	Beason	Carol	Bottom Line Echo Company
15	Beason	Fred	Bottom Line Echo Company
16	Beckmann	Lee	Georgia Ports Authority
17	Bellis	Jennifer	Southern Environmental Law Center
18	Bergen	Clete	Citizens for Clean Air and Water
19	Berson	Will	Georgia Conservancy
20	Biezenbos	Erica	Citizen
21	Birdwell	Billy	U. S. Army Corps of Engineers
22	Blanton	Jack	Skidaway Institute of Oceanography
23	Bogatie	Charles	Stone Container Corporation
24	Boltin	Tripp	S.C. Dept. of Natural Resources Fisheries Division
25	Bonitatibus	Tonya	Savannah Riverkeeper
26	Booher	Sam	Georgia Wildlife Federation
27	Bossart	John	Applied Technology and Management
28	Bouchard	Pat	Tybee Island
29	Bowen-Li	Russell	Engelhard Corp.
30	Bowers	B. Gail	League of Women Voters
31	Boyles	Robert	S.C. Department of Natural Resources
32	Breen	John	National Park Service – Fort Pulaski
33	Brewton	Ben	Coastal Environmental Organization
34	Broome	Doug	International Paper Realty Corp.
35	Browne	Tommy	Savannah Pilots Association
36	Brownell	Prescott	U. S. Dept. of Commerce, National Marine Fisheries Service
37	Browning	Donny	U. S. Fish and Wildlife Service
38	Brush	Janell	Florida Cooperative Fish and Wildlife Research Unit
39	Budds	Garrett James	Coastal Conservation League
40	Burke	Roger	U. S. Army Corps of Engineers – Mobile District
41	Bush	Douglas	Peeples Industries
42	Buxton	Eddie	General Engineering
43	Cahill	Kevin	Audobon Society
44	Caldwell	Dale	Georgia Department of Natural Resources – EPD
45	Calhoun	Andy	Colonial Terminals, Inc.
46	Callahan	Bridget	Applied Technology and Management
47	Campbell	Leon	Citizen
48	Cannon	Robert	Citizen
49	Carroll	C. Ron	University of Georgia
50	Carty	Jennifer	U. S. Coast Guard
51	Center	Tony	Congressional Candidate

REGISTERED ATTENDEES OF THE SAVANNAH HARBOR EXPANSION
PROJECT STAKEHOLDERS EVALUATION GROUP MEETINGS

52	Chapman	Kathy	U. S. Fish and Wildlife Service
53	Chase	Tom	Moffatt & Nichol
54	Clark	Sabrina	U. S. Fish and Wildlife Service
55	Coburn	Michael	Peeples Industries
56	Cohen	Juliet	S.C. More than a Port
57	Collins	Mark	S.C. Dept of Natural Resources
58	Collins Rahn	Lucille	Coastal Group Sierra Club
59	Colvin	Elizabeth	Georgia Department of Natural Resources
60	Conrads	Paul	USGS-WRD-SC
61	Considine	John	Savannah Resident
62	Cooey	Robert	Moran / Georgia Pilots
63	Cooley	Martin	U. S. Army Corps of Engineers
64	Cousins	Luke	Private
65	Covington	Ellie	U. S. Army Corps of Engineers
66	Cox	John	Applied Technology and Management
67	Crenshaw	Jason	WJCL–TV
68	Crosby	Leroy	U. S. Army Corps of Engineers
69	Daily	F.W.	Citizen /Retired Physician
70	Darby	Jim	Coastal Group Sierra Club
71	Dark	Ann	Coastal Group Sierra Club
72	Davie	Steven	Tetra Tech
73	Davis	Robert	Port Data Systems (Tampa Bay PORTS)
74	Davis	Jared W.	Sen. Zell Miller
75	Davy	Kay	NOAA
76	Dekrone	Steve	Port Data Systems
77	Derickson	Ken	U. S. Army Corps of Engineers
78	Desa	Christopher	Jonaro Technomar Services LLC
79	DeScherer	Chris	Southern Environmental Law Center
80	Devisfruto	June	National Park Service
81	Diamantides	Jerry	David Miller & Associates
82	Dixon	Sonny	WTOC-TV
83	Donald	David Charles	Savannah Morning News
84	Donaldson	Bill	El Paso Global LNG
85	Drake	Sam	Citizen / Fife & Clydesdale Plantations / U.S. Fish & Wildlife Service
86	DuBeck	Guy	Georgia Department of Natural Resources - WRD
87	Duberstein	Jamie	Florida Cooperative Fish and Wildlife - University of Florida
88	Dumas	Kenny	City of Savannah – Water Dept.
89	Duncan	Ed	S.C. Dept. of Natural Resources Marine Resources Division
90	Dunlap	Rob	S.C. Dept. of Natural Resources
91	Durden	Susan	U. S. Army Corps of Engineers
92	Dysart	Ben	Dysart & Associates
93	Edleman	S. H.	Savannah Pilots Association
94	Edwards	Mark	Georgia DNR
95	Ellis	Bo	Applied Technology and Management
96	Embres	Joe	U. S. Coast Guard
97	Ennis	William	Koch Materials Company
98	Ernst	Donald	Citizen
99	Ernst	Andrew	Hunter, Maclean, Exley & Dunn, P.C.
100	EuDaly	Ed	U. S. Fish and Wildlife Service
101	Fajen	Michael	CITGO Asphalt Refining Company
102	Farmer	Bill	Citizen / City of Tybee Island
103	Fenwick	Charlie	National Park Service – Fort Pulaski
104	Fisher	George	Georgia Department of Transportation

REGISTERED ATTENDEES OF THE SAVANNAH HARBOR EXPANSION
PROJECT STAKEHOLDERS EVALUATION GROUP MEETINGS

105	Fleming	Joel	Georgia DNR Wildlife Resources - Fisheries Management
106	Flock	Alan	U. S. Fish and Wildlife Service
107	Folker	Julie	Navy League Board of Directors
108	Foran	Michael	Savannah Pilots Association
109	Foyle	Tony	Georgia Southern University
110	Gaddis	Gabe	Georgia Department of Natural Resource
111	Gale	Jeri	Georgia Conservancy
112	Galloway	Brandon	Galloway & Associates
113	Gane	Brad	Georgia Department of Natural Resource
114	Garrett	Alan	U. S. Army Corps of Engineers
115	Gay	Dodie	Enviro Assets / Savannah Area Chamber of Commerce
116	Gebhardt	Angela	Congressman Jack Kingston
117	Gibbs	Mark	U. S. Coast Guard Marine Safety Office Savannah
118	Gignilliat	Matt	Savannah Electric
119	Ginett	Joe	Citizen
120	Grabill	Bill	U. S. Fish and Wildlife Service
121	Grainey	Karen	Sierra Club
122	Grandison	Johnny	U. S. Army Corps of Engineers – Mobile District
123	Graves	Chris	U. S. Fish and Wildlife Service
124	Greene	Larry	U. S. Coast Guard Marine Safety Office Savannah
125	Greenwood	Darrell	Sierra Club, SC
126	Griess	Jane	U. S. Fish and Wildlife Service
127	Griffen	Charles	Georgia Ports Authority
128	Griffin	David	Georgia Department of Transportation
129	Haas	Kevin	Georgia Tech Savannah
130	Hair	Billy	Chatham County Commissioners
131	Haire	David	Georgia Department of Transportation
132	Hall	Carl	Georgia Wildlife Federation
133	Hanzalik	James	U. S. Coast Guard Marine Safety Office Savannah
134	Harmon	David	CITGO Asphalt Refining Company
135	Harris	Duane	Georgia Department of Natural Resources – CRD
136	Harris	Maxine	League of Women Voters
137	Harrison	Robert	Fife & Clydesdale Plantations
138	Harrison	Joe	Robinson-Humphrey Company, Inc.
139	Hastie	Kyla	U. S. Fish and Wildlife Service
140	Hawks	Jodi	Mulberry Grove Foundation
141	Hayes	Chuck	U. S. Fish and Wildlife Service
142	Headrick	Jerry	Blue Circle Cement
143	Heitzke	Ken	Town of Hilton Head
144	Held	Mark	U. S. Army Corps of Engineers
145	Hendricks	Tim	Georgia Steamship Company / Georgia Pacific
146	Henry	Jim	GSU/ACRL
147	Hernandez	Debra	S.C. Dept. of Health and Environmental Control
148	Herrell	Tammy	National Park Service – Fort Pulaski
149	Hiett	Joe	Connect Savannah
150	Hill	Richard	U. S. Army Corps of Engineers
151	Hill	Harvey	U. S. Fish and Wildlife Service
152	Hines	Dean	Citizen
153	Hodge	Jeanne	U. S. Army Corps of Engineers
154	Hoke	Joe	U. S. Army Corps of Engineers
155	Holman	Blan	Southern Environmental Law Center
156	Hughes	Vance	Kilpatrick Stockton, LPP
157	Hurt	Robert	Hurt, Norton & Associates

REGISTERED ATTENDEES OF THE SAVANNAH HARBOR EXPANSION
PROJECT STAKEHOLDERS EVALUATION GROUP MEETINGS

158	Jarous	Betty	U. S. Fish and Wildlife Service
159	Jennings	Judy	Coastal Group Sierra Club
160	Jennings	Cecil	USGS - Georgia Coop.
161	Johnson	John	76 Products Company
162	Johnson	Bill	Office of Congressman Jack Kingston
163	Johnson	Lisa	Port Data Systems
164	Johnson	Tim	S.C. Beaufort County Citizen
165	Johnson	Paul	WTOC-TV
166	Jordan	Dave	Sierra Club
167	Joyner	Curtis	S.C. Dept. of Health and Environmental Control - OCRM
168	Jue	Harry	City of Savannah
169	Keegan	Larry	Lockwood Greene Engineers / CH2M Hill
170	Kelly	Allison	Georgia Conservancy
171	Kelly	Sheryl	Southern Environmental Law Center
172	Kempke	Suzanne	Armstrong Atlantic State University – Dept. of Biology
173	King	Jeff	U. S. Army Corps of Engineers
174	King	Mitch	U. S. Fish and Wildlife Service
175	Kitchens	Wiley	University of Florida – WEC
176	Klonowski	Karl	U. S. Army Corps of Engineers
177	Knight	Laura	University of Georgia
178	Knott	David	S.C. Dept. of Natural Resources
179	Knowles	Sally	S.C. Dept of Health and Environmental Control
180	Krause	Rick	Hydrovision
181	Kromer	Danny	Office of Congressman Clyburn
182	Kronquest	Stacey	Savannah Riverkeeper
183	Krueger	Gail	Savannah Morning News
184	Kyler	David	Center for A Sustainable Coast
185	Lamb	Zachary	Georgia Conservancy
186	Landers	Mary	Savannah Morning News
187	Landmeyer	Jim	U. S. Geological Survey
188	Larson	Jeff	Georgia Environmental Protection Division
189	Lee	Steven	U. S. Army Corps of Engineers
190	Liakakis	Pete	Chatham County / Savannah City Council
191	Liebschner	Martin	Old Fort Jackson
192	Lin	Guoming	Interested Citizen
193	Lively	Leland	Savannah Electric
194	Lloyd	Heath	City of Savannah
195	Long	Nathan	Thomas and Hutton Engineering Company
196	Lowry	Steve	Middleton, Mathis, Adams & Tate
197	Luther	Mark	Port Data Systems
198	Lyons	Larry	U. S. Army Corps of Engineers
199	Macbeth	Ben	CITGO
200	Maggioni	Ralph	Foreign Trade Zone
201	Maier	Phil	S.C. Department of Natural Resources
202	Maimone	Mark	CDM
203	Malloy	Andrea	S.C. Coastal Conservation League
204	Marscher	Bill	CWTF
205	Marscher	Fran	League of Women Voters
206	Martin	Ramon	Georgia DNR – Wildlife Resources Division
207	Martin	James	U. S. Army Corps of Engineers, WES
208	Matyok	Tom	Center For A Sustainable Coast
209	Maulden	Gary	U. S. Army Corps of Engineers
210	Mayle	Mary	Savannah Morning News

REGISTERED ATTENDEES OF THE SAVANNAH HARBOR EXPANSION
PROJECT STAKEHOLDERS EVALUATION GROUP MEETINGS

211	McAdams	Tom	Engelhard / Harbor Committee
212	McBride	Eddie	International Longshoremen's Association Local 1414
213	McCollum	Jerry	Georgia Wildlife Federation
214	McCormack	Leland	S.C. Dept. of Natural Resources
215	McCurry	Jamie	Georgia Ports Authority
216	McCutchen	John	Southern LNG
217	McDonald	Joyce	U. S. Army Corps of Engineers
218	McDonald	Jim	U. S. Coast Guard
219	McDougal	Art	Colonial Oil Industries, Inc.
220	McIntire	James	Carriers Container Council
221	McIntosh	Neff	Coastal Environmental Organization
222	McIntosh	Patricia	Georgia Conservancy
223	McIntosh	Margaret	U. S. Army Corps of Engineers
224	McKee	Gwen	Georgia Wildlife Federation & CEO
225	Meronek	Tom	Georgia DNR – Wildlife Resources
226	Metz	Craig	Office of Congressman Floyd Spence
227	Michaels	Ron	Georgia DNR – Coastal Resources Div.
228	Mikell	Robert	S.C. Dept. of Health and Environmental Control
229	Miklos	Adam	International Paper
230	Miller	Doug	Savannah Morning News
231	Miller	Gerald	U. S. Environmental Protection Agency
232	Missroon	James	Citizen
233	Modzelewski	Ed	Applied Technology and Management
234	Moffitt	Pete	South Atlantic Fishery Management Council
235	Montague	Clay	University of Florida
236	Moore	Kelie	Georgia DNR Coastal Resources Division
237	Moore	Charles	S.C. Dept. of Natural Resources
238	Moorer	Hope	Georgia Ports Authority
239	Morekis	Jim	Creative Loafing
240	Morgan	Henry	Citizen
241	Moseby	Bernard	U. S. Army Corps of Engineers
242	Moss	Dean	Beaufort-Jasper Water & Sewer Authority
243	Mueller	Heinz	US EPA, Region Four, Environmental Accountabilily Division
244	Nadelman	Fred	Citizens for Clean Air and Water
245	Neal	Larry	MACTEC
246	Nelson	Christie	Lockwood Greene Engineers
247	Neuhauser	Hans	Georgia Land Trust Center
248	Njikam	Forpu	U. S. Army Corps of Engineers
249	O'Brien	Pam	City of Tybee Island
250	O'Kane	Jason	U. S. Army Corps of Engineers
251	O'Kelly	Robert	U. S. Army Corps of Engineers
252	O'Conner	Andrew	Ferrene & Associates, P.A.
253	Off	Lou	Tybee Island Beach Task Force
254	Oliver	James	
255	Olsen	Erik	Olsen Associates, Inc.
256	Oosterhoudt	Jim	The Retec Group
257	Ottenweller	Katherine	Southern Environmental Law Center
258	Pafford	Julian	Savannah Electric
259	Parker	Walter	City of Tybee Island
260	Parker	James	U. S. Army Corps of Engineers
261	Parrott	Dan	U. S. Army Corps of Engineers
262	Parsons	Keith	Georgia Department of Natural Resources
263	Pedrick	James	Blue Circle Cement

REGISTERED ATTENDEES OF THE SAVANNAH HARBOR EXPANSION
PROJECT STAKEHOLDERS EVALUATION GROUP MEETINGS

264	Peeples	Frank	Peeples Industries
265	Penberthy	DaWayne	Southern LNG
266	Perling	Florence	League of Women Voters
267	Perry	Bob	S.C. Dept. of Natural Resources
268	Petit	Jerry	Citizen (SC)
269	Phillips	John	Georgia Department of Transportation
270	Phillips	Jack	U. S. Army Corps of Engineers
271	Phillips	Darrell	WTOC-TV
272	Plachy	Douglas	U. S. Army Corps of Engineers
273	Post	Bill	S.C. Dept. of Natural Resources Marine Resources Research
274	Poulos	Mike	Citizen
275	Procopio	Maria	Savannah Riverkeeper
276	Prusa	Thomas	U. S. Fish and Wildlife Service
277	Pugliese	Roger	South Atlantic Fisheries Management Council
278	Quigley	Erin	Interested Student (Ga. Conservancy & Skidaway Island)
279	Quintero	Diana M.	Georgia Tech (student)
280	Rackley	David	U. S. Dept. of Commerce, National Marine Fisheries Service
281	Rado	Melissa	S.C. Dept. of Health and Environmental Control - OCRM
282	Rae	Andrew	Coastal Group Sierra Club
283	Rees	Ali	Rees Engineering & Environmental Services
284	Rees	Morgan	Rees Engineering & Environmental Services
285	Reese	Patricia	Georgia Ports Authority
286	Reich	Courtney	Metropolitan Planning Commission
287	Reichard	Jim	Georgia Southern University
288	Reinert	Tom	University of Florida
289	Renner	James	Golder Associates, Inc.
290	Resinger	Jacqueline	Resident, Daufuski Island
291	Rhett	Brad	Georgia Conservancy
292	Rhodes	Ray	S.C. Dept. of Natural Resources
293	Rice	David	Citizen
294	Rich	Fred	Georgia Southern University
295	Richards	Patty	S.C. Coastal Conservation League
296	Richards	Jimmy	Savannah Sugar Refinery
297	Richards	Mary E.	U. S. Army Corps of Engineers
298	Richardson	Lenett	Office of U.S. Congressman Jack Kingston
299	Roberto	Douglas	Georgia-Pacific Corporation
300	Robinette	John	U. S. Fish and Wildlife Service
301	Robinson	Brittany	International Paper / Harbor Committee
302	Rockwell	Jason	WTOC-TV
303	Roden	Randy	Domtar Gypsum
304	Rogers	Larry	Georgia Department of Natural Resources – EPD
305	Rominger	McLeod	TICO Terminal Services
306	Rothschild	Brent	National Park Service – Fort Pulaski
307	Rothschild	Maury	Savannah Foods
308	Russom	Kevin	Berlion Ltd. / Georgia Pacific
309	Rutherford	Frieda	Tybee Island Beach Task Force
310	Saddler	Emily	U. S. Coast Guard - MSU
311	Saia	John	U. S. Army Corps of Engineers
312	Samz	Charles	Coastal Group Sierra Club
313	San Juan	Lauree	Ogeechee Audubon Society
314	Sapp	Bill	Southern Environmental Law Center
315	Sawyer	John	City of Savannah
316	Saxon	Ed	Beaufort-Jasper Water & Sewer Authority

REGISTERED ATTENDEES OF THE SAVANNAH HARBOR EXPANSION
PROJECT STAKEHOLDERS EVALUATION GROUP MEETINGS

317	Scanlon	Bob	City of Savannah / Manufacturers Council
318	Scardino	Tom	Candidate Ga. House District 125
319	Schaller	David	Georgia Ports Authority
320	Schanze	Thomas	Applied Technology and Management
321	Schechter	Joe	Intermarine USA
322	Schilling	Nancy	Friends of the Rivers at Lowcountry Institute / SC Marine Association & AIWA
323	Schmitt	Col. Joseph	U. S. Army Corps of Engineers
324	Schuberth	Christopher	Chatham Environmental Forum
325	Seebald	Ray	U. S. Coast Guard
326	Seyle	Wade	U. S. Army Corps of Engineers
327	Shaw	R. Lewis	S.C. Dept. of Health and Environmental Control
328	Shelby	John	League of Women Voters of Savannah/Chatham
329	Shipman	Susan	Georgia DNR, Coastal Resources Division
330	Shortland	Becky	Georgia Conservancy
331	Sibley	John	Georgia Conservancy
332	Sikes	Kristy	Armstrong Atlantic State University
333	Simo	Paul	Georgia Trust for Historic Preservation
334	Simonds	Pete	U. S. Coast Guard Marine Safety Office Savannah
335	Sinkler	Michelle	Southern Environmental Law Center
336	Skinner	Ben	U. S. Army Corps of Engineers
337	Smith	Scott	Coastal Heritage Society
338	Smith	Brion	Lockwood Greene Engineers
339	Smith	Ryan	Thomas and Hutton Engineering Company
340	Smith	Cardwell	U. S. Army Corps of Engineers
341	Smyth	James	U. S. Department of the Army, Civil Works
342	Snedeker	John	Synergistic Dynamics, Inc.
343	Snyder	Steve	S.C. Dept. of Health and Environmental Control
344	Sprague	Ronald	RRoy Enterprises, L.L.C.
345	Stafford	John	Ogeechee Audubon Society
346	Statler	Kim	Lowcountry Alliance
347	Stevens	Stuart	Georgia Department of Natural Resources
348	Stewart	Jennifer	Georgia Tech (student)
349	Stringer	Pat	League of Women Voters
350	Stroup	Rodger	S.C. Historical Association
351	Sutlive	Charles	Savannah Maritime Association
352	Tanner	Margaret	MACTEC
353	Taylor	Christie	Georgia Guardian
354	Thomas	Raymond J.	
355	Thomas	Paul	E.M. Industries
356	Thomas	Matt	Georgia DNR - Water Resources Division
357	Thomas	Marian	Lockwood Greene Engineers
358	Thorpe	Dale	U. S. Army Corps of Engineers – Institute for Water Resources (IWR)
359	Thran	Ann	Georgia DNR – Permitting
360	Tolleson	Chris	Integrated Science & Engineering
361	Tollison	Trip	Savannah Area Chamber of Commerce / U.S. Rep. Jack Kingston
362	Toma	Mike	Armstrong Atlantic State University
363	Tomlinson	Leon	Georgia Sierra Club
364	Traylor	Mell	Long Island Club Corporation
365	Tucker	Sandy	U. S. Fish and Wildlife Service
366	Tyler	Billie L.	City of Pooler
367	Tyndall	Carr	Stone Container Corporation
368	Urbine	Wayne	U. S. Army Corps of Engineers

REGISTERED ATTENDEES OF THE SAVANNAH HARBOR EXPANSION
PROJECT STAKEHOLDERS EVALUATION GROUP MEETINGS

369	Vacquer	Mike	International Paper
370	Valente	Ray	Searay Environmental Consulting
371	Vermilye	Terry	Citizen
372	Walker	Laura	City of Savannah
373	Wanders	Steve	CH2M Hill
374	Waters	Wade	Mulberry Grove Foundation
375	Watson	Charles	KAC/R&D / Watson Technical Consultants
376	Webb	Robb	U. S. Coast Guard
377	Webb	Russell	U. S. Fish and Wildlife Service
378	Webster	Billy	S.C. Dept. of Health and Environmental Control
379	Welborn	Tom	U. S. Environmental Protection Agency, Region IV
380	Wendt	Priscilla	S.C. Dept. of Natural Resources
381	Werner	Ben	Savannah Morning News
382	Wesley	Rick	Savannah Bar Pilots
383	Wester	Randy	National Park Service – Fort Pulaski
384	Wiggins	Wilbur	U. S. Army Corps of Engineers
385	Wikoff	Bill	U. S. Fish and Wildlife Service
386	Wilkes	Mark	Jasper County
387	Wilkes	Mark	Metropolitan Planning Commission
388	Will	Ted	Georgia Department of Natural Resources – WRD
389	Williams	Joel	Coastal Conservation Association
390	Williams	Beth	U. S. Army Corps of Engineers
391	Willis	Steve	Center For A Sustainable Coast
392	Wills	Caitlin	University of Georgia
393	Wise	Lloyd	U. S. Environmental Protection Agency
394	Witherington	Mimi	Sen. Max Cleland
395	Wood	Judy	U. S. Army Corps of Engineers
396	Woodall	Mark	Sierra Club
397	Woods	Milton	Jasper County
398	Woolf	Wesley	National Wildlife Federation
399	Wright	Tom	Wright Systems and Project Management
400	Wynne	John	Georgia DNR – Coastal Resources Division
401	Yandel	Justin	Coastal Environmental Organization
402	Young	W.L.	Jasper County Planning Board
403	Yuschishin	Myron	U. S. Army Corps of Engineers
404	Zadach	Steve	Georgia Stevedores Association

Appendix E

SEG Recommended Studies

SEG List of Recommended Studies

1. A hydrodynamic computer model to accurately evaluate the impacts of channel deepening on salinity in the Savannah Harbor and the resulting impacts on the Savannah National Wildlife Refuge, the endangered shortnose sturgeon, striped bass spawning and nursery habitat through use of a hydrodynamic computer model.
2. A study report outlining an evaluation of the impacts of harbor channel deepening on chloride levels, especially at the City of Savannah's water intake through the use of a hydrodynamic computer model optimized for chlorides.
3. A hydrodynamic computer model to accurately predict the impacts of channel deepening on dissolved oxygen deficit in the Savannah Harbor and the resulting impacts on the endangered shortnose sturgeon through the use of a hydrodynamic computer model optimized for dissolved oxygen.
4. A consensus mitigation plan to address identified impacts to dissolved oxygen, salinity and chloride for an acceptable channel depth
5. A study report on the economic impacts of the deepening and proposed mitigation plan.
6. A report on how the mitigation plan will complement and interface with the Corps of Engineers' concurrent environmental restoration project in the Savannah River Harbor.
7. An evaluation of beach erosion on Tybee Beach.
8. A study of the distribution of shortnose sturgeon in the lower Savannah River.
9. A temporal and spatial distribution study of the fisheries in the Savannah River to document the spatial, seasonal, and inter-annual use of nursery habitats by estuarine dependent species within the Savannah River estuary.
10. A hurricane surge study to determine if the deepening project will have an impact on the magnitude of surge associated with hurricanes that may affect Savannah.
11. A study to determine if the deepening project will cause further erosion along the banks of the Savannah River.

Appendix F

Operating Guidelines Committee memo of 2008, adopted by consensus in May 2008

Recommendation for SEG position on Corps use of study committee reports and other information in preparing the General Reevaluation Report (GRR), Mitigation Plan, and draft EIS for the Savannah Harbor Expansion Project.

The SEG recommends that the Corps incorporate into their analysis of the project the reports from the various study committees, recognizing that these may be incomplete or inaccurate. To ensure the most accurate and comprehensive use of information by the Corps in further analysis of the project's impacts, mitigation alternatives and their impacts as well, we recommend the following standards of review.

1. **Degree of risk and uncertainty.**
To determine the usefulness of project analysis, decision-makers (including the public) must have reliable advice about the certainty/uncertainty of the assessment of impacts and mitigation alternatives. Likewise, implications about any uncertainty must be clarified. If risk is determined to be significant, contingencies for quickly responding to impacts must be provided so that unforeseen adverse consequences will be minimized. *This should include specification of all assured sources of funding that will be available to cover the costs of any previously unforeseen corrective actions or compensation for cost overruns that may need to be pursued to protect public resources.*

2. **Systemic Implications.**
Due to the complex and interactive nature of the natural systems affected by the project, impacts on one resource or group of resources may have consequences for others, either short-term or long-term. Studies focusing on one resource (e.g., striped bass) may be complete and accurate on one level, but may have implications for other resources – such as species or habitats of concern. The same can be said for mitigation efforts – a reasonable mitigation alternative for controlling or compensating for one kind of adverse impact for a resource of immediate concern may itself produce undesired effects on other resources. Such systemic and interactive effects must be clearly explained and fully evaluated when analyzing the project's impacts and mitigation measures that are based on a comprehensive list of individual issues or resources. As with the case of uncertainty, contingencies for intervening to prevent significant but unforeseen systemic impacts must be well planned and thoroughly described as part of the Corps analysis and mitigation plan.

3. **Metrics & methods for evaluation impacts.**
Whatever studies or recommendations are adopted, including those augmented by additional Corps analysis, Corps reporting must specify carefully considered methods for monitoring and evaluating the impacts of both the project and mitigation efforts. These methods must specify in detail the protocol for gathering and assessing information, and the criteria to be used to trigger enactment of contingency plans for controlling adverse effects if and when they arise. Contingency procedures should include the use of more rigorous monitoring and assessment methods to assist in determining the causes of undesired impacts and the alternatives for reducing or eliminating them. Such procedures must also include the option of stopping project implementation activities for an indeterminate period to prevent unacceptable impacts from occurring. In any case, project analysis and recommendations must specify the threshold of conditions that must be ensured to enable the project to remain feasible in the public interest. If these conditions cannot be maintained, procedures must be clearly outlined for intervening to prevent the project or its mitigation from causing further damage to public resources.

ENVIRONMENTAL IMPACT STATEMENT
APPENDIX Z: Environmental Clearances

SAVANNAH HARBOR EXPANSION PROJECT

Chatham County, Georgia and Jasper County, South Carolina

January 2012

US Army Corps
of Engineers
Savannah District
South Atlantic Division

TABLE OF CONTENTS

1. US FWS Endangered Species Act Concurrence Report 1

2. NMFS Biological Opinion 4

3. GA DNR-EPD Water Quality Certification 239

4. SC DHEC Final Agency Decision 249

5. SC DHEC Water Quality Certification 257

6. GA DNR-CRD Coastal Zone Management Consistency 259

7. SC DHEC Coastal Zone Management Consistency 262

8. GA HPD Section 106 Compliance Letter 263

9. SC DAH Section 106 Compliance Letter 264

United States Department of the Interior
Fish and Wildlife Service
105 West Park Drive, Suite D
Athens, Georgia 30606
Phone: (706) 613-9493
Fax: (706) 613-6059

West Georgia Sub Office
P.O. Box 52560
Ft. Benning, Georgia 31995-2560
Phone: (706) 544-6428
Fax: (706) 544-6419

Coastal Sub Office
4980 Wildlife Drive
Townsend, Georgia 31331
Phone: (912) 832-8739
Fax: (912) 832-8744

April 28, 2011

Colonel Jeffrey M. Hall
U. S. Army Corps of Engineers, Savannah District
100 West Oglethorpe Avenue
Savannah, Georgia 31401-3640
Attention: William G. Bailey

Dear Colonel Hall:

The U. S. Fish and Wildlife Service (Service) has reviewed the U. S. Army Corps of Engineers (USACE) Savannah Harbor Expansion Project, General Reevaluation Report (GRR) and Draft Tier II Environmental Impact Statement (DEIS) of November 15, 2010, concerning Savannah Harbor Expansion Project (SHEP) on the Savannah River, Chatham County, Georgia and Jasper County, South Carolina. The Biological Assessment of Threatened and Endangered Species (BATES) is included as Appendix B. This report is submitted in accordance with provisions of the Endangered Species Act (ESA) of 1973, as amended; (16 U.S.C. 1531 et seq.).

The SHEP involves deepening the harbor from the current inner harbor depth of 42 feet by as much as 6 feet to a maximum authorized depth of 48 feet. Authorizing language in the Water Resources Development Act of 1999 stipulates that the project may proceed only after the Secretary of the Interior, Secretary of Commerce, and Administrator of the Environmental Protection Agency approve the selected plan and determine that the associated mitigation plan adequately addresses its potential environmental impacts. The subject documents describe various models that were developed to predict changes to the environment resulting from alternative channel depths and mitigation measures. Predicted changes to the environment include: salinity increases, loss of tidal freshwater marsh, reduced striped bass reproduction and recruitment, negative impacts to shortnose sturgeon habitat, reduced dissolved oxygen (DO), and potential exposure of wildlife to cadmium in dredged sediments.

The BATES examines the effects of the proposed action on all species that may be present in the project area and concludes that the piping plover *(Charadrius melodus)*, wood stork *(Mycteria americana)*, West Indian manatee *(Trichechus manatus)*, right *(Eubaleana glacialis)* and humpback whales *(Megaptera novaeangliae)*, sea turtles, and shortnose sturgeon *(Acipenser brevirostrum)* may be affected by the project. The right and humpback whales, and shortnose sturgeon are the responsibility of the National Marine Fisheries Service (NMFS). At this time, we understand that the USACE and NMFS are in consultation on the NMFS species. The sea turtles are NMFS responsibility while in the water and the Service's when nesting on

shore, including hatchlings leaving the nest. Within the Savannah project area primarily only one species of sea turtle, the loggerhead sea turtle (*Caretta caretta*) nests regularly on the adjacent beaches of Tybee and Daufuskie Islands.

Dredging operations, placement of sediment, and subsequent maintenance have the potential to adversely affect animals and plants in a variety of ways. These include actions of the dredging equipment; physical contact with dredging equipment and vessels; physical barriers imposed by the presence of dredging equipment; and placement of dredged sediment in various locations. Potential impacts vary according to the type of equipment used, the nature and location of sediment discharged, the time period in relation to life cycles of organisms that could be affected, and the nature of the interaction of a particular species with the dredging activities.

The Service designated the north end of Tybee Island, Georgia, adjacent to the project, as critical habitat for the wintering piping plover. Some dredge sediments are planned to be placed in nearshore areas to migrate on-shore for beach renourishment. The placement may have temporary adverse impacts on foraging habitat. Small portions of the habitat would be directly affected short-term at any point in time and adjacent habitat will be available. Because erosion of the Tybee shoreline would be reduced, the intertidal areas that provide foraging habitat to the piping plover would experience a long term benefit.

Wood storks feed and loaf in the confined disposal facilities (CDFs) for sediments from the Savannah River. Continued use of upland CDFs for sediment placement could be considered a minor enhancement of wood stork feeding habitat. Procedures for sediment placement should insure birds would not be exposed to cadmium-laden sediments.

The West Indian manatee has site fidelity to summer habitat in the Savannah River. Manatees feed in shallow water on saltmarsh cordgrass *(Spartina alterniflora)*. As the dredging will occur in the deepest part of the channel, direct effects on manatees from the dredging operation and the placement of sediment should be minor. Additionally, the project would not adversely affect any conditions relating to habitat requirements such as the cordgrass. A large percentage of manatee mortality is due to collisions with watercrafts. The dredging operations will involve various vessels presenting the potential for collisions. The USACE will implement "Standard State and Federal Manatee Protection Conditions" to insure that the project does not affect manatees.

Of the five sea turtle species that may be found in the waters of the project, only the loggerhead turtle nests regularly on the adjacent beaches of Tybee and Daufuskie Islands. Sea turtles have site fidelity to their nesting beaches. The presence of artificial lighting on dredge equipment near nesting beaches is detrimental to critical behavioral aspects of the nesting process, including nesting female emergence, nest site selection, and the nocturnal sea-finding behavior of both hatchlings and nesting females. While still adhering to minimum luminance requirements, light emanating from equipment will be minimized to reduce the potential harmful effects. To minimize risk of sea turtle impacts due to dredges, environmental windows were established which restrict dredging to periods when turtles are least abundant or least likely to be affected by dredging. The environmental windows for turtle-safe dredging have targeted the winter months when sea turtle abundance is dramatically reduced and generally

outside of the nesting period. Turbidity is produced by nearshore sediment placement that can adversely affect sea turtles. The primary concern is disorientation of female turtles trying to reach the nesting beach. There are also concerns about potential impacts to hatchlings entering the ocean. Although ambient turbidities in the nearshore Tybee Island area are already high because of the Savannah River, to reduce potential impacts, the USACE would restrict sediment placement in this area to the period from 1 August to 30 April. The proposed nearshore placement of sediments is not expected to adversely impact the beach nesting activities of sea turtles.

Based on the information summarized above, the BATES concludes that the proposed action "may affect, but is not likely to adversely affect" piping plover, wood stork, West Indian manatee, right and humpback whales, sea turtles, and shortnose sturgeon that may be present within the area. The BATES includes conditions that would be followed to protect endangered species during construction and operation of the project. We concur with your determination for the piping plover, wood stork, West Indian manatee, and nesting sea turtles. We believe that the requirements of section 7 of the ESA have been satisfied for these species when they are under our responsibility. However, obligations under section 7 of the ESA must be reconsidered if: (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered; (2) this action is subsequently modified in a manner which was not previously considered in this assessment; or (3) a new species is listed or critical habitat determined that may be affected by the identified action.

We appreciate the opportunity to comment on this project. If you have any further questions, please contact our Coastal Georgia Sub Office biologist, Bill Wikoff, at 912-832-8739 extension 5.

Sincerely,

Sandra S. Tucker

Sandra S. Tucker
Field Supervisor

cc: USFWS, Townsend, Georgia

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
(727) 824-5312; FAX 824-5309
http://sero.nmfs.noaa.gov

F/SER31: KBD

NOV 04 2011

Colonel Jeffrey M. Hall
Commander, Savannah District
U.S. Army Corps of Engineers
Department of the Army
100 W. Oglethorpe Avenue
Savannah, Georgia 31402-0889

Dear Colonel Hall:

NOAA's National Marine Fisheries Service (NMFS) provides the attached final biological opinion (opinion) on species listed under the Endangered Species Act (ESA) of 1973. NMFS is providing the U.S. Army Corps of Engineers (COE) this opinion pursuant to 50 CFR 402.14(h). This document is based on our review of impacts associated with the proposed federal navigational channel dredging activities for the Savannah Harbor Expansion Project (SHEP) to be conducted by the Savannah District COE.

Information concerning the proposed action was obtained by our review of the Biological Assessment (BA), Draft Environmental Impact Statement (DEIS), and Draft General Re-evaluation Report (DGRR) for the SHEP in Chatham County, Georgia, and Jasper County, South Carolina. Supplemental reports were also provided by the Savannah District. This opinion concludes that the proposed action is not likely to jeopardize species listed or proposed for listing under the ESA under NMFS purview and provides reasonable and prudent measures, along with their implementing terms and conditions.

The findings presented in the opinion are not intended to act as the Secretary of Commerce's (the Secretary) final approval of this project as required by the Water Resources and Development Act of 1999 (WRDA) Section 101(b)(9), Public Law 106-53. The Secretary's final decision will depend on a determination that the proposed mitigation measures will adequately address the potential environmental impacts of the project. The mitigative measures include the following actions that must be fulfilled in the agreed upon time frames included in the opinion:

1) Finalization of the off-channel rock ramp fish passage design in coordination with NMFS and the other federal and state resource agencies.

2) Construction of the fish passage facility at the New Savannah Bluff Lock and Dam to provide access to historical spawning habitat for sturgeon as a mitigation measure.

3) Completion of the development and implementation of a comprehensive monitoring and adaptive management plan in coordination with NMFS and the other federal and state resource agencies to help insure the success of all mitigative measures including the fish passage facility.

The no jeopardy conclusion of the opinion is contingent on agreement to implement and maintain all of the mitigative measures.

We appreciate the COE's efforts in working together with NMFS to identify methods and measures to address complex conservation issues that, when implemented, will provide protection for endangered species under NMFS' authority.

We will continue to provide interagency coordination on this project under all our authorities and to work with the COE to finalize the agreed upon protective measures associated with this project. Our primary contact for endangered species issues is Kay Davy. She may be reached by phone at (954) 356-6791 or by e-mail at Kay.Davy@noaa.gov.

Sincerely,

Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure

Endangered Species Act – Section 7 Consultation
Final Biological Opinion

Action Agency:	U.S. Army Corps of Engineers (COE), Savannah District
Activity:	Deepening of the Savannah Harbor Federal Navigational Channel in association with the Savannah Harbor Expansion Project (NMFS Consultation No. F/SER/2010/05579)
Consulting Agency:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS), Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida
Approved By:	Roy E. Crabtree, Ph.D., Regional Administrator NMFS, Southeast Regional Office St. Petersburg, Florida
Date Issued:	NOV 04 2011

TABLE OF CONTENTS

Introduction 2
1 CONSULTATION HISTORY 3
2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA 10
3 SPECIES AND CRITICAL HABITAT OCCURRING IN THE ACTION AREA 35
4 ENVIRONMENTAL BASELINE 93
5 EFFECTS OF THE ACTION 126
6 CUMULATIVE EFFECTS 167
7 JEOPARDY ANALYSIS 168
8 CONCLUSION 175
9 INCIDENTAL TAKE STATEMENT (ITS) 176
10 CONSERVATION RECOMMENDATIONS 194
11 REINITIATION OF CONSULTATION 198
12 LITERATURE CITED 199
APPENDIX A 228
APPENDIX B 229
APPENDIX C 230
APPENDIX D 231
APPENDIX E 232

Introduction

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 to result in the destruction or adverse modification of any designated critical habitat of such species. The National Marine Fisheries Service and the U.S. Fish and Wildlife Service (USFWS) share responsibilities for administering the ESA. When the action of a federal agency may affect a species or designated critical habitat protected under the ESA, that agency is required to consult with either NMFS or USFWS, depending on the species and/or critical habitat that may be affected.

Consultations on most listed species and critical habitat in the marine environment are conducted between the action agency and NMFS. Consultation is concluded after NMFS determines that an 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 reasonable and prudent alternatives (RPAs) if the action is expected to jeopardize the continued existence of the species, 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 federal navigational channel dredging activities for the Savannah Harbor Expansion Project to be conducted by the Savannah District COE. The opinion analyzes project effects on sea turtles (Northwest Atlantic loggerhead distinct population segment [DPS], Kemp's ridley, leatherback, hawksbill, and green), North Atlantic right whales, humpback whales, and shortnose sturgeon. It also represents our conference opinion for the South Atlantic DPS of Atlantic sturgeon, which is proposed for listing under the ESA. Conference is only required where the proposed action "is likely to jeopardize" the proposed species; if the listing is finalized without changes from the proposed rule, the conference opinion can quickly be adopted and made operative and avoid potential delays associated with reinitiation of consultation.

Information for this opinion was provided by the COE, or was obtained from a variety of sources including published and unpublished literature cited herein and other sources of information including the COE Sea Turtle Data Warehouse (http://el.erdc.usace.army.mil/seaturtles/index.cfm; COE 2011).

NMFS serves as a cooperating agency for this project pursuant to the National Environmental Policy Act (NEPA), along with the Environmental Protection Agency

(Region IV), the Department of the Interior (acting through the U.S. Fish and Wildlife Service), and the Georgia Ports Authority. NMFS has responsibilities as a consulting agency under the ESA, the Marine Mammal Protection Act (MMPA), and the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (16 U.S.C. §1801 *et seq.*).

BIOLOGICAL OPINION

1 CONSULTATION HISTORY

This section includes information associated with NMFS' current and past involvement with dredging of the lower Savannah River and entrance channel as it relates to the proposed Savannah Harbor Expansion Project (SHEP).

July 1991: COE publishes Savannah Harbor Deepening Feasibility Report. The project would deepen the inner harbor and entrance channel from -38 feet Mean Low Water (MLW) to -42 feet MLW. The outer entrance channel would be deepened from -40 feet MLW to -44 feet MLW. NMFS concurred with the COE's determination that the proposed 4-foot deepening was not likely to adversely affect threatened and endangered species since the COE would abide by the soon-to-be-issued NMFS 1991 Regional Biological Opinion on South Atlantic hopper dredging for the deepening.

November 25, 1991: NMFS issues a regional biological opinion (RBO), "Dredging of channels in the southeastern United States from North Carolina through Cape Canaveral, Florida, to the COE South Atlantic Division (SAD), which includes the Savannah District."

August 25, 1995: NMFS issues a RBO, "Hopper dredging of channels and beach nourishment activities in the Southeastern United States from North Carolina through Florida East Coast," which supersedes the 1991 RBO.

September 1995: COE prepares a Biological Assessment of Threatened and Endangered Species (BATES) and EIS for the Savannah Harbor Long Term Management Strategy (LTMS), Chatham County, Georgia, and Jasper County, South Carolina, that addresses maintenance dredging of the navigation channel and deposition of dredged sediment material.

September 25, 1997: NMFS issues a RBO, "The continued hopper dredging of channels and borrow areas in the southeastern United States," which supersedes the 1995 RBO. It set an annual documented incidental take for the region of 7 Kemp's ridley, 7 green, 2 hawksbill, and 35 loggerhead sea turtles. It also set an annual documented incidental take of 5 shortnose sturgeon and clarified monitoring requirements for beach nourishment projects. The hopper dredge windows, as established in the 1995 RBO, were incorporated into this RBO, provided the COE: (1) continued to minimize sea turtle takes by refining the turtle deflecting dragheads, (2) tried to schedule hopper dredging

work in the highest risk areas (Canaveral, Brunswick, Savannah, and Kings Bay) during periods when nearshore waters are coolest (after December 15 but well before March), (3) attempted to complete all projects during the cold-water months when possible, and (4) shut down operations when high numbers of turtle takes occur before approaching the incidental take limit for a given species. This is the current opinion authorizing threatened and endangered species take pursuant to COE dredging activities in the SAD.

October 1997: COE assists Georgia Ports Authority (GPA) in development of a Sampling and Analysis Plan for sampling sediments that would be extracted during harbor deepening. The plan was coordinated with all state and federal agencies, including NMFS.

July 28, 1998: A Feasibility Report and Tier I Environmental Impact Statement (EIS) for deepening the Savannah Harbor is generated in accordance with the NEPA. The Tier I EIS was initially drafted and prepared by the GPA, under the authority of Section 203 of the Water Resources Development Act of 1986 (WRDA 86). The proposed harbor improvement would deepen the existing -42 feet MLW deep-draft navigation channel to -48 feet MLW (preferred alternative). The maximum impact alternative analyzed in the EIS was -50 feet MLW. The DEIS concluded that formal consultation with NMFS Protected Resources Division (PRD) would not be necessary for any species as long as the avoidance and habitat measures proposed in the BATES were implemented.

August 17, 1999: Section 101(b)(9) of WRDA 99, Public Law 106-53 specifies a number of conditions that must be met before SHEP can be constructed. The conditions include the successful completion of the NEPA process, including any necessary consultation under the ESA, the Fish and Wildlife Coordination Act, and the Magnuson-Stevens Act, and the demonstration of compliance with these and other relevant environmental laws. In addition, the Secretaries of the Army, Interior, and Commerce, and the Administrator of the Environmental Protection Agency, must all approve the selected plan and determine that the associated mitigation plan adequately addresses the environmental impacts of the project before it can be approved for construction.

December 22, 1999: COE issues a Record of Decision (ROD) on the Tier I EIS that states the COE Washington-level review determined that the proposed project was not formulated in accordance with applicable COE planning procedures and regulations and that an acceptable mitigation plan had not been determined. Analyses provided in the Tier I EIS only evaluated the potential impacts for a -50 foot MLW channel depth. Additional analyses must be performed in a Tier II EIS to more completely identify and evaluate the potential impacts of alternative depths, develop an acceptable mitigation plan, and conclusively determine the National Economic Development (NED) plan and the cost sharing for the mitigation features.

January 21, 2000: COE hosts an Interagency Fisheries Committee meeting to discuss potential species which could be impacted by SHEP and to review the results of EPA's research on effects of low dissolved oxygen on juvenile shortnose sturgeon. NMFS Habitat Conservation Division (HCD) staff attend.

September 7, 2001: COE requests participation of NMFS as a Federal Cooperating Agency with the development of SHEP pursuant to NEPA. NMFS agrees to participate but states that participation will be limited to matters involving nationally important fishery resources that may be affected by the project, and to matters pertaining to mitigation where trust resources are involved.

September 10, 2002: COE hosts Interagency Fisheries Committee meeting and discusses inclusion of shortnose sturgeon in fisheries models for SHEP. The group identified the lower end of Middle River as a possible habitat for juvenile shortnose sturgeon during the winter. NMFS HCD staff attend.

November 13, 2002: COE hosts SHEP Interagency Fisheries Committee meeting to discuss review of habitat suitability models for various fisheries. Shortnose sturgeon is chosen as a key species for analysis while other species are deleted from analysis. NMFS HCD staff attend.

December 19, 2002: COE hosts SHEP Interagency Fisheries Committee meeting. NMFS HCD and SCDNR identify habitat "areas of concern" for shortnose sturgeon in the lower Middle River. Clarification of the use of the "Hydro model" to determine minimum levels of dissolved oxygen as it relates to fisheries species is discussed. The group decided that 5 percent occurrence values (95% exceedance) should be identified as a measure of the minimum dissolved oxygen levels in the estuary and should be reported every 0.2 miles. The information would not be part of the habitat suitability criteria, but would be additional information to assess the general fishery habitat conditions in the estuary under different flow conditions.

January 28, 2003: COE hosts SHEP Interagency Fisheries Committee meeting and discusses using a pass/fail approach in determining suitable habitat for key species (e.g., shortnose sturgeon). ATM, consulting for the COE, takes on responsibility for describing rationale for habitat criteria to be used to identify suitable habitat for shortnose sturgeon in the Savannah River estuary. NMFS HCD staff attend.

April 21, 2003: COE hosts SHEP Interagency Fisheries Committee meeting and discusses the habitat areas of concern for shortnose sturgeon: juveniles in winter in the lower Middle River; adults in winter in the Savannah River, and juveniles in summer further upstream in the Savannah River. The group agreed it wanted dissolved oxygen data from only a portion of the channel cross-section that would include the deepest cell(s). NMFS PRD staff attend.

July 1, 2003: COE hosts SHEP interagency coordination meeting on wetlands and discusses the effects of salinity increase on marshes and fisheries. NMFS HCD staff attend.

June 16, 2005: COE hosts SHEP Lead and Cooperating Agency meeting. The cooperating agencies (including NMFS) state that the Stakeholders Evaluation Group

(SEG) provides enhanced public input, but cannot make decisions for the federal agencies. The Lead and Cooperating agencies agree that the SEG is advisory to the GPA.

May 31, 2006: COE hosts SHEP Wetlands Interagency Coordination Team Meeting. The group decided to use two levels of sea level rise (25 and 50 cm) over the 50-year project life. Impact analysis parameters were chosen using average historical flows based on 1997 water data and drought flows based on 2001 water data. NMFS HCD staff attend.

June 1, 2006: COE hosts SHEP Interagency Fisheries Committee meeting and discusses the measures developed to define acceptable habitat for key species. The intent is to use the hydraulic and water quality models to identify the amount and location of suitable and unsuitable habitat so that potential impacts of the harbor expansion project could be identified and evaluated. During the meeting there was surprise expressed that the analysis identified areas as unsuitable shortnose sturgeon habitat because of failure to meet salinity criteria. The committee had expected some areas to be unsuitable because of low dissolved oxygen conditions. The COE stated they would re-check how the model determined a cell was unsuitable for sturgeon. NMFS HCD staff attend.

December 15, 2006: COE hosts SHEP Wetlands Interagency Coordination Team meeting. NMFS HCD staff attend and provide comments on FWS' proposal to reroute flow of the Middle River through Rifle Cut, stating that this could drastically increase salinity in the lower Middle River, which could affect the suitability of that habitat for shortnose sturgeon.

January 19, 2007: COE hosts Interagency Water Quality Coordination Team meeting. NMFS-HCD states that the dissolved oxygen injection systems should be designed with an intake velocity of ≤ 0.5 feet per second across the screens to minimize potential impacts to fish and that the system operation should include the ability and a procedure to cease operation if a fish entrainment event occurs.

June 20-21, 2007: COE hosts Interagency Coordination Meeting to review mitigation alternatives and to select appropriate mitigation for SHEP. The group decides to use the existing sea level in basic impact evaluation. The group felt that fish passage at the New Savannah Bluff Lock and Dam would be one method of mitigation for impacts to shortnose sturgeon habitat. The COE explained that although Congress has not funded rehabilitation of the lock and dam, local governments continue to position themselves for the continued existence of the dam. The COE states it would not consider proposing removal as part of this project unless the concept is first discussed with the local governments and an indication that they would not oppose such a proposal is received. NMFS HCD staff recommends that the COE initiate EFH consultation and begin ESA consultation with NOAA.

August 26-28, 2008: COE hosts Alternative Formulation Briefing. NMFS HCD and PRD attend and present a list of potential issues associated with SHEP regarding

potential effects to species protected by the ESA and EFH resources protected under the Magnuson-Stevens Act.

September 12, 2008: SAD submits the South Atlantic Regional Biological Assessment for reinitiation of the RBO. SAD also states that additional information regarding modifications to seasonal hopper dredging activities will be forthcoming.

November 19, 2008: NMFS and SAD hold a conference to discuss modifications to hopper dredging windows and relocation trawling activities during which time SAD presents information and analyses supporting its request to modify the conditions of the existing RBO.

July 16, 2009: NMFS and COE meet to discuss suggested changes to SHEP Monitoring and Adaptive Management Plan.

July 31, 2009: NMFS provides recommendations for inclusion in the SHEP Monitoring and Adaptive Management Plan (Appendix D of the DEIS)

August 12, 2009: NMFS requests the COE use the 50-percentile of maximum bottom salinity parameter and 14.9 ppt salinity as the upper threshold for modeling acceptable juvenile shortnose sturgeon habitat in the winter. The new criteria will be proposed to the Fisheries Interagency Coordination Team for agency-wide approval.

November 12, 2009: NMFS PRD provides comments on proposed SHEP entrance channel extension and alignment and requests additional information on the dredging activities associated with the channel extension.

December 9, 2009: COE responds to NMFS PRD request for additional information and analysis of proposed SHEP entrance channel extension/alignment.

February 4, 2010: NMFS PRD submits additional questions and comments on proposed entrance channel extension/alignment to be addressed in Biological Assessment and DEIS being prepared for SHEP.

April 9, 2010: COE provides a Biological Assessment of Threatened and Endangered Species (BATES) for SHEP to NMFS.

April 28, 2010: NMFS submits e-mail request to COE to review dissolved oxygen data showing current conditions, conditions with the proposed deepening, conditions with deepening and hydrologic modification, and conditions with deepening plus hydrologic modification and dissolved oxygen injection.

May 5, 2010: NMFS provides comments on the need to include removal of the New Savannah Bluff Lock and Dam as a mitigation alternative.

August 10, 2010: Preliminary versions of DEIS and DGRR are provided to cooperating agencies for review.

September 10, 2010: NMFS provides comments on the preliminary DEIS and GRR.

September 30, 2010: NMFS meets with COE to discuss outstanding data requests including the need to see the effects of adding the high 2004 point source loads to the sturgeon habitat models. NMFS questions the suitability of habitat in the Back River due to anecdotal reports of the Back River having areas that may be too shallow to provide habitat to sturgeon.

October 18, 2010: NMFS provides comments to COE after re-initiation of agency review of proposed fish passage at the New Savannah Bluff Lock and Dam as partial mitigation for SHEP. NMFS notifies COE about proposed listing of Atlantic sturgeon in the comments.

November 8, 2010: NMFS provides initial comments on language used in preliminary DEIS for protection of whales. COE partially modifies text before issuance of DEIS.

November 15, 2010: The DEIS and DGRR are released for public/agency review.

November 24, 2010: NMFS notifies the COE of intent to conduct joint ESA and EFH consultation. NMFS also identifies the need for habitat modeling for juvenile shortnose sturgeon to include the revised salinity criteria and provides a list of ten outstanding issues not thoroughly addressed in the DEIS.

November 30, 2010: COE provides a response to NMFS' list of ten outstanding issues.

December 1, 2010: NMFS provides comments on the supplemental information provided in "Evaluation of Juvenile Shortnose Sturgeon Habitat Impacts with Proposed Mitigation Plan," noting that the COE ran the model using August conditions instead of the requested January conditions.

December 6, 2010: COE provides the corrected model runs for January conditions for juvenile shortnose sturgeon.

December 20, 2010: COE provides final agreement to NMFS to implement vessel speed restrictions for the protection of North Atlantic and humpback whales, in vessels associated with dredging.

December 29, 2010: COE provides reports with 2004 point source loading included in the habitat suitability models.

January 13, 2011: NMFS provides comments on the previous sturgeon habitat modeling reports and requests additional modeling runs with corrected information (Middle River sill in place, average dissolved oxygen loading, acreage with deepening only, etc.).

January 25, 2011: NMFS provides joint ESA/EFH comments to COE.

January 26, 2011: COE provides comments on NMFS' request for additional modeling runs.

March 11, 2011: COE provides updated evaluations of habitat impacts to shortnose sturgeon juveniles and adults during winter and summer. Formal consultation between NMFS and the COE begins with the receipt of this information.

April 25-27, 2011: COE hosts a workshop to discuss fish passage designs at the New Savannah Bluff Lock and Dam. NMFS provides comments on dam removal and performance criteria for fish passage.

May 11, 2011: COE provides a proposal to construct an off-channel rock ramp for fish passage at the New Savannah Bluff Lock and Dam, citing that the fish passage design (full-channel rock ramp) recommended by the April 25-27 workshop would not be cost effective.

May 27, 2011: COE provides responses to NMFS questions regarding information on the three proposed designs for fish passage at the New Savannah Bluff Lock and Dam presented in the COE "information paper" of May 11, 2011.

July 1, 2011: NMFS provides draft biological opinion on the Savannah Harbor Expansion Project to the COE.

August 25, 2011: NMFS hosts interagency meeting on-site at New Savannah Bluff Lock and Dam with Dr. Luther Aadland, a noted sturgeon fish passage expert. Dr. Aadland is provided with the COE's design plans for an off-channel rock ramp fish passage at the site.

September 6, 2011: COE meets with NMFS to discuss the draft Reasonable and Prudent Measures and Terms and Conditions provided in the draft biological opinion.

September 12, 2011: Dr. Aadland provides a written report summarizing his review of the COE's design plans for fish passage at the New Savannah Bluff Lock and Dam.

October 7, 2011: COE provides final written comments on the draft biological opinion.

October 21, 2011: COE meets with NMFS to negotiate the Reasonable and Prudent Measures and Terms and Conditions to be included in the final version of the biological opinion.

2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

2.1 Proposed Action

The Savannah District has proposed deepening the federal navigational channel of the Savannah Harbor from the existing depth of -42 feet mean lower low water (MLLW), which has been maintained since 1994 using a 2-foot allowable overdepth and up to 6-feet advance maintenance dredging, as deep as -48 feet. Five incremental deepening alternatives and a "No Action" alternative are evaluated. The No Action alternative is the existing project depth of -42 feet. The U.S. Congress conditionally authorized deepening of the Savannah Harbor up to an additional 6 feet in the Water Resources Development Act of 1999 (Section 101(b)(9)). Authorization is dependent upon the completion of a Tier II EIS, approval of the project by the Secretary of Commerce, Administrator of the Environmental Protection Agency (EPA), Secretary of Interior, Secretary of Army, and a determination by the Secretaries and the Administrator of the EPA that the associated mitigation plan adequately addresses the potential environmental impacts of the project.

According to the DGRR, the Garden City Terminal, located in the Savannah Harbor and operated by the GPA, is the second largest container port on the East Coast and the fourth largest in the Nation. The harbor and deep-draft navigation channel comprise the lower 19.5 miles of the Savannah River and 16.1 miles of channel across the ocean bar to the Atlantic Ocean. The Savannah Harbor currently has the shallowest controlling depth of any major U.S. port. Its depth constraints are similar to the current constraints of the Panama Canal; however, the Panama Canal Expansion Project will be completed by 2014 and will allow passage for vessels up to 50 feet in draft. Information in the DGRR states that since the last authorized deepening to -42 feet MLLW performed in 1994, container ship design and traffic has exceeded projections and in excess of 70 percent of vessels enter the Savannah Harbor are carrying less than their maximum capacity due to draft restrictions, which has resulted in increased shipping costs. Other problems are associated with existing ships experiencing problems with turning capabilities and impaired maneuverability in certain reaches of the inner harbor. It is expected that the severity of problems associated with turning capabilities and overall maneuverability in certain reaches of the inner harbor will increase as vessel size increases.

The COE's development of a NED plan determined that net economic benefits are maximized with the 47-foot depth alternative. Initially, the GPA (as the non-federal sponsor) supported the Maximum Authorized Plan of the 48-foot depth alternative, which was later retracted. The final selected plan will be included in the final EIS and GRR. This opinion will address the 47-foot depth alternative as the maximum depth alternative.

2.1.1 Construction Activities

Brief History of Dredging within the Savannah Harbor
Congress authorized construction of the federal navigation project at Savannah Harbor, which was initially constructed in 1874. In 1896, two jetties were constructed at the mouth of the Savannah River entrance. A submerged offshore breakwater was completed in 1897 to stabilize the inlet and provide a shelter for shipping entering Tybee Roads. Tybee Island is located on the south side of the entrance channel to the Savannah River. The navigation channel of the Savannah River was deepened from 21.5-feet Mean Low Water (MLW) to a depth of 26-feet MLW in 1912 to accommodate larger ships. Depth increases were later made in 1936 to 30-feet MLW and in 1945 to 36-feet MLW. The channel was widened and deepened in 1972 to a depth of 40-feet MLW. In 1994, the authorized depth of the channel was increased to 42-feet MLW. At present, approximately 32.5 miles of navigation channel exist, extending from Savannah Harbor into the Atlantic Ocean.

Proposed Dredging within the Savannah Harbor
All of the project deepening alternatives, -44 feet, -45 feet, -46 feet, -47 feet, and -48 feet, would include dredging from Stations -98+600B ranging to -95+680B (the length of the Entrance Channel Extension varies with each deepening alternative) to 103+000 (Garden City Terminal - River Mile 19.5). The deepening would include the Kings Island Turning Basin and eight berths (Berths 2, 3, 4, 5, 6, 7, 8, and 9) at the Garden City Terminal. Project work would also include widening of three bend wideners and construction of two passing lanes along with extension of the Entrance Channel. By maintaining the existing side slopes of the channel, the proposed deepening alternatives would have a narrower channel at the project depth than currently exists. According to the DEIS, decreasing the channel width by maintaining the existing side slopes at different depths will not adversely impact adjacent marine and estuarine habitat. However, removal of the bottom substrate within the dredging areas would eliminate all benthic resources in those locations. To maintain slope stability, a ratio of 3H:1V would be used in the inner harbor and 5H:1V in the ocean bar channel. Congress authorizes federal navigation channels by specific depth and width. The inherent imprecision in dredging processes varies with the physical conditions, the dredged material characteristics, the channel design (i.e., depths being dredged, side slopes), and the type of dredging equipment (e.g., mechanical, hydraulic, hopper). Due to these variables and the resulting imprecision associated with the dredging activity, COE design, cost estimating, and construction contracting documents recognize that dredging below the Congressionally authorized project dimensions will occur and is necessary to assure the required depth and width as well as cost effective operability. In order to balance project construction requirements against the need to limit dredging and disposal to the minimum required to achieve the designed dimensions, a paid or allowable overdepth of up to 2 feet is incorporated into the project-dredging prism. Material removed from this allowable overdepth is paid under the terms of the dredging contract. Material removed beyond the limits of the allowable overdepth is not paid. Each alternative would include overdepth and advance maintenance dredging (Table 1). Advance maintenance dredging extends the length of time during which authorized channel depths are available. The purpose of

advance maintenance dredging is to reduce the frequency of dredging and reduce overall maintenance costs.

Begin Station	End Station	Authorized Advance Maintenance (feet)	Required Contract Depth (feet MLLW)
Inner Harbor			
112+500	105+500	2.0	32.0
105+500	103+000	2.0	38.0
103+000	102+000	0.0	42.0
102+000	100+000	2.0	44.0
100+000	79+600	2.0	44.0
79+600	70+000	2.0	44.0
70+000	50+000	4.0	46.0
50+000	37+000	4.0	46.0
37+000	35+000	6.0	48.0
35+000	24+000	4.0	46.0
24+000	0+000	2.0	44.0
Port Wentworth TB		0.0	30.0
Argyle Island TB		0.0	30.0
Kings Island TB		8.0	50.0
Marsh Island TB		0	34.0
Fig Island TB		4.0	38.0

Table 1. Present Advance Maintenance Sections.

With the 47-foot alternative, approximately 23.6 million cubic yards (mcy) of sediment removed from Stations 103+000 to 4+000 and the Entrance Channel would be placed in the existing upland confined disposal facilities (CDFs) or placed in the EPA-approved Ocean Dredged Material Disposal Site (ODMDS). The ODMDS was designated by EPA under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA), as amended (40 CFR Parts 220 to 228). The COE had originally planned to place a portion of the dredged material in nearshore feeder berms, but the decision was made to instead place all material removed from the Entrance Channel into the ODMDS. Total amount of dredged material that would be removed with the other depth alternatives would be: approximately 10.3 mcy of material with the 44-foot alternative, 14.6 mcy with the 45-foot alternative, 19.0 mcy with the 46-foot alternative, and 28.0 mcy with the 48-foot alternative. The estimated annual volume for operation and maintenance is 7.1 mcy for each of the alternatives. The estimated construction period of the entire project would be approximately three to four years.

The proposed methods of dredging include hydraulic pipeline dredge, hopper dredge, mechanical dredge, or similar equipment. Hopper dredges would predominantly be used within the ocean bar channel (Stations 0+000 to 98+600) of the harbor (Figure 1). The proposed project includes operating under the Terms and Conditions set forth in the 1991 and 1995 RBOs, and the current (1997) South Atlantic Regional Biological Opinion (SARBO), and the CESAD Hopper Dredging Protocol (Appendix E). The COE proposes

that hopper dredge operations would be conducted from December 1 to March 31. Bed-levelers are currently permitted for certain reaches of the upper harbor, with conditions required to minimize turbidity impacts. The project proposes to authorize their use only in the Bar Channel. Furthermore, their use would be restricted to the leveling of high spots in the channel or placement area, where use of a hopper dredge for such work would be expected to result in equal or greater take of endangered species.

The COE has a specific set of specifications for the Savannah District that deal with large whale protection measures. These specifications apply to Savannah Harbor and require a NMFS-approved endangered species observer approved for whale monitoring be onboard each hopper dredge during the time that right whales may be in the area. Savannah District's specifications included:

No incidental take of right whales is authorized. Vessel speeds of no more than 10 knots as set forth in the proposed action shall be used. However, the Contractor shall restrict dredge and attendant vessel speeds to 5 knots or less (or minimum safe speed) during night (sunset to sunrise) operations unless there is no information from the right whale early warning system (RWEWS) or any other observations/information that reveals any right whales within 15 nautical miles of the project area. (NMFS notes that RWEWS flights are not conducted on a regular basis off of Savannah.) If aerial surveys for right whales show no sightings on a particular day, the vessel speeds of no more than 10 knots as set forth in the proposed action shall be used during the following nighttime operations. If a right whale is determined through any means to be in the project area on a particular day, negative results from any other type of survey on that same day shall not serve to cancel that night's restriction of dredge and attendant vessel speeds. For Savannah Harbor, the project area is defined as the Savannah Harbor Entrance Channel (Stations 0+000 to -60+000B), the designated offshore disposal areas shown on the Contract drawings, and transit routes. If right whale occurrence/ distribution information is not available from the RWEWS due to severe weather restrictions, then vessel speeds will be restricted to 5 knots (or minimum safe speed) during night operations. It is currently expected that the RWEWS will be in effect from December through March for Savannah. No aerial survey is required when the RWEWS is not in effect. Nighttime speeds will still be restricted to 5 knots or less (or minimum safe speed) when the RWEWS is not in effect if other information indicates right whales are in the project area. The requirement for nighttime speed restrictions are available from the COR (OP-NN) or the RWEWS on a daily basis. Previous right whale monitoring along the Georgia coast indicates that for Savannah Harbor the Contractor might expect up to 8 nights of reduced speed operations between 1 December and 31 March. For Brunswick Harbor, the Contractor might expect up to 13 nights of reduced speed operations between 1 December and 31 March. Contractor should also expect at least 22 days of additional reduced speed operations between the period of 1 December and 31 March due to weather restricting RWES aerial surveys. During daylight hours, the dredge operator shall take necessary precautions to avoid whales. If whales have been spotted within 15 nautical miles of the project area in the previous 24 hours, then the dredge shall slow down to 5 knots or less (or minimum safe speed) when transiting to and from the dump site during evening hours or during daylight hours when there is limited visibility due to

fog or sea states of greater than Beaufort 3. The hopper dredge shall not get closer than 500 yards to right whales. The speed limits for hopper dredges as set forth in the proposed action would only apply until a new Regional Biological Opinion for hopper dredging is signed, at which time the project would abide by the conditions in the Regional Opinion.

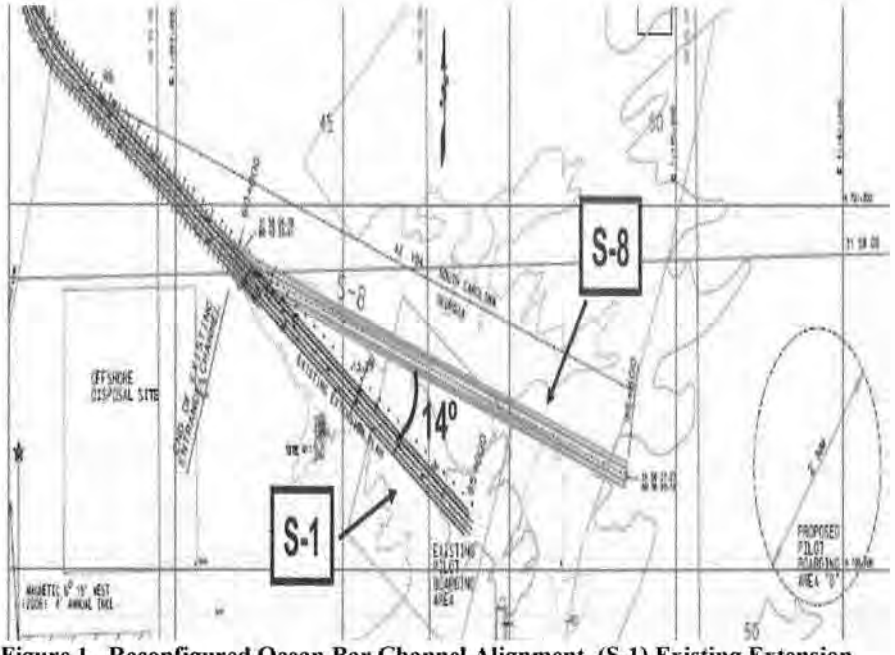


Figure 1. Reconfigured Ocean Bar Channel Alignment. (S-1) Existing Extension Plan, (S-8) Proposed Extension Plan

2.1.2 Flow Re-routing Modification

The deepening of the navigational channel would permit higher salinity water to travel further up the river. The salt water would affect freshwater habitats found within the Savannah National Wildlife Refuge adjacent to the project area along the middle and back river. To address this project effect, the COE developed flow re-routing modification plans that would re-direct freshwater to areas adjacent to (and found within) the refuge with the intent of minimizing the loss of the freshwater tidal marsh. The intent was to identify alterations that could be made in the braided rivers and tidal creeks to reduce salinity levels in critical areas of the estuary. Over 160 different flow re-routing models were conducted to evaluate the effects of each plan. An interagency team comprised of natural resource agency representatives evaluated the models and the COE determined the design that would be most effective at each of the flow re-routing locations. After further evaluation of the options presented by the COE, the interagency team concurred with the COE's approach in August 2006. Ultimately, two plans were

selected for the different deepening scenarios. Plan 6A (Figure 2) was selected for deepening to 45, 46, 47, and 48 feet, while Plan 6B (Figure 3) was selected for the 44-foot deepening alternative.

Both of the plans developed for the different deepening alternatives include construction of a diversion feature and closing of the lower arm at McCoy Cut, filling the Sediment Basin to -3.85 m NGVD (National Geodetic Vertical Datum of 1929), removing the Tide gate and its associated abutments and piers, and closing Rifle Cut. Plan 6a also includes deepening within the upper reaches of the Middle and Back Rivers to -3 m NGVD and -4 m NGVD within McCoy Cut.

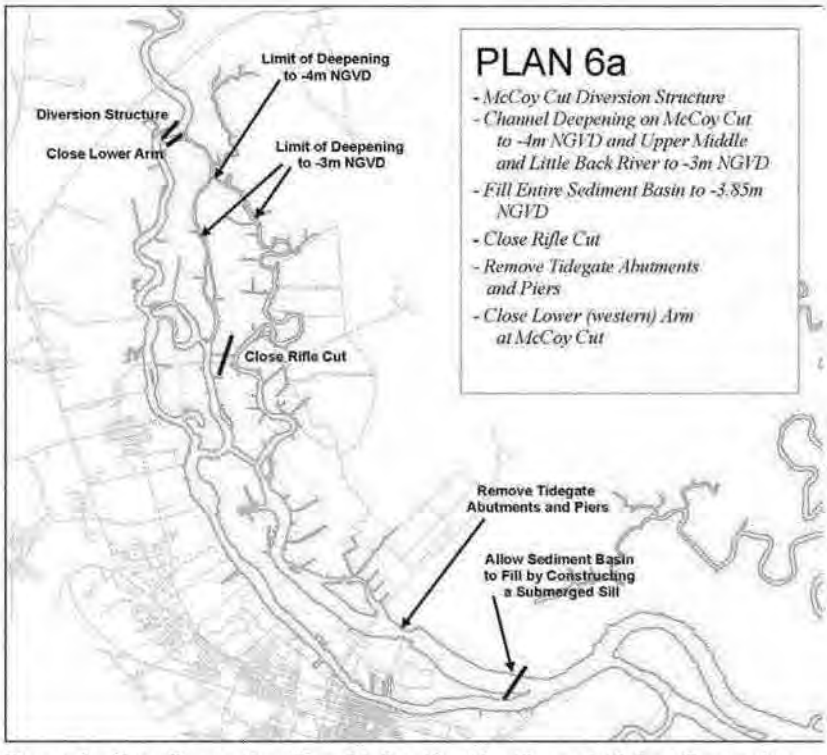


Figure 2. Flow Re-routing Plan 6A for 45-, 46-, 47-, and 48-foot Deepening

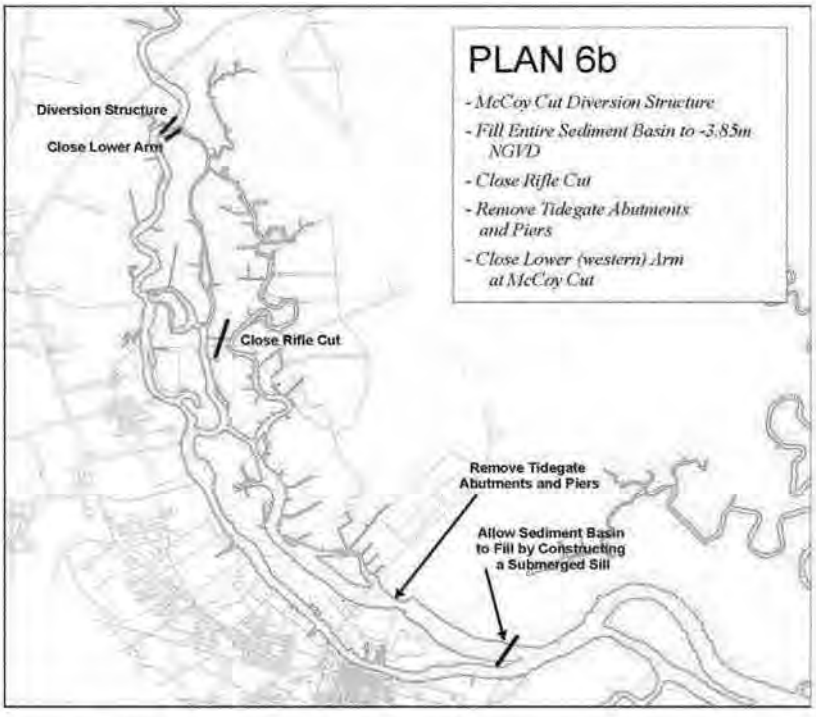


Figure 3. Flow Re-routing Plan for 44-foot Deepening

2.1.3 Dissolved Oxygen Injection

Deepening the navigation channel would adversely impact dissolved oxygen levels in the harbor and can be divided into three issues: (1) as the channel depth increases, the ability of oxygen to reach the river bottom decreases, causing lower average levels of dissolved oxygen at the bottom; (2) as the channel prism enlarges, additional saltwater is moved to the upper portions of the harbor and into the estuary, decreasing the ability of those waters to accept oxygen from the air; and (3) as the channel prism enlarges, the average tidal velocity decreases, reducing the mixing of oxygen throughout the water column. A drop in dissolved oxygen levels typically occurs during summer months at the upper end of tidal rivers in Georgia and South Carolina. This results from the combined effect of the reduced diffusion of oxygen into warm waters and the higher rate of uptake of oxygen from biologic organisms. To address the project impacts the COE has included a feature in the mitigation plan for each depth alternative to minimize that adverse effect.

The COE conducted a demonstration project to investigate whether injection of dissolved oxygen could be a viable method of improving dissolved oxygen levels in the harbor. The COE found that, due to site-specific requirements, a land-based injection system would be the most effective solution and that the use of Speece cones (Figure 4) would be

the most efficient technique to inject oxygen into the water. The systems would be deployed to remove the incremental effects of the channel deepening. Eight to ten Speece cones would be needed to increase dissolved oxygen and would be located at three sites (Figure 5). Cones placed at all three locations—one near Georgia Pacific, and two on the east and west side of Hutchinson Island—would be needed for each channel depth alternative. The systems would be land-based, with water being withdrawn from the river through pipes, then super-saturated with oxygen and returned to the river. The water intake structures would be located at mid-water depths and would include screens to reduce the intake of trash and other suspended solids. The screens would be sized to keep flow velocities from exceeding 0.5 feet per second to minimize entrainment of fish larvae. The intake and discharge would be located along the side of the river and not extend into the authorized navigation channel. Tidal flows and currents would mix the dissolved oxygen in the water column.

Figure 4. Speece Cones set up as Demonstration Project on the Savannah River

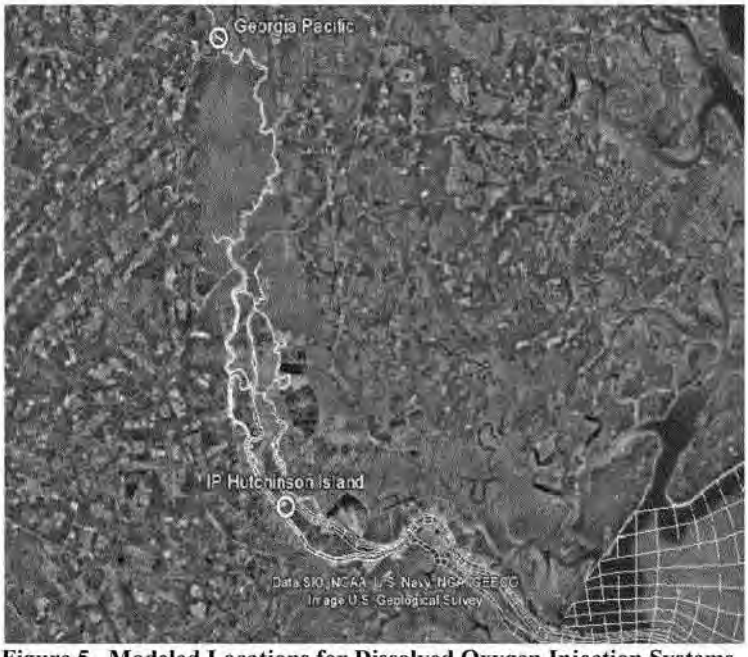


Figure 5. Modeled Locations for Dissolved Oxygen Injection Systems

Modeling of Dissolved Oxygen Injection

Two models were used to evaluate the impacts of the deepening alternatives on the dissolved oxygen regime in Savannah Harbor. The Environmental Fluid Dynamics Code (EFDC) model was used to develop the hydrodynamic data and then linked to the Water Quality Analysis Simulation Program Version 7.0 (WASP7) to obtain the dissolved oxygen data predictions. The study evaluated 26 spatial zones (Figure 6) that extend from Clyo, Georgia (61 miles above Fort Pulaski), to the Atlantic Ocean (17 miles offshore from Fort Pulaski). The 26 zones included 11 zones for Front River (FR), 6 zones for Middle River (MR), 3 zones for Back River (BR), 3 zones for Little Back River (LBR), 2 zones for South Channel (SC), and 1 zone for the Savannah River (SR) above the I-95 Bridge. The South Carolina standards for dissolved oxygen were used to evaluate severity of impacts, because they were the most restrictive at the time of the study (daily average of 5 mg/Liter, with an instantaneous minimum of 4.0 mg/Liter, applied throughout the water column).

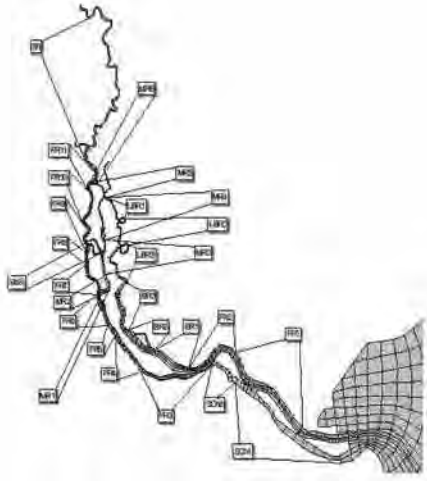


Figure 6. Zones used for Dissolved Oxygen Modeling.

As specified by the Water Quality Interagency Coordination Team, the COE conducted its basic dissolved oxygen impact analyses using average summer drought river flow conditions (August 1999). The interagency team also requested the COE evaluate the project's potential effects under other conditions, as sensitivity tests for the input conditions. These additional analyses included average flows in the river (August 1997), natural conditions (i.e., river depths prior to any harbor deepening), 2004 point source loads, and full permitted point source loads. Project impacts to dissolved oxygen were found to be higher under droughts than during average flow conditions.

In general, the models showed that there would be significant upstream shifts of lower dissolved oxygen zones in bottom and surface layers of the estuary as the channel deepening increased in magnitude. The studies also indicated that deteriorations of the lowest dissolved oxygen values along critical cells (the cell with the lowest dissolved oxygen concentration during specified simulation period) of major parts of the estuary increase proportionately to the amount of deepening. The COE's data reflected conditions in the bottom half of the water column (i.e., bottom 3 layers of the 6-layer model), where dissolved oxygen levels are lower.

For the 47-foot channel alternative, a substantial decrease in dissolved oxygen would occur in the critical cells of Front River Zone FR6, FR7, FR8, FR9, FR11, and Middle River Zones MR1 and MR6 as well as Back River Zones BR1, BR2, and BR3. Dissolved oxygen would increase in Lower Back River Zones LBR1 and LBR2.

To mitigate for the low dissolved oxygen, the Speece cones would add dissolved oxygen directly into the estuary. These systems would be operated during conditions of low dissolved oxygen (below 5.0 mg/L average or 4.0 mg/L instantaneous reading) occurring during the summer when dissolved oxygen monitoring indicates the minimum accepted levels had been exceeded (State of South Carolina dissolved oxygen standards of 5.0 mg/L average, but allow 4.0 mg/L instantaneous reading). The number of Speece cones that would be used varies with the deepening alternative selected. The dissolved oxygen levels are higher near the injection site and taper off to lower levels as distance from the site increases. Removing the incremental adverse project effect at a great distance from the injection site would require large amounts of oxygen. A tradeoff results between the amount of oxygen required and the distance from the injection site. The dissolved oxygen system configuration is designed to remove the incremental effect of a deeper channel in 97 percent of the cells in the hydrodynamic model.

2.1.4 Monitoring and Adaptive Management Plan

The COE has proposed development of a comprehensive monitoring and adaptive management plan that would ensure that impacts are not exceeded and that the mitigation plans would function as intended. The multi-phase monitoring program would be conducted during pre-construction, construction, and post-construction, and would include the following features:

1. Continuous hydrodynamic and water quality monitoring
2. Intense 30-day periods of hydrodynamic and water quality monitoring
3. Bathymetric monitoring
4. Recalibration of the hydrodynamic and water quality models, if necessary
5. Monitoring wetland vegetation
6. Monitoring salinity levels in the marshes
7. Monitoring shortnose sturgeon and Atlantic sturgeon distribution
8. Monitoring fish passage at New Savannah Bluff Lock and Dam
9. Monitoring chloride levels at the City of Savannah's water intakes on Abercorn Creek
10. Long Term monitoring of hydrodynamic and water quality parameters at select locations

The adaptive management approach would assess the monitoring results and make modifications, if necessary. Multi-agency approval of the adaptive management decisions would be needed before actions would be initiated.

The monitoring plan would be used to evaluate the accuracy of the predicted environmental impacts with the correlative goal of improving the predictive capability of

the models used to identify and quantify project-induced impacts. The second component consists of assessing the effectiveness of the mitigation features with the goal of determining the efficacy of the constructed mitigation feature at reducing impacts. Physical parameters would be monitored within the estuary that describe how the system is functioning with the mitigation in place. Biota would also be monitored to determine the system's biological responses to those parameters. After post-construction monitoring data is available, the updated models would be re-run using the observed river flow conditions. This would provide the basis for the model's predictions for conditions under the observed conditions. Those predictions would be compared to the observed physical parameters to determine the accuracy of the models and the effectiveness of the mitigation features. The third component concerns modification of the project to ensure the levels of environmental effects predicted in the EIS are not exceeded. The goal is to implement whatever modification is needed to the mitigation plan to keep the levels of observed environmental effects within the values predicted in the EIS. Monitoring would continue beyond the length of the full post-construction monitoring program to evaluate the effectiveness of the mitigation feature that was changed. The additional monitoring would ensure that the modification was effective and that the observed environmental effects are then within the values predicted in the EIS. The COE has stated they will coordinate with the resource agencies in further development of the comprehensive and detailed monitoring and adaptive management plan.

2.1.5 Proposed Fish Passage at the New Savannah Bluff Lock and Dam

When the COE's fish habitat models indicated that all of the deepening scenarios would involve the loss of sturgeon habitat and that the loss of sturgeon habitat within the lower Savannah River cannot be replaced, the COE suggested an action that would increase the extent of sturgeon habitat in the Savannah River at the upper range of habitat used by sturgeon. They referred to a previous study, which proposed adding a fish bypass at the lowest dam on the river, the New Savannah Bluff Lock and Dam near Augusta, Georgia.[1] The construction of a fish passageway would open up an additional 20 miles of habitat upstream of the dam to provide access to historical spawning habitat. Fish passage would also benefit American shad and other anadromous fish species, thereby helping those populations. The first design proposed by the COE was a horseshoe-shaped rock ramp. In October 2010, the COE, at NMFS' request, asked for comments on the design and its potential for successful passage of sturgeon. NMFS responded that dam removal was the preferred choice because there would be no risk of it failing to pass sturgeon, and that the proposed fish bypass design was probably not likely to successfully pass sturgeon. The remarks were based on new knowledge of fish passage design and the behavior of sturgeon in regards to fish bypasses. Other resource agencies also voiced their concern with the proposed design. To address these concerns, the COE hosted a fish passage workshop, held April 25-27, 2011, which brought in sturgeon experts to discuss fish

[1] After the fish passage design was developed in 2002, no funds were available for its construction or for the required rehabilitation of the lock and dam. This study followed a previous study in 2000 (Section 216 Disposition Study) where the COE had proposed to recommend to Congress that the New Savannah Bluff Lock and Dam Project be deauthorized and completely removed.

passage design criteria. During the workshop, a matrix was developed that explored design alternatives and provided performance criteria for each alternative. The results indicated that dam removal would be the best option as it had the highest expected passage effectiveness associated with it, but it would also result in loss of the pool, which had been identified as a concern by local governments upstream. The second best alternative proposed would be a full rock ramp built across the existing sill of the dam. The lock would remain operational and the pool would be maintained. The in-channel, full-river rock ramp would be the most natural pathway, as it would not involve a diversion to a side channel. Using the theory that percent of flow through a fish passage facility is roughly equal to the percentage of fish that would pass through, they felt this option would be 90 percent effective in upstream passage and 100 percent in downstream passage efficiency. A separate floodway would be constructed to assist in flood control. The third choice consisted of a hybrid design that would include partial removal of two of the dam's gates and construction of a rock ramp on the upland side of the dam.

Five other alternatives were also discussed that included different levels of effectiveness and offered design challenges that would need to be overcome to obtain successful upstream and downstream passage. Since most fish passage engineers who were invited were unavailable to attend the workshop, the COE proposed to consult their engineers who worked on the fish passage design for the Cape Fear River Lock and Dam (not yet constructed) to review new design criteria for fish passage at the New Savannah Bluff Lock and Dam. The workshop participants determined that the performance criteria for any passage design should be safe and effective passage with negligible chances for harm to fish as a result of interactions with the passage facility or dam.

Based on the input provided by the resource agencies and sturgeon experts, the COE conducted a reassessment of their proposed fish passage design from the November 2010 DEIS. The COE provided NMFS an "Information Paper" on May 11, 2011, discussing their assessment of alternative designs and informed NMFS they intend to include an off-channel rock ramp in the Final EIS. Although not specifically considered at the interagency workshop, the COE considers the off-channel rock ramp to be a variation of the full rock ramp and hybrid rock ramp designs since they would all transport roughly the same volume of water. They differ by their location across the channel's cross-section. The COE's information paper considered the off-channel rock ramp, the full river rock ramp, and the hybrid rock ramp. The COE selected the off-channel rock ramp because it has significantly lower estimated cost to construct and the predicted passage efficiency would be almost as high as with the more expensive designs.

The Off-Channel Rock Ramp (Figure 7) would consist of a rock ramp constructed around the South Carolina side of the dam. This design takes into account the aspects of the workshop's preferred designs and performance criteria discussed at the workshop and in subsequent responses by COE to resource agency questions on the May 11, 2011, Information Paper.

OFF-CHANNEL ROCK RAMP

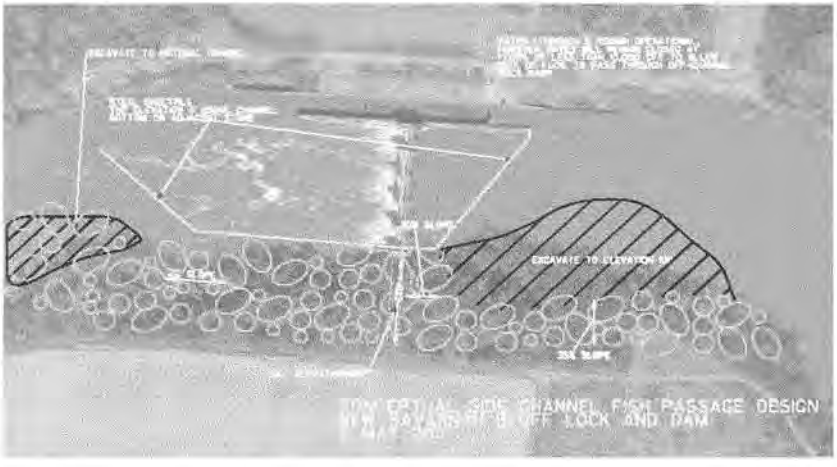


Figure 7. COE-proposed Off-channel Fish By-pass Design at New Savannah Bluff Lock and Dam

The design features consist of:

1. A rock ramp to be constructed in South Carolina within excavated uplands along one side of the dam
2. All five gates of the dam would remain operational
3. Gates 1 and 5 would be structurally modified so they function as lift gates rather than overflow gates
4. Allowance of 100 percent of the flow to pass through the fishway up to 8,000 cfs
5. Ramp would be sloped up to a minimum crest elevation of EL 109 feet at a 2 percent slope (1:50) on the downstream side and a 20 percent slope (1:5) on the upstream side
6. Top crest would be 25 feet wide
7. Ramp would provide water depths of at least 3.5 feet.

This design would allow 100 percent of the river flow to pass through the ramp at flows up to 8,000 cfs. When the upper pool exceeds EL 115 feet, anticipated when river flows exceed 8,000 cfs, the gates would be opened to pass the high flows. Gates 1 and 5 would be modified to operate in the same way as gates 2, 3, and 4. A gate opening schedule would be developed to minimize water velocity through the gates. When the flows are less than 8,000 cfs, the gates would be closed. The water elevation and flow

characteristics through the rock ramp under a range of river flows are shown in the following table (Table 2):

Off-Channel Rock Ramp

Flow (cfs)	Upper Pool Elevation (feet)	Depth of Flow Over Rock Ramp (feet)	Percent of Flow	Velocity at Crest (fps)
3,100	112.57	3.57	100%	7.53
3,600	112.87	3.87	100%	7.92
4,300	113.27	4.27	100%	8.39
5,000	113.63	4.63	100%	8.82
6,000	114.13	5.13	100%	9.37
8,000	115.04	6.04	100%	10.29
10,000	115*	6*	80%*	10.29*
12,000	115*	6*	67%*	10.29*
15,000	115*	6*	53%*	10.29*
20,000	115*	6*	40%*	10.29*
25,000	115*	6*	32%*	10.29*
30,000	115*	6*	27%*	10.29*

*estimated values

Table 2. Off-Channel Rock Ramp water elevation and flow characteristics

Based on recent average flow rates at the New Savannah Bluff Lock and Dam, the design would accommodate 100 percent of the river flow (i.e., daily river flows would be less than 8,000 cfs) for up to 64 percent of the days of February through June. The period from February to June is critical to sturgeon as this is when the adults are migrating upriver to spawn, and then return downstream following spawning, and the larval sturgeon will be beginning their migration to the lower reaches of the river. The percent of flow through the passage is considered an important determinant in the effectiveness for fish passage. For upstream passage, the proportion of flow coming out of the passage is an attractant for fish to enter the fish passage. Similarly for downstream passage, the proportion of flow can help determine how fish are led by water velocity or passively carried to the upstream fish passage entrance. As it is currently configured, sturgeon are unable to migrate upriver through the lock and dam. It is thought that high submerged sills at the base of the lock and dam prevent bottom-oriented sturgeon from following the attractant flow to reach habitat above the dam. The off-channel rock ramp would be constructed to provide a suitable bottom topography, slope, and substrate, which would simulate the natural river bottom and attractant flow. To maximize the attractant flow it would have a high percentage of days when all or most of the flow would pass through the rock ramp. Figure 8 shows the by-month proportion of days with flows less than given values. In March, the month with the highest flows, there have been, on average, 14 days when 100% of the river flow would flow through the off-channel rock ramp. There have been 7 days when river flow has been between 8,000 cfs and 15,000 cfs and the proportion of flow through the channel would be between 53 and 100%. During only

10 days in March, less than 53% of the river flow would pass through the passage. In the late spring months of May and June, when downstream passage is more critical, the 100 percent flow capacity of the off-channel rock ramp increases to 78 percent of the time.

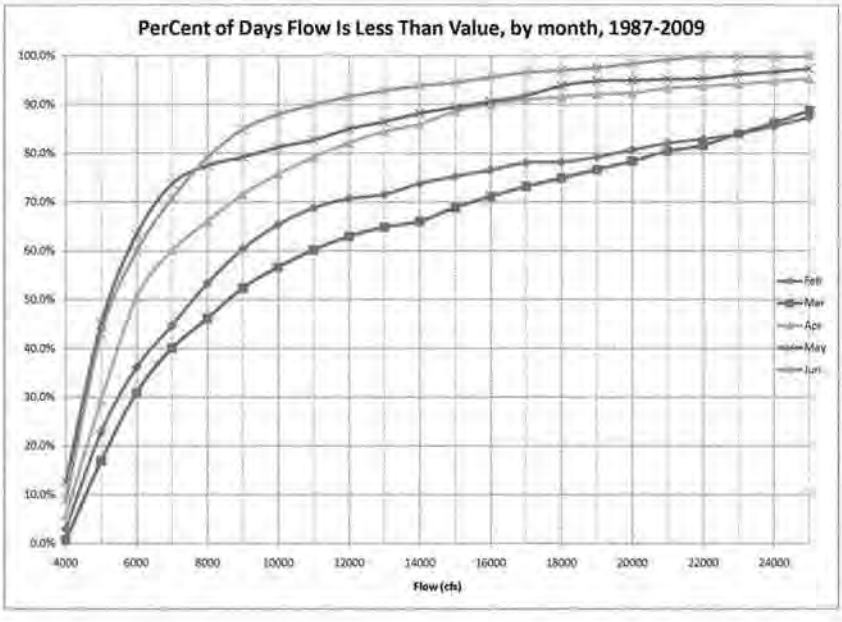


Figure 8. Percentage of monthly flow at New Savannah Bluff Lock and Dam that meets target value from 1987-2009

A submerged sheet pile wall would be placed at a height of 3 to 4 feet above the river bottom or above the rock ramp. This wall would guide the bottom-oriented sturgeon out of the deep river channel and through the ramp in both upstream and downstream directions. Use of the submerged sheet pile guide walls across most of the channel width will increase the passage performance during days when some flow will pass through the spillway gates. Even if flow through the gates attracts upstream migrating fish toward the base of the dam, the guide wall is intended to lead fish to the fish passage entrance. Similarly, downstream migrating fish will be led toward the upstream entrance to the passage, when some water is spilled through the gates. With this guide wall feature, additional sturgeon should use the rock ramp to move past the lock and dam, and the performance of the ramp would be expected to be higher than just the percent of river flow moving through it. A small amount of dredging would be performed to shape the

channel bottom so that the thalweg[2] flows to the rock ramp. This thalweg feature would also increase the design's expected upstream and downstream passage performance for sturgeon.

The rock ramp would use a 2 percent upstream slope, well within the 4 percent slope design criteria provided by the agencies during the interagency fish passage workshop. The maximum velocities expected on the ramp would vary depending on river flows. They would range from around 7 feet/second at flows of 3,100 cfs to around 10 feet/second at 10,000 cfs. The velocity down the main slope of the off-channel rock ramp would be 1-3 feet/second slower than that predicted for the full-river rock ramp, due to the longer length of the off-channel rock ramp. Incorporating numerous rock boulders to form pools up the rock slope would reduce the typical velocity the sturgeon would have to navigate. With incorporation of the rock boulders to provide areas of low velocity, this design should readily pass sturgeon. The design also includes a small ramp on the upstream end of the passage. Its 1:5 slope is flatter than one recently designed for the Cape Fear River Lock and Dam to pass sturgeon, so it is believed that it should acceptably pass sturgeon downstream at the New Savannah Bluff Lock and Dam. Since construction at the Cape Fear River fish passage has not been completed yet, we cannot assess its effectiveness. Downstream migrating sturgeon do not need to swim against the current, so the slope does not affect the water velocities they would need to contend with, and it is just needed to provide the bottom-oriented fish with a smooth transition into the passage, rather than an abrupt sill.

This design would require the least modification to the existing dam of the three alternatives that the COE considered. None of the gates would need to be removed from the dam; however, the two end gates would need to be modified from a 12-foot height to 15-feet. The present ability of the lock and dam project to reduce flood levels in upstream areas would be retained. The dam itself would not require modification. The lock and its operation would be unaffected. Upstream infrastructure in Augusta and North Augusta should not be impacted since the pool would not need to be lowered, even during construction. The off-channel rock ramp would reduce the work that would need to be performed if funds become available to rehabilitate the lock and dam. However, the funds for rehabilitation of the lock and dam would not be provided by the SHEP. Construction of the rock ramp as a part of SHEP would address Congress' prior requirement for a fish passage design developed in 2002 to be constructed at the New Savannah Bluff Lock and Dam, since it would provide the same function. It would also reduce the cost of the rehabilitation project. The dam would still need to be rehabilitated, to stabilize its structure and ensure its function continues to be provided in the future. The lock and its control house would still require the same amount of rehabilitation.

Lands presently associated with the lock and dam would be needed to construct and operate the rock ramp around the SC end of the dam. Those lands are presently wooded and not used to operate the existing project. They provide structural stability to the dam and serve a limited security function. Those purposes would not be affected by construction and operation of the off-channel rock ramp. Additional lands would also

[2] A thalweg is defined as a line drawn to join the lowest points along the entire length of a streambed.

need to be acquired to construct the rock ramp and for an access road to the site. Those lands would be acquired as part of the SHEP and not as part of the rehabilitation of the lock and dam. NMFS has included a Reasonable and Prudent Measure with an implementing term and condition as part of the incidental take statement of this opinion requiring that the initiation of COE land acquisition needed for construction of the off-channel rock ramp be completed prior to, or concurrent with, the start of SHEP dredging actions.

The off-channel rock ramp considered in this opinion is a preliminary design and does not include specific design details. The design was intended to meet the criteria set forth by the workshop of safe and effective up-stream and downstream passage with negligible chances for harm to fish as a result of interactions with the passage facility or dam. NMFS sent the COE follow-up questions on details of the off-channel rock ramp and the COEs May 11, 2011 Information Paper. The COE responded on May 27 with considerable additional technical detail but also noted that detailed design work still needs to be done before some specific questions (e.g., 3-d water velocities) can be answered. Some of those answers may affect technical details of the final design (e.g., dimensions of the guide walls, passageway cross-sections). Dr. Luther Aadland, a technical expert on fish passage design for passing sturgeon, was contracted by NMFS to review the COE's design for the off-channel rock ramp. Based on his experience with designing fish passages and successful passage of sturgeon, Dr. Aadland concluded that design modifications to the proposed fish passage would be needed. NMFS has requested that the COE review Dr. Aadland's comments and incorporate the necessary modifications as provided by Dr. Aadland. The COE has stated that they will work with NMFS and other resource agencies (i.e., FWS, SCDNR, and GADNR) to complete the final design of this facility. They have also indicated that they intend to consult with Dr. Aadland and to work with an engineering firm to prepare the final design. The COE will provide a comparison analysis of existing fish passages with similar characteristics to the New Savannah Bluff Lock and Dam fish passage conditions in order to study the effectiveness of the rock ramp design for sturgeon.

The incidental take statement includes terms and conditions that require NMFS' review and validation of the final design and requires timeframes for design completion and construction. The proposed action for this project and incidental take statement of this opinion also include monitoring and adaptive management to help insure the success of all mitigative measures including the fish passage facility.

2.1.6 Sea Turtle Conservation Measures

The COE SAD has a well-established suite of sea turtle conservation measures that are implemented to minimize the incidental take of sea turtles during hopper dredging, under the SARBO. The dredging for SHEP will not be conducted under the SARBO, but rather will be authorized by and subject to the requirements of this biological opinion.

Draghead Deflector
The COE requires the use of sea turtle deflecting dragheads on all hopper-dredging projects where the potential for sea turtle interactions exist. Contractors are required to equip dragheads with rigid sea turtle deflectors which are rigidly attached to the draghead. In order to assure that the turtle deflecting draghead is engineered and installed correctly, the Contractor provides the COE with drawings and calculations for the project depth to be dredged. These submittals are approved by the COE prior to project commencement. The leading edge of the deflector must be designed to have a plowing effect of at least 6-inch depth when the draghead is being operated so that turtles located in front of the draghead are pushed away by the resultant sand wave. The dragtender must have the appropriate instrumentation on board the dredge to assure that the critical "approach angle" is maintained during dredging operations. The design "approach angle" or the angle of lower draghead pipe relative to the average sediment plane is very important to the proper operation of a deflector. Hopper dredge contract specifications require that dredge pumps not be operated when the dragheads are not firmly on the bottom. The pumps must either be shut off or reduced in speed to the point where no suction velocity or vacuum exists while the dredge is turning. Pumping water through the dragheads is not allowed while maneuvering or during travel to/from the disposal area. To assure that these conditions are understood and implemented by the Contractor, the COE requires that the Contractor develop a written operational plan to minimize turtle takes and submit it as part of the Environmental Protection Plan for approval prior to project commencement. In order to assure contractor compliance with all sea turtle protection measures during hopper dredge operations, detailed quality assurance inspections are performed by COE personnel on each hopper dredge contract, as well as after each sea turtle take. Sea turtle deflecting dragheads will be required for this project.

Environmental Windows
To minimize risk of sea turtle incidental takes by dredges, environmental windows were established by NMFS, and further refined by the COE, which restrict dredging to periods when turtles are least abundant or least likely to be affected by dredging. The environmental windows for turtle-safe dredging target the winter months when sea turtle abundance is dramatically reduced. Turtle abundance is greatly reduced at water temperatures below 13°C, and they are typically absent during temperatures below 11°C. The environmental window for the hopper dredging activities within the project area is from December 1 through March 31 of any year.

Inflow/Overflow Screening
In accordance with the Reasonable and Prudent Measures (RPMs) outlined in previous (1995 and 1997) NMFS SARBO's, all SAD hopper dredging contracts require 100 percent inflow screening throughout the duration of each contract. One hundred percent inflow screening is required, and 100 percent overflow screening is recommended, when sea turtle observers are required on hopper dredges in areas and seasons when sea turtles may be present. If conditions disallow 100 percent inflow screening, inflow screening can be reduced, but 100 percent overflow screening is required, and an explanation must be included in the preliminary dredging report.

The water intake ports on the top of the draghead shall be screened with metal elliptical cages, or other suitable means to exclude sea turtles from entering the drag arm. The configuration of inflow and overflow screening is hopper dredge specific, resulting in multiple Contractor configurations to meet COE contract screening requirements. COE hopper dredging contracts require a 4-inch x 4-inch screen mesh size for inflow screening to allow biotic and abiotic debris to be screened and evaluated by endangered species observers before being allowed into the hopper. The same screen mesh size is used for overflow screening. The efficacy of this inflow and overflow screening mechanism depends on the dredge specific configuration. Some configurations are more prone to clogging with debris, thus resulting in reduced monitoring efficiency and coverage. In some cases, clay and debris accumulation in the inflow boxes is so significant that effective observer coverage is not possible and the COE must reduce or replace the inflow screening with 100 percent overflow screening. Depending on the type of debris encountered, overflow screening may become clogged with floating debris and compromise the safety of the vessel. The COE has consulted with the NMFS on a case-by-case basis to address these site specific circumstances. Ample lighting on a hopper dredge is specifically required for the observers on board to provide safe access at night to the inflow boxes and screens.

Observers

During hopper dredging operations, observers approved by NMFS for sea turtles, sturgeon, and whales are required to be aboard the hopper dredge to monitor for the presence of the species. The COE will require 100 percent observer coverage (i.e., 24 hour monitoring requiring two observers each monitoring for 12 hours daily) conducted from December 1 to March 31, the dredging window for hopper dredge operations. During transit to and from offshore borrow or placement areas, the observer monitors from the bridge during daylight hours for the presence of protected species, during the period December 1 through March 31. During dredging operations, while dragheads are submerged, the observer continuously monitors the inflow and/or overflow screening for turtles and/or turtle parts. Upon completion of each load cycle, dragheads are monitored as the draghead is lifted from the sea surface and is placed on the saddle in order to assure that sea turtles or turtle body parts that may be impinged within the dragheads are properly documented. Physical inspections of dragheads and inflow and overflow screening/boxes for threatened and endangered species take are performed to the maximum extent practicable. A trained turtle observer will be placed on the hopper dredges to monitor for sea turtles for 100 percent of the period from December 1 to March 31.

Dredging Quality Management Program (Silent Inspector)

The Dredging Quality Management Program is an automated dredge monitoring system comprised of both hardware and software developed by the COE. The COE developed the program as a low cost, repeatable, impartial system for automated dredge monitoring. Currently, it is required for all COE hopper and scow contracts; however, it is not on all Government-owned dredges yet. NMFS will require the COE to use hopper dredges equipped with the appropriate automated dredge monitoring system for this project. The

system integrates various automated systems to digitally record dredging and disposal activities for both government-owned and contract dredges. The system collects and records measurements from shipboard sensors, calculate the dredging activities, and displays this information using standard reports and graphical displays.

On hopper dredges, the program monitors the operating conditions of the dredge in near real time. Once loaded into the program database, graphical displays can be generated to help assure contractor compliance with the draghead operating requirements in order to minimize sea turtle take risk. Visual graphs can be used to display dredging data variables such as draghead elevation, slurry density, and slurry velocity. If a sea turtle take occurs, these data can be used to generate graphs that may help in developing risk assessments to assess what the conditions of the dragheads were during any given load cycle. If a sea turtle take can be correlated to non-compliance with contract specification requirements through the program, it is possible to let the Contractor know of the action so it can be corrected and the risk of taking another turtle minimized.

Dredging shall be suspended upon the taking of more than two turtles in any 24-hour day, the taking of one hawksbill turtle, or one leatherback turtle, or one green turtle, or once three turtles are taken. Dredging operations will not re-commence until coordination between South Atlantic Division and the NMFS has taken place and any remediation requirements are implemented to ensure compliance with the Endangered Species Act.

Relocation Trawling
Relocation trawling for the project is subject to requirements, terms, and conditions for trawl times, handling during trawling, captured sea turtle holding, scientific measurement, take and release time during trawling, injury, flipper tagging, PIT-Tag scanning, and other sampling procedure conditions. There are also PIT-Tag scanning and data submission requirements and handling fibropapillomatose turtle guidelines that must be followed (See Section 9.4). Relocation trawling involves directed take of sea turtles (capture and handling). However, since it also meets the definition of a reasonable and prudent measure (by capturing and relocating turtles that would otherwise be killed in dredges), it will be authorized through this opinion. Further, since it involves take and some of the take may be lethal, the effects of this RPM are evaluated as effects of the proposed action, and in the jeopardy analysis.

2.1.7 Whale Conservation Measures

The COE will require monitoring by endangered species observers with at-sea large whale identification experience to conduct daytime observations for whales between November 1 and April 30. In addition, the COE will restrict the speeds of vessels during offshore transits to reduce the risk of injury and mortality to North Atlantic Right Whales.

To ensure that dredging operations do not adversely affect the North Atlantic right whale and other marine mammals, the COE has a specific set of specifications for the Savannah District that deal with large whale protection measures. These specifications apply to

Savannah Harbor and require a NMFS-approved endangered species observer approved for whale monitoring be onboard each hopper dredge during the time that right whales may be in the area. Savannah District's specification language is included below:

No incidental take of right whales is authorized. Vessel speeds of no more than 10 knots as set forth in the proposed action shall be used. However, the Contractor shall restrict dredge and attendant vessel speeds to 5 knots or less (or minimum safe speed) during night (sunset to sunrise) operations unless there is no information from the right whale early warning system (RWEWS) or any other observations/information that reveals any right whales within 15 nautical miles of the project area. (NMFS' notes that RWEWS flights are not conducted on a regular basis off of Savannah.) If aerial surveys for right whales show no sightings on a particular day, the vessel speeds of no more than 10 knots as set forth in the proposed action shall be used during the following nighttime operations. If a right whale is determined through any means to be in the project area on a particular day, negative results from any other type of survey on that same day shall not serve to cancel that night's restriction of dredge and attendant vessel speeds. For Savannah Harbor, the project area is defined as the Savannah Harbor Entrance Channel (Stations 0+000 to -60+000B), the designated offshore disposal areas shown on the Contract drawings, and transit routes. If right whale occurrence/distribution information is not available from the RWEWS due to severe weather restrictions, then vessel speeds will be restricted to 5 knots (or minimum safe speed) during night operations. It is currently expected that the RWEWS will be in effect from December through March for Savannah. No aerial survey is required when the RWEWS is not in effect. Nighttime speeds will still be restricted to 5 knots or less (or minimum safe speed) when the RWEWS is not in effect if other information indicates right whales are in the project area. The requirement for nighttime speed restrictions are available from the COR (OP-NN) or the RWEWS on a daily basis. Previous right whale monitoring along the Georgia coast indicates that for Savannah Harbor the Contractor might expect up to 8 nights of reduced speed operations between 1 December and 31 March. For Brunswick Harbor, the Contractor might expect up to 13 nights of reduced speed operations between 1 December and 31 March. Contractor should also expect at least 22 days of additional reduced speed operations between the period of 1 December and 31 March due to weather restricting RWES aerial surveys. During daylight hours, the dredge operator shall take necessary precautions to avoid whales. If whales have been spotted within 15 nautical miles of the project area in the previous 24 hours, then the dredge shall slow down to 5 knots or less (or minimum safe speed) when transiting to and from the dump site during evening hours or during daylight hours when there is limited visibility due to fog or sea states of greater than Beaufort 3. The hopper dredge shall not get closer than 500 yards to right whales. The speed limits for hopper dredges would only apply until a new Regional Biological Opinion for hopper dredging is signed, at which time the project would abide by the conditions in that new opinion.

The COE has established precautionary collision avoidance measures to be implemented during dredging and sediment placement operations that take place during the time North Atlantic right whales are present in waters offshore of the Savannah Harbor project. These include:

Pre-project briefing
Before the initiation of the project, at the pre-construction/partnering meeting, the COE briefs the Contractor on the presence of the species, and reviews the requirements for right whale protection.

Contractor requirements
Each Contractor will be required to instruct all personnel associated with the dredging/construction project about the possible presence of endangered North Atlantic right whales in the area and the need to avoid collisions. Each Contractor will also be required to brief his personnel concerning the civil and criminal penalties for harming, harassing, or killing species that are protected under the ESA and the MMPA. Dredges and all other disposal and attendant vessels are required to stop, alter course, or otherwise maneuver to avoid approaching the known location of a North Atlantic right whale. The contractor will be required to submit an endangered species watch plan that is adequate to protect North Atlantic right whales from the impacts of the proposed work.

Vessel speed
During transport of dredged material through offshore waters to the disposal site and when returning to the dredge site, dredge vessels and all support vessels will use extreme caution and proceed at a safe speed, no greater than 10 knots, from November 1 through April 30 such that the vessel can take proper and effective action to avoid a collision with a North Atlantic Right Whale or other marine mammal, and can be stopped within a distance appropriate to the prevailing circumstances and conditions. During daylight hours, the dredge operator must take necessary precautions to avoid whales. During evening hours or when there is limited visibility due to fog or sea states of greater than Beaufort 3, the dredge must slow down to no greater than 5 knots when transiting between areas if whales have been spotted by observers or RWEWS within 15 nm (nautical miles) of the vessel's path within the previous 24 hours. Slower vessel speeds can reduce the potential for a vessel strike with a listed species by providing more time for animals to react to a vessel and move out of the way. Slower vessel speeds also reduce the likelihood of a strike resulting in serious injury or mortality.

Observers
Monitoring is required by NMFS-approved endangered species observers with at-sea large whale identification experience to conduct daytime observations for whales between November 1 and April 30. Observers would monitor for the presence of marine mammals from the bridge during daylight hours while transiting to and from the disposal area. Floating weeds, algal mats, Sargassum rafts, clusters of seabirds, and jellyfish are good indicators of the potential presence of sea turtles and marine mammals. Therefore, increased vigilance in watching for sea turtles and marine mammals will be taken where these are present. During daylight hours, the dredge operator must take necessary precautions to avoid whales.

The COE will notify the program manager for the whale aerial survey of dredging activities that are likely to take place during calving season, and likely beginning, ending, and duration of the dredging activities.

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." Savannah Harbor is an approximately 32.5-mile federal navigation project located along the Savannah River in southeast Georgia. The Savannah River basin includes portions of North Carolina, South Carolina, and Georgia and flows through the Blue Ridge Mountain, Piedmont, and Coastal Plain provinces. The river constitutes the state boundary between Georgia and South Carolina along its entire length of 313 miles. Freshwater flow is largely controlled by three COE-operated reservoirs (Hartwell, Richard B. Russell, and Clarks Hill – known as J. Strom Thurmond Dam in South Carolina) and the New Savannah Bluff Lock and Dam just south of Augusta, Georgia (Figure 9). Other dams are the Steven's Creek Dam located north of Augusta and the Augusta Diversion Dam. The Augusta Canal is created by the Augusta Diversion Dam and is the nation's only industrial power canal still in use for its original purpose. The Augusta Shoals are located below the Augusta Diversion Dam. The Savannah River begins at the Hartwell Reservoir by the confluence of the Seneca and Tugaloo Rivers. It passes through the port city of Savannah and flows to the Atlantic Ocean. Tidal fluctuations average 6.8 feet at the mouth of the harbor and 7.9 feet at the upper limit of the harbor. Salinity ranges from 0 ppt in the freshwater flow to 35 ppt in the ocean bar channel. Most of the shipping channel is 500 feet wide, with the wider portions of the river ranging from 2,400 feet near the river entrance to 1,000 feet at the Kings Island Turning Basin.

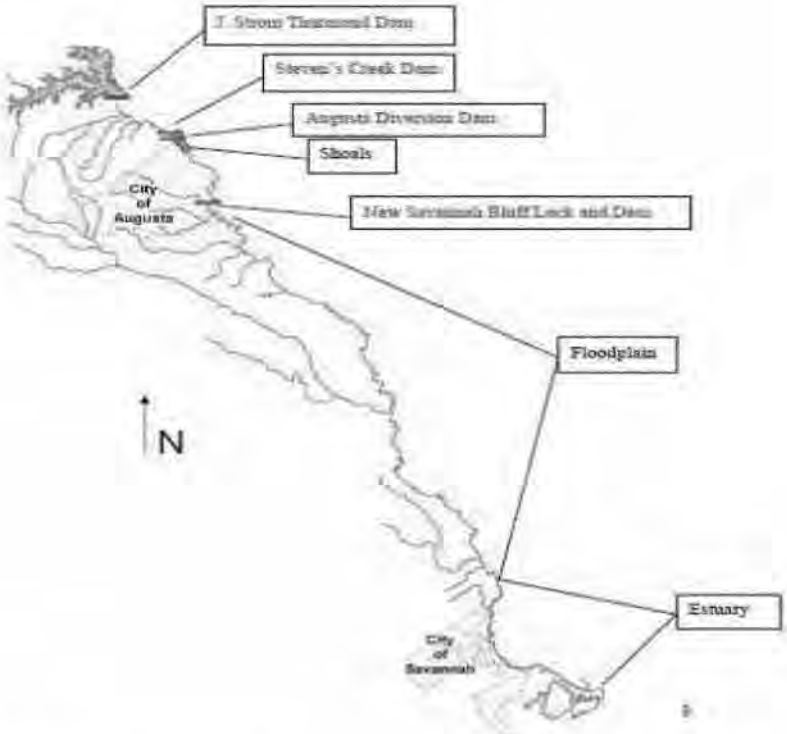


Figure 9. Dams on the Savannah River

The deepening site itself is located within Chatham County, Georgia, and Jasper County, South Carolina. Urban and industrial development extends northwestward along the Georgia side of the river. Lands on the opposite side of the Savannah River in Jasper County, South Carolina are characterized by a system of dikes, canals, and former rice fields constructed in the 18th and 19th centuries. It is dominated by tidal freshwater, brackish, and salt marsh that comprise the Savannah National Wildlife Refuge. A system of eight confined disposal facilities (CDFs), maintained by the COE and provided by the Georgia Department of Transportation (non-federal sponsor), are found along the river bank within South Carolina. Dredged material not suitable for disposal offshore would be placed in the upland CDFs. In the lower Savannah, the river branches into three sections referred to as the Front River, Middle River, and Back River. The Federal Navigational Channel is located within the Front River (Figure 10). A sediment basin is located in the lower portion of the Back River. Small canals (Rifle Cut, McCoy Cut) connect the Front, Middle, and Back Rivers. The mainland areas are separated from the ocean by a line of barrier islands and intervening salt marshes and tidal rivers. The mouth of the Savannah River is located just north of Tybee Island. The action area for the proposed project includes the entrance channel for Savannah and the river channel

from Station -60+000B, the oceanward extent of the Entrance Channel (or Ocean Bar Channel), to the Garden City Terminal at Station 103+000. Additionally, the action area includes several disposal sites including an authorized ocean dredged materials disposal site (ODMDS), and submerged berms located near Tybee Island. The action area includes the New Savannah Bluff Lock and Dam, the river downstream to Savannah, and also the upland area adjacent to the New Savannah Bluff Lock and Dam, within South Carolina, where a fish passage bypass would be constructed as a part of the proposed action.

Figure 10. Deepening and Harbor Modification Action Area

3 SPECIES AND CRITICAL HABITAT OCCURRING IN THE ACTION AREA

3.1 SPECIES

The following table lists the endangered (E) and threatened (T) species and DPSs (proposed) under the jurisdiction of NMFS that may occur in the action area:

Common Name	Scientific Name	Status
Sea Turtles		
Hawksbill sea turtle	*Eretmochelys imbricata*	E
Loggerhead sea turtle (Northwest Atlantic Ocean DPS)	*Caretta caretta*	T
Green sea turtle	*Chelonia mydas*	E/T[3]

[3] Green turtles are listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are listed as endangered.

Kemp's ridley sea turtle	*Lepidochelys kempii*	E
Leatherback sea turtle	*Dermochelys coriacea*	E
Fish		
Shortnose sturgeon	*Acipenser brevirostrum*	E
Atlantic sturgeon (South Atlantic DPS)	*Acipenser oxyrinchus oxyrinchus*	E (proposed)
Whales		
North Atlantic right whale	*Eubalaena glacialis*	E
Humpback whale	*Megaptera novaeangliae*	E

NMFS and USFWS issued a final rule designating nine DPS' for loggerhead sea turtles (76 FR 58,868, September 22, 2011; effective October 24, 2011). The Northwest Atlantic DPS (NWA DPS) is the only loggerhead DPS that occurs in the action area. Additionally, On October 16, 2010, NMFS proposed ESA listing for the Atlantic sturgeon (*A. oxyrinchus oxyrinchus*); five DPSs were identified. The Atlantic sturgeon South Atlantic DPS inhabits the Savannah River and is proposed for listing as endangered (75 FR 61904).

3.2 Critical Habitat

There is currently no designated critical habitat in the action area. NMFS is required to designate critical habitat for Atlantic sturgeon at the time of final listing unless not determinable, in which case NMFS must designate critical habitat within one additional year. NMFS intends to propose critical habitat for the loggerhead NWA DPS in future rulemaking as critical habitat was deemed not determinable at the time of the listing.

3.3 Species Not Likely to be Adversely Affected

We have determined that the proposed action being considered in this opinion is not likely to adversely affect leatherback sea turtles, green sea turtles, hawksbill sea turtles, North Atlantic right whales, and humpback whales, and these species are excluded from further analysis and consideration in this opinion. The following discussion summarizes our rationale for this determination.

Leatherback Sea Turtle
Leatherback sea turtles (Figure 11) may be found in the action area, particularly when onshore winds and/or currents push jellyfish, their preferred prey, close to inshore.

Figure 11. Leatherback sea turtle

However, leatherbacks are primarily a pelagic species, preferring deeper waters than those of the action area (the deepest portions of the offshore action area are less than 60-feet-deep). Furthermore, in over 30 years of NMFS consultations with the COE on hopper dredging projects carried out in the Savannah Harbor, there has never been a documented take of a leatherback sea turtle by a hopper dredge. Because of this and their very large size (compared to hopper dredge dragheads), pelagic nature (surface and mid-water), preference for deeper waters located beyond the project area further offshore, and feeding habits (which make it unlikely they would ever encounter a bottom-hugging hopper dredge draghead), NMFS believes the possibility that they would be adversely affected by a hopper dredge is discountable.

Green Sea Turtle

Green sea turtles (Figure 12) are distributed circumglobally and can be found in the Pacific, Indian, and Atlantic Oceans as well as the Mediterranean Sea (NMFS and USFWS 1991, NMFS and USFWS 2007a). 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.

Figure 12. Green sea turtle

Green sea turtle foraging areas in the southeastern United States include any coastal shallow waters having macroalgae or seagrasses. This includes areas near mainland coastlines, islands, reefs, or shelves, as well as open-ocean surface waters, especially where advection from wind and currents concentrates pelagic organisms (Hirth 1997, NMFS and USFWS 1991). 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.

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 Lagoon 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 Caribbean coast of Panama, the Miskito Coast in Nicaragua, 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).

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). Certain Florida nesting beaches have been designated index beaches. Index beaches were established to standardize data collection methods and effort on key nesting beaches. Since establishment of the index beaches in 1989, the pattern of green turtle nesting shows biennial peaks in abundance with a generally positive trend during the ten years of regular monitoring. This is perhaps due to increased protective legislation throughout the Caribbean (Meylan et al. 1995). Occasional nesting has been documented along the Gulf coast of Florida, at southwest Florida beaches, as well as the beaches on the Florida Panhandle (Meylan et al. 1995). More recently, green turtle nesting occurred on Bald Head Island, North Carolina; just east of the mouth of the Cape Fear River; on Onslow Island; and on Cape Hatteras National Seashore. Increased nesting has also been observed along the Atlantic coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Recent modeling by Chaloupka et al. (2007) using data sets of 25 years or more has resulted in an estimate of the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9 percent, and the Tortuguero, Costa Rica, population growing at 4.9 percent annually.

During the past 30 years of maintenance dredging in the Savannah Harbor Entrance Channel, green sea turtles have not been encountered and no take of green sea turtles has occurred. It is doubtful they would be found in the area due to the lack of preferred habitat (i.e., shallow well-vegetated bottom) and absence of preferred food items (e.g., seagrass, macroalgae). Considering these factors, it is not expected that interactions would occur in the action area; therefore, NMFS believes the possibility that they would be adversely affected is discountable.

Hawksbill Sea Turtle

In the western Atlantic, the largest hawksbill (Figure 13) nesting population occurs on the Yucatán Peninsula of Mexico (Garduño-Andrade et al. 1999). With respect to the United

Figure 13. Hawksbill sea turtle

States, nesting occurs in Puerto Rico, the U.S. Virgin Islands, and along 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 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). Hawksbill sea turtles could occasionally be found in the action area. Hawksbills are the most tropical sea turtle species, ranging from approximately 30°N latitude to 30°S latitude. They are closely associated with coral reefs and other hardbottom habitats, but they are also found in other habitats including inlets, bays, and coastal lagoons (NMFS and USFWS 1993). Adult foraging habitat, which may or may not overlap with developmental habitat, is typically coral reefs, although other hardbottom 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 1999). Other food items, notably corallimorphs and zooanthids, have been documented to be important in some areas of the Caribbean (van Dam and Díez 1997, Mayor et al. 1998, León and Diez 2000). With the frequent trawling of the project area associated with the shrimp fishery, there is no abundance of sponges or other food items available to hawksbill sea turtles.

During the past 30 years of NMFS consultations with the COE on hopper dredging projects carried out in the Savannah Harbor there has never been a documented take of a hawksbill sea turtle by a hopper dredge. Due to hawksbill sea turtles' preferred habitat and diet, it is not expected that interactions would occur in the action area; therefore, NMFS believes the possibility that they would be adversely affected is discountable.

North Atlantic Right Whale

The nearshore waters of northeast Florida and southern Georgia were first identified as a likely calving and nursery area for right whales (Figure 14) in 1984. While sightings off Georgia and Florida include primarily adult females and calves, juveniles and adult males are also commonly observed. Annual right whale migration to and from, and use of, calving grounds off the southeastern U.S. coast, occur from November 1 through April 30. Systematic surveys conducted off the coast of North Carolina during the winters of 2001 and 2002 sighted 8 calves, suggesting that the calving grounds may extend through South Carolina as far north as Cape Fear, North Carolina (Waring et al. 2009).

Figure 14. North Atlantic right whale

Twenty percent of all right whale mortalities observed between 1970 and 1989 were caused by vessel collisions/interactions with right whales. Seven percent of the population exhibit scars indicative of additional, non-lethal vessel interactions (Kraus 1990). So far in 2011, of four deceased right whales encountered, half were associated with rope entanglement, one had multiple skull and vertebral fractures that are consistent with ship strike, and a fourth was found floating offshore with no evidence of entanglement. In January 2011, a live right whale was observed with approximately 14 propeller cuts across its body; it had been observed five days earlier with no injuries. On January 24, 2011, a right whale entered the St. John's River in Florida and proceeded upstream. Its presence for nine hours in the navigational channel resulted in the closure of commercial marine traffic, Navy operations, and COE dredging activities.

The COE has proposed to create a new bar channel extension-alignment would result in a 14 degree offset from the extension's original orientation and/or approach. With respect to the already-established vessel travel corridors in the area, the 14 degree offset for the extension constitutes a negligible correction factor for the Bar Channel, and the new alignment would not introduce any additional variability to the existing approach and departure vectors (i.e., vessel tracks) currently used by ship traffic. The configuration of the new alignment for the entrance channel is roughly oriented perpendicular to the coastline, which is intended to ensure that ships approaching the entrance channel from seaward direction will take the shortest path through coastal waters and lessen the chance of encountering a migrating whale.

NMFS review of the project indicates that the proposed action will not result in increased level of container vessel visits to the area, however due to the nature of the project NMFS is expecting a significant increase in vessel traffic related to dredge activities transiting between the navigational channel and the disposal sites.

As a result of the potential for interactions between hopper dredges and right whales, the 1991 biological opinion for the dredging of channels in the southeastern United States from North Carolina through Cape Canaveral, Florida (NMFS 1991) required observers on board dredges operating from December through March off Georgia and northern Florida to maintain surveys for the occurrence of right whales during transit between channels and disposal areas. Continuation of aerial surveys which had been instituted in Kings Bay, Georgia, was also required. Since January 1994, aerial surveys funded by the COE in association with dredging activities in the Southeast have been amplified through the implementation of the right whale early warning surveys (EWS). These surveys, jointly funded by the COE, NMFS, the Navy, and the Coast Guard, are conducted to identify the occurrence and distribution of right whales in the vicinity of ship channels in the winter breeding area, and to notify nearby vessel operators of whales in their path. However, the aerial surveys conducted off of Savannah are very sporadic, due to a lack of funding to cover the area off Savannah. The regularly-conducted EWS flights off Georgia cover the area from Sapelo Island, which is approximately 35 miles south of Savannah, to Brunswick.

Records of right whale ship strikes (Knowlton and Kraus 2001) and large whale ship strike records (Laist et al. 2001, Jensen and Silber 2003) have been compiled, and all indicate vessel speed is a principal factor in ship strikes. In assessing records in which vessel speed was known, Laist et al. (2001) found "a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision." The authors concluded that most deaths occurred when a vessel was traveling in excess of 14 knots.

NMFS considered whether it is better for a vessel to travel faster through a sensitive area (and thus get through it more quickly), or go slower, increasing the amount of time spent in the sensitive areas (exposure). Vanderlaan and Taggart (2007) attempted to briefly address this question by approximating the probability of a vessel-whale encounter as a function of vessel speed and length of exposure (in time) using a very simplistic random walk model. Their simple model demonstrates that the encounter probability increases slowly with decreasing speed and begins to increase rapidly only at speeds below 3-4 knots (Vanderlaan and Taggart 2007); at these speeds the approximated encounter probability is increasingly more a function of whale movement and decreasingly less a function of vessel movement (i.e. a modeled, randomly-moving whale overtaking or encountering a near-stationary ship). Therefore, a vessel reducing its speed from 24 knots (or any other speed between 24 and 10 knots) to 10 knots would not increase the encounter probability. The encounter probability changes with the number of vessels, and would show different results if this model used multiple whales and various sizes or speeds for the whale and vessel. To ensure that these variables would not increase encounter probability at 10 knots, NMFS independently conducted a sensitivity analysis using a random walk model, and tested the additional variables mentioned above. The outputs of this sensitivity analysis agreed with the findings of the Vanderlaan and Taggart (2007) random walk model. In conclusion, slower vessels do not increase the risk of ship strike simply by transiting through an area for a longer time, unless they were to go 4 knots or less.

Jensen and Silber (2003) identified 292 records of known or probable ship strikes of all large whale species from 1975 to 2002. In 58 of the records, ship speed at the time of collision was known: it ranged from 2 to 51 knots, with an average of 18.1 knots. A majority (79 percent) of ship strikes occurred at speeds of 13 knots or greater. Of the 58 cases where speed was known, 19 (32.8 percent) resulted in serious injury to the whale. The mean vessel speed that resulted in serious injury or death to the whale was 18.6 knots (Jensen and Silber 2003).

Using a total of 64 records of ship strikes in which vessel speed was known, Pace and Silber (2005) tested speed as a predictor of the probability of death or serious injury. The authors concluded that there was strong evidence that the probability of death or serious injury increased rapidly with increasing speed. Specifically, the predicted probability of serious injury or death increased from 45 percent to 75 percent as vessel speed increased from 10 to 14 knots, and exceeded 90 percent at 17 knots. Interpretation of the logistic regression curve used to obtain these probabilities indicates that there is a 100 percent probability of serious injury or death around 25 knots and faster. In a related study,

Vanderlaan and Taggart (2007) analyzed all published historical data on vessels striking large whales. The authors found that the probability of a lethal injury resulting from a strike ranged from 20 percent at 9 knots to 80 percent at 15 knots and 100 percent at 21 knots or more.

Related studies of the occurrence and severity of strikes relative to vessel speed have been conducted for other species and locations. Panigada et al. (2006) concluded that vessel speed restrictions and the relocation of vessel routes in high cetacean density areas would reduce the likelihood of ship strikes of fin whales in the Mediterranean Sea. Speed zones were adopted in Florida in the early 2000s to reduce the numbers of collisions and manatee injuries resulting from collisions with boats. Laist and Shaw (2006) assessed the effectiveness of these speed zones at reducing watercraft-related manatee deaths. Watercraft-related manatee deaths did decline in the areas assessed in the paper, and the authors reported that this decline reflected the fact that well-designed speed restrictions could be effective if properly enforced. They further stated that "reduced speed allows time for animals to detect and avoid oncoming boats, and that similar measures may be useful for other marine mammal species vulnerable to collision impacts with vessels (e.g., North Atlantic right whales)" (Laist and Shaw 2006).

The behavior of whales in the path of approaching ships is uncertain, but in some cases, last-second flight responses may occur. If a whale attempts to avoid an oncoming vessel at the last minute, a burst of speed coupled with a push from the bow wave could mean that mere seconds might determine whether the whale is struck (Laist et al. 2001). A reduction in speed from 18 knots to 10 knots would give whales an additional 8.6 seconds (at a distance of 100 m) to avoid the vessel in this flight response (Laist 2005, unpublished data). In a separate study involving whale behavior, Kite-Powell et al. (2007) developed a model that analyzed ship strike risk with respect to vessel speed and whale avoidance behavior. The authors of the ship strike analysis assert that ship strike risk decreases as speed decreases and the distance that the whale detects the vessel increases. Assuming certain whale behavior, the model suggests that the ship strike risk posed by a conventional ship (e.g., container ship) traveling at 20 to 25 knots can be reduced by 30 percent at a speed of 12 or 14 knots, and by 40 percent at 10 knots, due to the whales' increased ability to detect and avoid approaching vessels. If a whale detects and reacts to an oncoming vessel at a distance of 820 ft (250 m) or greater, it will likely avoid a ship strike, whereas at detection distances less than 328 ft (100 m), the probability of ship strike is almost one hundred percent at speeds of 15 knots or faster. However, research on vessel-whale collisions indicates that of three speeds considered — 10, 12, and 14 knots — adopting a speed limit of 10 knots would be the most beneficial to the recovery of the right whale population. Historically, only a small percentage of ship strikes occurred at 10 knots, and those that did usually resulted in injury rather than death (Laist et al. 2001). Although, it is important to note of the three speeds considered above, while a 10-knot speed restriction is most effective at reducing the risk of ship strikes, it will not eliminate the risk; there is still a 45 percent predicted probability of serious injury or mortality at 10 knots (Pace and Silber 2005).

In summary, NMFS believes that the mandatory dredge-related-vessel speed limit during the right whale migration/calving season of no greater than 10 knots (no greater than 5 knots at night and during periods of limited visibility), will reduce the chance of an inadvertent collision with a right whale by (1) significantly increasing the watch stander(s) reaction time (i.e., the time between when s/he detects the whale and takes action to avoid it), (2) significantly increasing the likelihood of detection of a right whale that may be in, near, or approaching the path of the vessel, and (3) significantly increasing the likelihood that the whale will detect the oncoming vessel and avoid it.

NMFS-approved endangered species observers will be required to be present to watch for marine mammals during all daytime hopper dredging and vessel transits that occur during the right whale migration/calving season. This will further reduce the chances of an inadvertent collision with a right whale by increasing vessel reaction time, whale reaction time, and likelihood of detection of a right whale. Depending on the size of the vessel used, it is estimated there could be 769 to 2,307 hopper dredge trips during the project. During the previous ten years of entrance channel dredging, there were 263 days of dredging. If it is assumed that there were 3 trips per day, as is normally conducted, this would have resulted in 789 trips. Based on the estimated total dredged material to be removed (13,325,513 cubic yards) during this project, there would be approximately 1,439 trips.

Another factor to be considered is the probability of a right whale encounter by vessels associated with dredging activities for this action. During the fiscal year 2011 right whale EWS aerial survey for the Southeast calving grounds and the additional aerial surveys off the coast of Georgia and South Carolina, a total of 164 unique right whales were sighted, including 20 right whale calves. It is believed that about two-thirds of all right whales transiting the area are detected by the EWS (the rest go unseen because they are submerged and not detected). Given the density and numbers of these animals and their irregular distribution within the area designated as critical habitat, it is unlikely that right whales will be adversely impacted by dredge-related vessel transits, given the precautions stipulated for vessel avoidance. Additionally, the configuration of the new alignment for the entrance channel is roughly oriented perpendicular to the coastline, which should help ensure that ships approaching the entrance channel from seaward will take the shortest path through coastal waters and lessen the chance of encountering a whale.

Thus, NMFS concludes that the project's vessel related effects on North Atlantic right whales are discountable based on the rarity of the species and on the implementation of the suite of Whale Conservation measures discussed above.

Humpback Whale

Humpback whales (Figure 15) occur in waters under U.S. jurisdiction throughout the year. Migrations occur annually between their summer and winter ranges. The summer

Figure 15. Humpback whale

range for the Western North Atlantic stock includes the Gulf of Maine, Canadian Maritimes, western Greenland, and the Denmark Strait. All humpback whales feed while on the summer range. The primary winter range includes the Lesser Antilles, the Virgin Islands, Puerto Rico, and the Dominican Republic (NMFS 1991). In general, it is believed that calving and copulation take place on the winter range. Calves are born from December through March and are about 4 meters at birth. Sexually mature females give birth approximately every two to three years. Sexual maturity is reached between 4 and 6 years of age for females and between 7 and 15 years of age for males. Size at maturity is about 12 meters.

Until recently, humpback whales in the Mid- and South Atlantic were considered transients. Few were seen during aerial surveys conducted over a decade ago (Shoop et al. 1982). However, since 1989, sightings of feeding juvenile humpbacks have increased along the coast of Virginia and North Carolina, peaking during the months of January through March in 1991 and 1992 (Swingle et al. 1993). Studies conducted by the Virginia Marine Science Museum (VMSM) indicate that these whales are feeding on, among other things, bay anchovies and menhaden. Researchers theorize that juvenile humpback whales, which are unconstrained by breeding requirements that result in the migration of adults to relatively barren Caribbean waters, may be establishing a winter foraging area in the mid-Atlantic (Mayo, pers. comm., 1993). The lack of sightings south of the VMSM study area is a function of shipboard sighting effort, which was restricted to waters surrounding Virginia Beach, Virginia.

In concert with the increase in whale sightings, strandings of humpback whales have increased between New Jersey and Florida since 1985. The increase in sightings is attributed to population increase and shift in feeding areas to the mid-Atlantic during this season. Strandings were most frequent during the months of September through April in North Carolina and Virginia waters, and were composed primarily of juvenile humpback whales of no more than 11 meters in length (Wiley et al. 1995). Of the 18 humpbacks for which the cause of mortality was determined, six (33 percent) were killed by vessel strikes. An additional humpback had scars and bone fractures indicative of a previous vessel strike that may have contributed to its mortality.

As mentioned in the right whale species status, using a total of 64 records of ship strikes in which vessel speed was known, Pace and Silber (2005) tested speed as a predictor of

the probability of death or serious injury. The authors concluded that there was strong evidence that the probability of death or serious injury increased rapidly with increasing speed. Specifically, the predicted probability of serious injury or death increased from 45 percent to 75 percent as vessel speed increased from 10 to 14 knots, and exceeded 90 percent at 17 knots. Interpretation of the logistic regression curve used to obtain these probabilities indicates that there is a 100 percent probability of serious injury or death around 25 knots and faster.

Panigada et al. (2006) concluded that vessel speed restrictions and the relocation of vessel routes in high cetacean density areas would reduce the likelihood of ship strikes of fin whales in the Mediterranean Sea. The behavior of whales in the path of approaching ships is uncertain, but in some cases, last-second flight responses may occur. If a whale attempts to avoid an oncoming vessel at the last minute, a burst of speed coupled with a push from the bow wave could mean that mere seconds might determine whether the whale is struck (Laist et al. 2001). A reduction in speed from 18 knots to 10 knots would give whales an additional 8.6 seconds (at a distance of 100 m) to avoid the vessel in this flight response (Laist 2005, unpublished data). In a separate study involving whale behavior, Kite-Powell et al. (2007) developed a model that analyzed ship strike risk with respect to vessel speed and whale avoidance behavior.

The authors assert that ship strike risk decreases as speed decreases and the distance that the whale detects the vessel increases. Assuming certain whale behavior, the model suggests that the ship strike risk posed by a conventional ship (e.g., container ship) traveling at 20 to 25 knots can be reduced by 30 percent at a speed of 12 or 14 knots, and by 40 percent at 10 knots, due to the whales' increased ability to detect and avoid approaching vessels. If a whale detects and reacts to an oncoming vessel at a distance of 820 ft (250 m) or greater, it will likely avoid a ship strike, whereas at detection distances less than 328 ft (100 m), the probability of ship strike is almost one hundred percent at speeds of 15 knots or faster.

NMFS believes that Humpback whales transiting the area during the right whale migration will benefit from the mandatory dredge-related-vessel speed limit during the right whale migration/calving season of no greater than 10 knots (no greater than 5 knots at night and during periods of limited visibility), will reduce the chance of an inadvertent collision with a humpback whale by (1) significantly increasing the watch stander(s) reaction time (i.e., the time between when s/he detects the whale and takes action to avoid it), (2) significantly increasing the likelihood of detection of a humpback whale that may be in, near, or approaching the path of the vessel, and (3) significantly increasing the likelihood that the whale will detect the oncoming vessel and avoid it.

As noted above, the COE proposes that hopper dredge operations would only be conducted in the ocean bar channel from December 1 to March 31. Monitoring to avoid vessel strikes after the right whale migration/calving season will be done by the dredge operator and the sea turtle observer between 1 April and 30 November.

NMFS concludes that the project's dredge vessel related effects on humpback whales are discountable or insignificant based on implementation of the Whale Conservation Measures discussed above, and for the same reasons they are expected to prevent harm to the North Atlantic right whale.

Summary
For the reasons discussed above, NMFS has determined that hawksbill sea turtles, green sea turtles, leatherback sea turtles, North Atlantic right whales, and humpback whales are not likely to be adversely affected by the proposed action; therefore, these species will not be considered further in this opinion.

3.4 Species Likely to be Adversely Affected

Sea Turtles

The following 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. The global status and trends of the loggerhead sea turtle are included 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. The following subsections are synopses of the best available information on the life history, distribution, population trends, and current status of the two species of sea turtles that are likely to be adversely affected by one or more components of the proposed action. Additional background information on the status of sea turtle species can be found in a number of published documents, including: Kemp's ridley sea turtle (USFWS and NMFS 1992) and loggerhead sea turtle (NMFS and USFWS 2008) status reviews, stock assessments, and biological reports (NMFS and USFWS 1995, NMFS and USFWS 2007a-e, Marine Turtle Expert Working Group (TEWG) 1998, 2000, 2007, and 2009; NMFS SEFSC 2001 and 2009d, and Conant et al. 2009).

3.4.1 Status of Kemp's Ridley Sea Turtles

The Kemp's ridley (Figure 16) was listed as endangered on December 2, 1970. Internationally, the Kemp's ridley is 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's 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.

Figure 16. Kemp's ridley sea turtle

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). A 2005 dietary study of immature Kemp's ridleys off southwest Florida documented predation on benthic tunicates, a previously undocumented food source for this species (Witzell and Schmid 2005). These 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 (Pritchard 1969). 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, nesting 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) suggest that the decline in the ridley population has stopped and the population is now increasing (USFWS 2000). 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 (TEWG 2000). These trends are further supported by 2004-2007 nesting data from Mexico. The number of nests over that period has increased from 7,147 in 2004, to 10,099 in 2005, to 12,143 in 2006, and 15,032 during the 2007 nesting season (Gladys Porter Zoo nesting database 2007). In 2008, there were 17,882 nests in Mexico (Gladys Porter Zoo 2008), and nesting in 2009 reached 21,144 (Gladys Porter Zoo 2010). In 2010, nesting declined significantly, to 13,302 (Gladys Porter Zoo 2010) but it is too early to determine if this is a one-time decline or if it is indicative of a change in the trend. Final numbers for 2011were not available at the time of this opinion. However, preliminary information for Kemp's ridley nesting in Mexico indicates there were fewer nests than in 2009, but nesting numbers did rebound from 2010's reduced nesting to over 20,000 (pers. comm. Jaime Peña, Gladys Porter Zoo). A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 128 in 2007, 195 in 2008, and 197 in 2009. Texas nesting then experienced a decline similar to that seen in Mexico for 2010, with 140 nests (National Park Service data, http://www.nps.gov/pais/naturescience/strp.htm), but nesting rebounded in 2011 with a record 199 nests (National Park Service data, http://www.nps.gov/pais/naturescience/current-season.htm).

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 TEDs in the United States' and Mexico's shrimping fleets. 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. Recent calculations of nesting females determined from nest counts show that the population trend is increasing towards that recovery goal, with an estimate of 4,047 nesters in 2006 and 5,500 in 2007 (NMFS 2007f, Gladys Porter Zoo 2007).

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 sea 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* spp., and *Cancer* spp. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). Upon leaving Chesapeake Bay in autumn, juvenile Kemp's 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 and 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 threats as other sea turtle species, 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 sea turtles were found on Cape Cod beaches (R. Prescott, NMFS, pers. comm. 2001). Annual cold-stunning events do not always occur at this magnitude; the extent of episodic major cold-stun events may be associated with numbers of sea turtles utilizing Northeast waters in a given year, oceanographic conditions, and the occurrence of storm events in the late fall. Many cold-stunned sea turtles can survive if found early enough, but cold-stunning events can still represent a significant cause of natural mortality. A complete list of other indirect factors can be found in NMFS SEFSC (2001).

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 in previous sections. For example, in the spring of 2000, a total of 5 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 sea 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 5 Kemp's 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.

The impacts of pollution on Kemp's ridley sea turtles, as with all sea turtles, are still poorly understood. There is little data to provide an understanding of how water quality impacts sea turtles. In 2010, there was a massive oil well release in the Gulf of Mexico at British Petroleum's Deepwater Horizon well. Official estimates are that 4.9 million barrels of oil were released into the Gulf, with some experts estimating even higher volumes. At this time the assessment of total direct impact to sea turtles has not been determined. Additionally, the long-term impacts to sea turtles as a result of habitat impacts, prey loss, and subsurface oil particles and oil components broken down through physical, chemical, and biological processes are not known.

There is a large and growing body of literature on past, present, and future impacts of global climate change induced by human activities, i.e., global warming. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The Environmental Protection Agency's climate change Web page provides basic background information on these and other measured or anticipated effects (see www.epa.gov/climatechange/index.html). However, the impacts on sea turtles currently cannot, for the most part, be predicted with any degree of certainty.

The Intergovernmental Panel on Climate Change has stated that global climate change is unequivocal (IPCC 2007) and its impacts may be significant to the hatchling sex ratios of Kemp's ridley sea turtles (Wibbels 2003, NMFS and USFWS 2007c). In marine turtles, sex is determined by temperature in the middle third of incubation with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25°-35°C (Ackerman 1997). Increases in global temperature could potentially skew future sex ratios toward a higher numbers of females (NMFS and USFWS 2007c).

The effects from increased temperatures may be exacerbated on developed nesting beaches where shoreline armoring and construction has denuded vegetation. Sea level rise from global climate change (IPCC 2007) is also a potential problem, particularly for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Daniels et al. 1993, Fish et al. 2005, Baker et al. 2006). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as increased frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006, Baker et al. 2006).

Other changes in the marine ecosystem caused by global climate change (e.g., salinity, oceanic currents, dissolved oxygen levels, nutrient distribution, etc.) could influence the distribution and abundance of phytoplankton, zooplankton, submerged aquatic vegetation, forage fish, etc., which could ultimately affect the primary foraging areas of Kemp's ridley sea turtles.

3.4.2 Summary of Status for Kemp's Ridley Sea Turtles

The only major nesting site for Kemp's 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 from 1985 to 2009. Nesting has also exceeded 12,000 nests per year from 2004-2009 (Gladys Porter Zoo database). However, in 2010 the nesting declined dramatically compared to the previous few years. Early speculation on the decline may be related to the events of the Deepwater Horizon oil spill. 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 recover. 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.

3.4.3 Status of Northwest Atlantic Ocean DPS of Loggerhead Sea Turtles

The loggerhead sea turtle (Figure 17) 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. The majority of loggerhead nesting occurs in the Western Atlantic Ocean (south Florida, United States), and the western Indian Ocean (Masirah, Oman); in both locations nesting assemblages have more than 10,000 females nesting each year (NMFS and USFWS 2008). Loggerhead sea turtles are the most abundant species of sea turtle in U.S. waters.

Figure 17. Loggerhead sea turtle

NMFS and USFWS published a final rule designating nine DPSs for loggerhead sea turtles (76 FR 58,868, September 22, 2011; effective October 24, 2011). The DPSs established by this rule include: (1) Northwest Atlantic Ocean (threatened); (2) Northeast Atlantic Ocean (endangered); (3) South Atlantic Ocean (threatened); (4) Mediterranean Sea (endangered); (5) North Pacific Ocean (endangered); (6) South Pacific Ocean (endangered); (7) North Indian Ocean (endangered); (8) Southeast Indo-Pacific Ocean (endangered); and (9) Southwest Indian Ocean (threatened). The NWA DPS is the only one that occurs within the action area and therefore is the only one to be considered in this opinion.

Atlantic Ocean

Within the NWA DPS, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. Previous Section 7 analyses have recognized 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 and TEWG 2000); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (NMFS 2001b). The recovery plan for the Northwest Atlantic population of loggerhead sea turtles concluded, based on recent advances in genetic analyses, that there is no genetic distinction between loggerheads nesting on adjacent beaches along the Florida Peninsula and that specific boundaries for subpopulations could not be designated based on genetic differences alone. Thus, the plan uses a combination of geographic distribution of nesting densities, geographic

separation, and geopolitical boundaries, in addition to genetic differences, to identify recovery units. The recovery units are: (1) the Northern Recovery Unit (Florida/Georgia border north through southern Virginia); (2) the Peninsular Florida Recovery Unit (Florida/Georgia border through Pinellas County, Florida); (3) the Dry Tortugas Recovery Unit (islands located west of Key West, Florida); (4) the Northern Gulf of Mexico Recovery Unit (Franklin County, Florida, through Texas); and (5) the Greater Caribbean Recovery Unit (Mexico through French Guiana, the Bahamas, Lesser Antilles, and Greater Antilles) (NMFS and USFWS 2008). The recovery plan concluded that all recovery units are essential to the recovery of the species. Although the recovery plan was written prior to the listing of the NWA DPS, the recovery units for what was then termed the Northwest Atlantic population apply to the NWA DPS.

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 new data from tag returns, strandings, and nesting surveys, NMFS SEFSC (2001) estimated ages of maturity ranging from 20-38 years and benthic immature stage (sea turtles that have come back to inshore and nearshore waters)—the life stage following the pelagic immature stage—lasting from 14-32 years.

Mating takes place in late March-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 per 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 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-c), 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 of loggerheads 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 of North Carolina, particularly off Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (≥ 11°C) (Epperly et al. 1995a-c). 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 a variety of habitats.

More recent studies are revealing that the loggerhead's life history is more complex than previously believed. Rather than making discrete developmental shifts from oceanic to neritic environments, research is showing that both adults and (presumed) neritic stage juveniles continue to use the oceanic environment and will move back and forth between the two habitats (Witzell 2002, Blumenthal et al. 2006, Hawkes et al. 2006, McClellan and Read 2007). One of the studies tracked the movements of adult females post-nesting and found a difference in habitat use was related to body size with larger turtles staying in coastal waters and smaller turtles traveling to oceanic waters (Hawkes et al. 2006). A tracking study of large juveniles found that the habitat preferences of this life stage were also diverse with some remaining in neritic waters while others moved off into oceanic waters (McClellan and Read 2007). However, unlike the Hawkes et al. study (2006), there was no significant difference in the body size of turtles that remained in neritic waters versus oceanic waters (McClellan and Read 2007). In either case, the research not only supports the need to revise the life history model for loggerheads but also demonstrates that threats to loggerheads in both the neritic and oceanic environments are likely impacting multiple life stages of this species.

Population Dynamics and Status

A number of stock assessments and similar reviews (TEWG 1998, TEWG 2000, NMFS SEFSC 2001 and 2009d, Heppell et al. 2003, NMFS and USFWS 2008, Conant et al. 2009, TEWG 2009) have examined the stock status of loggerheads in the Atlantic Ocean, but none have been able to develop a reliable estimate of absolute population size.

Numbers of nests and nesting females can vary widely from year to year. However, nesting beach surveys can provide a reliable assessment of trends in the adult female population, due to the strong nest site fidelity of females turtles, as long as such studies are sufficiently long and effort and methods are standardized (see, e.g., NMFS and USFWS 2008). NMFS and USFWS (2008) concluded that the lack of change in two important demographic parameters of loggerheads, remigration interval and clutch frequency, indicate that time series on numbers of nests can provide reliable information on trends in the female population. Recent analysis of available data for the Peninsular Florida Recovery Unit has led to the conclusion that the observed decline in nesting for that unit over the last several years can best be explained by an actual decline in the number of adult female loggerheads in the population (Witherington et al. 2009).

Annual nest totals from beaches within what NMFS and USFWS have defined as the Northern Recovery Unit (NRU) averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches (GDNR unpublished data, NCWRC unpublished data, SCDNR unpublished data), and represent approximately 1,272 nesting females per year (4.1 nests per female, Murphy and Hopkins 1984). The loggerhead nesting trend from daily beach surveys showed a significant decline of 1.3 percent annually. Nest totals from aerial surveys conducted by SCDNR showed a 1.9 percent annual decline in nesting in South Carolina since 1980. Overall, there is strong statistical data to suggest the NRU has experienced a long-term decline. Data in 2008 has shown improved nesting numbers, but future nesting years will need to be analyzed to determine if a change in trend is occurring. In 2008, 841 loggerhead nests were observed compared to the 10-year average of 715 nests in North Carolina. The number dropped to 276 in 2009, but rose again to 846 in 2010. In South Carolina, 2008 was the seventh highest nesting year on record since 1980, with 4,500 nests, but this did not change the long-term trend line indicating a decline on South Carolina beaches. Then in 2009 nesting dropped to 2183, with an increase to 3,141 in 2010. Georgia beach surveys located a total of 1,648 nests in 2008. This number surpassed the previous statewide record of 1,504 nests in 2003. In 2009, the number of nests declined to 998, and in 2010, a new statewide record was established with 1,760 loggerhead nests. According to analyses by Georgia DNR, the 40-year time-series trend data show an overall decline in nesting, but the shorter comprehensive survey data (20 years) indicate a stable population (SCDNR 2008; GDNR, NCWRC, and SCDNR nesting data located at www.seaturtle.org).

Another consideration that may add to the importance and vulnerability of the NRU is the sex ratio of this subpopulation. NMFS scientists have estimated that the Northern subpopulation produces 65 percent males (NMFS SEFSC 2001). However, 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 Peninsular Florida Recovery Unit (PFRU) is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed a mean of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females per year (from NMFS and USFWS 2008). The statewide estimated total for 2010, was 73,702 (FWRI nesting database). An analysis of index nesting beach data shows a 26 percent decline in nesting by the PFRU between 1989 and 2008, and a mean annual rate of decline of 1.6 percent despite a large increase in nesting for 2008, to 38,643 nests (Witherington et al. 2009, NMFS and USFWS 2008, FWRI nesting database). In 2009, nesting levels, while still higher than the lows of 2004, 2006, and 2007, dropped below 2008 levels to approximately 32,717 nests, but in 2010 a large increase was seen, with 47,880 nests on the index nesting beaches (FWRI nesting database). The 2010 Florida index nesting number is the largest since 2000. With the addition of data through 2010,

the nesting trend for the proposed NWA DPS of loggerheads became only slightly negative and not statistically different from zero (no trend) (NMFS and USFWS 2010). Nesting at the index nesting beaches in 2011 declined from 2010, but was still the second highest since 2001, at 43,595 nests (FWRI nesting database).

The remaining three recovery units—Dry Tortugas (DTRU), Northern Gulf of Mexico (NGMRU), and Greater Caribbean (GCRU)—are much smaller nesting assemblages but still considered essential to the continued existence of the species. Nesting surveys for the DTRU are conducted as part of Florida's statewide survey program. Survey effort has been relatively stable during the 9-year period from 1995-2004 (although the 2002 year was missed). Nest counts ranged from 168-270, with a mean of 246, but with no detectable trend during this period (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data, NMFS and USFWS 2008). Nest counts for the NGMRU are focused on index beaches rather than all beaches where nesting occurs. The 12-year dataset (1997-2008) of index nesting beaches in the area shows a significant declining trend of 4.7 percent annually (NMFS and USFWS 2008). Similarly, nesting survey effort has been inconsistent among the GCRU nesting beaches and no trend can be determined for this subpopulation. 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. However, nesting has declined since 2001, and the previously reported increasing trend appears to not have been sustained (NMFS and USFWS 2008).

Determining the meaning of the nesting decline data is confounded by various in-water research that suggests the abundance of neritic juvenile loggerheads is steady or increasing (Ehrhart et al. 2007, M. Bresette, pers. comm. regarding captures at the St. Lucie Power Plant, SCDNR unpublished SEAMAP-SA data, Epperly et al. 2007). Ehrhart et al. (2007) found no significant regression-line trend in the long-term dataset. However, notable increases in recent years and a statistically significant increase in CPUE of 102.4 percent from the 4-year period of 1982-1985 to the 2002-2005 periods were found. Epperly et al. (2007) determined the trends of increasing loggerhead catch rates from all the aforementioned studies in combination provide evidence there has been an increase in neritic juvenile loggerhead abundance in the southeastern United States in the recent past. A study led by the South Carolina Department of Natural Resources found that standardized trawl survey CPUEs for loggerheads from South Carolina to North Florida was 1.5 times higher in summer 2008 than summer 2000. However, even though there were persistent inter-annual increases from 2000-2008, the difference was not statistically significant, likely due to the relatively short time series. Comparison to other datasets from the 1950s through 1990s showed much higher CPUEs in recent years regionally and in the South Atlantic Bight, leading SCDNR to conclude that it is highly improbable that CPUE increases of such magnitude could occur without a real and substantial increase in actual abundance (Arendt et al. 2009). Whether this increase in abundance represents a true population increase among juveniles or merely a shift in spatial occurrence is not clear. NMFS and USFWS (2008), citing Bjorndal et al. 2005, caution about extrapolating localized in-water trends to the broader population and relating localized trends in neritic sites to population trends at nesting beaches. The

apparent overall increase in the abundance of neritic loggerheads in the southeastern United States may be due to increased abundance of the largest Stage III individuals (oceanic/neritic juveniles, historically referred to as small benthic juveniles), which could indicate a relatively large cohort that will recruit to maturity in the near future (TEWG 2009). However, in-water studies throughout the eastern United States also indicate a substantial decrease in the abundance of the smallest Stage III loggerheads, a pattern also corroborated by stranding data (TEWG 2009).

The NMFS Southeast Fishery Science Center has developed a preliminary stage/age demographic model to help determine the estimated impacts of mortality reductions on loggerhead sea turtle population dynamics (NMFS SEFSC 2009). This model does not incorporate existing trends in the data (such as nesting trends) but instead relies on utilizing the available information on the relevant life-history parameters for sea turtles and then predicts future population trajectories based upon model runs using those parameters. Therefore, the model results do not build upon, but instead are complementary to, the trend data obtained through nest counts and other observations. The model uses the range of published information for the various parameters including mortality by stage, stage duration (years in a stage), and fecundity parameters such as eggs per nest, nests per nesting female, hatchling emergence success, sex ratio, and remigration interval. Model runs were done for each individual recovery unit as well as the western North Atlantic population as a whole, and the resulting trajectories were found to be very similar. One of the most robust results from the model was an estimate of the adult female population size for the western North Atlantic in the 2004-2008 time frame. The distribution resulting from the model runs suggest the adult female population size to be likely between approximately 20,000 to 40,000 individuals, with a low likelihood of being up to 70,000 (NMFS SEFSC 2009). A much less robust estimate for total benthic females in the western North Atlantic was also obtained, with a likely range of approximately 30,000-300,000 individuals, up to less than 1 million (NMFS SEFSC 2009).

The results of one set of model runs suggest that the western North Atlantic population is most likely declining, but this result was very sensitive to the choice of the position of the parameters within their range and hypothesized distributions. This example was run to predict the distribution of projected population trajectories for benthic females using a range of starting population numbers from the 30,000 estimated minimum to the greater than the 300,000 likely upper end of the range and declining trajectories were estimated for all of the population estimates. After 10,000 simulation runs of the models using the parameter ranges, 14 percent of the runs resulted in growing populations, while 86 percent resulted in declining populations. While this does not translate to an equivalent statement that there is an 86 percent chance of a declining population, it does illustrate that given the life history parameter information currently thought to comprise the likely range of possibilities, it appears most likely that with no changes to those parameters the population is projected to decline. Additional model runs using the range of values for each life history parameter, the assumption of non-uniform distribution for those parameters, and a 5 percent natural (non-anthropogenic) mortality for the benthic stages resulted in a determination that a 60-70 percent reduction in anthropogenic mortality in

the benthic stages would be needed to bring 50 percent of the model runs to a static (zero growth or decline) or increasing trajectory.

As a result of the large uncertainty in our knowledge of loggerhead life history, at this point predicting the future populations or population trajectories of loggerhead sea turtles with precision is very uncertain. The model results, however, are useful in guiding future research needs to better understand the life history parameters that have the most significant impact in the model. Additionally, the model results provide valuable insights into the likely overall declining status of the species and in the impacts of large-scale changes to various life history parameters (such as mortality rates for given stages) and how they may change the trajectories. The results of the model, in conjunction with analyses conducted on nest count trends (such as Witherington et al. 2009) which have suggested that the population decline is real, provides a strong basis for the conclusion that the western North Atlantic loggerhead population is in decline. NMFS also recently convened a new Turtle Expert Working Group (TEWG) for loggerhead sea turtles that gathered available data and examined the potential causes of the nesting decline and what the decline means in terms of population status. The TEWG ultimately could not determine whether or not decreasing annual numbers of nests among the Western North Atlantic loggerhead subpopulations were due to stochastic processes resulting in fewer nests, a decreasing average reproductive output of the adult females, decreasing numbers of adult females, or a combination of those factors. Past and present mortality factors that could impact current loggerhead nest numbers are many, and it is likely that several factors compound to create the current decline. Regardless of the source of the decline, it is clear that the reduced nesting will result in depressed recruitment to subsequent life stages over the coming decades (TEWG 2009).

Threats

The 5-year status review of loggerhead sea turtles recently completed by NMFS and the USFWS provides a summary of natural as well as anthropogenic threats to loggerhead sea turtles (NMFS and USFWS 2007c). The Loggerhead Recovery Team also undertook a comprehensive evaluation of threats to the species, and described them separately for the terrestrial, neritic, and oceanic zones (NMFS and USFWS 2008). The diversity of sea turtles' 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 and 2005 hurricane seasons. In August 2011, Hurricane Irene side-swiped the U.S. Atlantic sea turtle nesting beaches prior to making landfall farther to the north. Impacts to sea turtle nests and nesting beaches varied from minor to hundreds of nests and the loss of extensive nesting habitat on the various beaches. The damage to turtle nesting was somewhat mitigated by the storm's occurrence late in the nesting season, as many nests had already hatched and the hatchlings had already left the beach. Although no specific

information is available to determine the long-term population impacts of Hurricane Irene, the impact is not expected to be significant.

Other sources of natural mortality include cold-stunning and biotoxin exposure. Cold-stunning is not considered a major source of mortality, but cold-stunning of loggerhead turtles has been reported at several locations in the northeast and southeast United States, including the Indian River Lagoon in Florida (Mendonca and Ehrhart 1982, Witherington and Ehrhart 1989) and Texas inshore waters (Hildebrand 1982). Cold-stunning is a phenomenon during which turtles become incapacitated as a result of rapidly dropping water temperatures (Witherington and Ehrhart 1989, Morreale et al. 1992). As temperatures fall below 8°-10°C, turtles may lose their ability to swim and dive, often floating to the surface. The rate of cooling that precipitates cold-stunning appears to be the primary threat, rather than the water temperature itself (Milton and Lutz 2003). Sea turtles that overwinter in inshore waters are most susceptible to cold-stunning because temperature changes are most rapid in shallow water (Witherington and Ehrhart 1989). In January 2010, an unusually large cold-stunning event occurred throughout the southeast United States, with well over 3,000 sea turtles (mostly greens but also hundreds of loggerheads) found cold-stunned. Most were able to be saved, but a few hundred were found dead or died after being discovered in a cold-stunned state.

Anthropogenic factors that impact hatchlings and adult female sea 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 (in areas like 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 East Florida nesting beaches from Indian River to Broward County, including some high density beaches, 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 threats include oil and gas exploration, coastal development, marine transportation, marine pollution (which may have a direct impact, or an indirect impact by causing harmful algal blooms), 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. In 2010, there was a massive oil well release in the Gulf of Mexico at British Petroleum's Deepwater Horizon well. Official estimates are that 4.9 million barrels of oil were released into the Gulf, with some experts estimating much higher volumes. At this time the assessment of total direct impact to sea turtles has not been determined. Additionally, the long-term impacts to sea turtles as a result of habitat impacts, prey loss, and subsurface oil particles and oil

components broken down through physical, chemical, and biological processes are not known. Loggerheads in the pelagic environment are exposed to a series of longline fisheries, which include the highly migratory species' Atlantic 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. 1994). 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. The sizes and reproductive values of sea turtles taken by fisheries vary significantly, depending on the location and season of the fishery, and size-selectivity resulting from gear characteristics. Therefore, it is possible for fisheries that interact with fewer, more reproductively valuable turtles to have a greater detrimental effect on the population than one that takes greater numbers of less reproductively valuable turtles if the fishery removes a higher overall reproductive value from the population (Wallace et al. 2008). The Loggerhead Biological Review Team determined that the greatest threats to the Northwest Atlantic DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant, et al. 2009). Attaining a more thorough understanding of the characteristics, as well as the quantity, of sea turtle bycatch across all fisheries is of great importance.

There is a large and growing body of literature on past, present, and future impacts of global climate change exacerbated and accelerated by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. NOAA's climate information portal provides basic background information on these and other measured or anticipated effects (see http://www.climate.gov).

Impacts on sea turtles currently cannot, for the most part, be predicted with any degree of certainty; however significant impacts to the hatchling sex ratios of loggerhead turtles may result (NMFS and USFWS 2007c). In marine turtles, sex is determined by temperature in the middle third of incubation with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25°-35°C (Ackerman 1997). Increases in global temperature could potentially skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007c). Modeling suggests an increase of 2°C in air temperature would result in a sex ratio of over 80 percent female offspring for loggerheads nesting near Southport, North Carolina. The same increase in air temperatures at nesting beaches in Cape Canaveral, Florida, would result in close to 100 percent female offspring. More ominously, an air temperature increase of 3°C is likely to exceed the thermal threshold of most clutches, leading to death (Hawkes et al. 2007).

Warmer sea surface temperatures have been correlated with an earlier onset of loggerhead nesting in the spring (Weishampel et al. 2004, Hawkes et al. 2007), as well as short inter-nesting intervals (Hays et al. 2002) and shorter nesting season (Pike et al. 2006).

The effects from increased temperatures may be exacerbated on developed nesting beaches where shoreline armoring and construction have denuded vegetation. Erosion control structures could potentially result in the permanent loss of nesting beach habitat or deter nesting females (NRC 1990). Alternatively, nesting females may nest on the seaward side of the erosion control structures, potentially exposing them to repeated tidal overwash (NMFS and USFWS 2007c). Sea level rise from global climate change is also a potential problem for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Daniels et al. 1993, Fish et al. 2005, Baker et al. 2006). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006, Baker et al. 2006).

Other changes in the marine ecosystem caused by global climate change (e.g., salinity, oceanic currents, dissolved oxygen levels, nutrient distribution, etc.) could influence the distribution and abundance of phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish, etc., which could ultimately affect the primary foraging areas of loggerhead sea turtles.

Actions have been taken to reduce anthropogenic impacts to loggerhead sea turtles from various sources, particularly since the early 1990s. These include lighting ordinances, predation control, and nest relocations to help increase hatchling survival, as well as measures to reduce the mortality of pelagic immatures, benthic immatures, and sexually mature age classes in various fisheries and other marine activities. Recent actions have taken significant steps towards reducing the recurring sources of mortality of sea turtles in the environmental baseline and improving the status of all loggerhead subpopulations. For example, the Turtle Excluder Device (TED) regulation published on February 21, 2003 (68 FR 8456), represents a significant improvement in the baseline effects of trawl fisheries on loggerhead sea turtles, though shrimp trawling is still considered to be one of the largest source of anthropogenic mortality on loggerheads (NMFS SEFSC 2009).

3.4.4 Summary of Status for Loggerhead Sea Turtles

NMFS recognizes five recovery units of loggerhead sea turtles in the western North Atlantic based on genetic studies and management regimes. Cohorts from all of these are known to occur within the action area of this consultation, and together comprise the NWA DPS. Using data up through 2007-2008, no long-term data suggest any of the loggerhead subpopulations throughout the entire North Atlantic were increasing in annual numbers of nests (TEWG 2009). Additionally, using both computation of susceptibility to quasi-extinction and stage-based deterministic modeling to determine the effects of known threats to Northwest Atlantic loggerheads, the Loggerhead Biological Review Team determined that this population is likely to decline in the foreseeable future, driven primarily by the mortality of juvenile and adult loggerheads from fishery bycatch throughout the North Atlantic Ocean. These computations were done for each of the recovery units, and all of them resulted in an expected decline (Conant et al. 2009). However, with the recent increase in nesting, data through 2010 changes the trend for the

PFRU from negative to no trend (slightly negative but not statistically significant) (NMFS and USFWS 2010). Nesting at the index nesting beaches for the PFRU in 2011 declined from 2010, but was still the second highest since 2001, at 43,595 nests (FWRI nesting database). Because of its size, the PFRU may be critical to the survival of the species in the Atlantic Ocean.

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).

Sturgeon

3.4.5 Status of Shortnose Sturgeon

Shortnose sturgeon (*Acipenser brevirostrum)* (Figure 18) inhabit large coastal rivers of eastern North America. Although it is considered an anadromous species, shortnose sturgeon distributed in the southern areas of the United States are more properly characterized as "freshwater amphidromous" meaning that they move between fresh and salt water during some part of their life cycle, but not necessarily for spawning. Historically, shortnose

Figure 18. Shortnose sturgeon

sturgeon were found in the coastal rivers along the east coast of North America from the Saint John River in Canada, to perhaps as far south as the Indian River in Florida (Gilbert 1989, Evermann and Bean 1898). In the southern portion of the range, they are currently found in the Altamaha, Ogeechee, and Savannah Rivers in Georgia. They are thought to be extremely rare or possibly extirpated from the St. Johns River in Florida as only a single specimen was found by the Florida Fish and Wildlife Conservation Commission during extensive sampling of the river in 2002/2003. Shortnose sturgeon prefer nearshore marine, estuarine, and riverine habitat of these large river systems. The species is significantly more abundant in some rivers in northern portions of its range than it is in the south. Bycatch in commercial fisheries and increased industrial uses of the nation's large coastal rivers during the 20th century (e.g., hydropower, nuclear power, port dredging) have contributed to the further decline and slow recovery of shortnose sturgeon.

While adult shortnose sturgeon may occasionally be found in marine waters during the summer, they typically are found in more estuarine waters, and in rivers near the saltwater-freshwater interface. There are spawning populations in the Savannah River and Hall et al. (1991) and Collins et al. (1993), using telemetry techniques, identified two distinct spawning locations. However, the status of stocks is poorly understood and

survival of juveniles and recruitment to the adult population has been identified as a potential limiting factor in population growth (Smith et al. 1992). According to historical distribution records much of the spawning and nursery habitat formerly available to sturgeon in the Savannah River is inaccessible (USFWS 2001).

In addition to the distribution of wild (native) shortnose sturgeon in the Savannah River, broodstock are currently held at the University of Florida, Gainesville, and the USFWS Warm Springs Fish Technology Center (Georgia and South Carolina), USGS Conte Research Center (Massachusetts), and Alden Research Lab (Massachusetts). These research facilities conduct a variety of research to investigate sturgeon culture, tagging technology, fish passage, embryonic development, and other biological studies. Shortnose sturgeon of Savannah River origin are also currently being held at several educational facilities for public display including North Carolina Aquarium, Wilmington, North Carolina; North Carolina Zoo Asheboro, North Carolina; and Riverbanks Zoo Columbia, South Carolina. Although, captive shortnose sturgeon may not typically be released into the wild and measures are taken to ensure escapement does not occur. Because wild and cultured shortnose sturgeon share similar genetic, physical, physiological, ecological, and behavioral characteristics, all individuals and components of shortnose sturgeon derived from or by those initially removed from the Savannah River, including populations of natural individuals and hatchery stocks derived from similar populations, are included in the ESA listing of the species.

Listing

Shortnose sturgeon were originally listed as an endangered species by the USFWS on March 11, 1967, under the Endangered Species Preservation Act (32 FR 4001). Shortnose sturgeon continued to meet the listing criteria as "endangered" under subsequent definitions specified in the 1969 Endangered Species Conservation Act and remained on the list with the inauguration of the ESA in 1973. NMFS assumed jurisdiction for shortnose sturgeon from the USFWS in 1974 (39 FR 41370). The shortnose sturgeon currently remains listed as an endangered species throughout all of its range along the east coast of the United States and Canada.

Although the original listing notice did not cite reasons for listing the species, a 1973 Resource Publication issued by the U.S. Department of Interior stated that shortnose sturgeon were "in peril ... gone in most of the rivers of its former range [but] probably not as yet extinct" (USDOI 1973). Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline. Anthropogenic factors are likely responsible for the persistently depressed abundance of shortnose sturgeon in southern rivers. Shortnose sturgeon in the southeastern United States are exposed to three or more of the following impacts: harvest (bycatch and poaching), dams, river flow regulation, pollution (e.g., paper mill effluent), or dredging of fresh/saltwater interface reaches.

Range

Geographic distribution of the shortnose sturgeon extends from the Saint John River, New Brunswick, Canada, to the St. Johns River, Florida (Vladykopy and Greeley 1963);

the historic extent may have extended as far south as Indian River, Florida (Evermann and Bean 1898, Gilbert 1989). Currently, the distribution of shortnose sturgeon across their range is disjunct, with northern populations separated from southern populations by a distance of about 400 km near their geographic center in Virginia.

Life History
The scientific name for the shortnose sturgeon is *Acipenser brevirostrum: Acipenser* is Latin for sturgeon and *brevirostrum* means short snout. LeSueur originally described the species from a specimen taken from the Delaware River (Dadswell et al. 1984).

The shortnose sturgeon is the smallest of the three sturgeon species that occur in eastern North America: they attain a maximum length of about 120 cm, and a weight of 24 kg (Dadswell et al. 1984). Adults resemble similar-sized juvenile Atlantic sturgeon (*A. oxyrinchus oxyrinchus*) that historically co-occurred in the lower mainstem rivers of major basins along the Atlantic coast. The shortnose sturgeon is distinguished from other North American sturgeons by a wide mouth, absence of a fontanelle, nearly complete absence of postdorsal scutes, and preanal scutes often arranged in a single row (Scott and Crossman 1973, Dadswell et al. 1984). Morphological differences between shortnose and Atlantic sturgeon have been discussed (Bath et al. 1981, Gilbert 1989, Kynard and Horgan 2002, Vecsei and Peterson 2004); most researchers in the field use mouth width versus interorbital width to separate species. Coloration varies but adult shortnose sturgeons are generally dark dorsally and are lighter ventrally, usually white to yellow in color beginning at the row of lateral scutes. All of the fins are pigmented, and the paired fins are outlined in white. There is no external sexual dimorphism in morphology.

Shortnose sturgeon migrate seasonally between upstream freshwater spawning habitat and downstream foraging mesohaline areas within the river based on water temperature, flow and salinity cues. Shortnose sturgeon have generally been described as being anadromous[4] but freshwater amphidromous[5] may be a better description for the fish occurring in the southern rivers because they rarely leave their natal rivers or associated estuaries (Kieffer and Kynard 1993).

Spawning migration and cues
Initiation of the upstream movement of shortnose sturgeon to spawn is likely triggered partially by water temperatures above 8°C (Dadswell 1979, Kynard 1997) during late winter/early spring (southern rivers) to mid-to-late spring (northern rivers); specifically occurring in the southern range (North Carolina and south) between late December and March. Southern populations of shortnose sturgeon usually spawn at least 200 km upriver (Kynard 1997) or throughout the fall zone, if they are able to reach it. Spawning areas are usually associated with areas where the substrate is composed of gravel, rubble, cobble, or large rocks (Dadswell 1979, Taubert 1980, Buckley and Kynard 1985a, Kynard 1997), or timber, scoured clay, and gravel (Hall et al. 1991). Water depth and flow are also important parameters for spawning site (Kieffer and Kynard 1996).

[4] An anadromous fish is defined as a species that lives in the ocean mostly, and breeds in fresh water.
[5] A freshwater amphidromous species is defined as a species that spawns and remains in freshwater for most of its life cycle but spends some time in saline water.

Spawning sites are characterized by moderate river flows with average bottom velocities between 0.4 and 0.8 m/s (Hall et al. 1991, Kieffer and Kynard 1996, NMFS 1998). Spawning in the southern rivers has been reported at water temperatures of 10.5°C in the Altamaha River (Heidt and Gilbert 1978) and 9°-12°C in the Savannah River (Hall et al. 1991. In the southern portion of the range, adults typically spawn well upriver in the late winter to early spring and spend the rest of the year in the vicinity of the fresh/brackish water interface (Collins and Smith 1993).

Shortnose sturgeon vary in pre-spawning migration patterns that may reflect energetic adaptations to migration distance, river discharge and temperature, and physiological condition of fish (Kieffer and Kynard 1993). The three patterns of migrations are: (1) a rapid, 1-step migration in spring only a few weeks before spawning, (2) a longer, 1-step migration many weeks in late winter and spring before spawning, and (3) a 2-step migration composed of a long fall migration, which places fish near the spawning site for overwintering, then a short migration in spring to spawn.

Following the spring spawning period, adult shortnose sturgeon move rapidly and directly downstream to freshwater reaches of rivers or river reaches that are influenced by tides; as a result, they often inhabit only a few short reaches of a river's entire length (Buckley and Kynard 1985a). Adult shortnose sturgeon are usually located in deeper downstream areas with soft substrate and vegetated bottom areas where their prey are present. Juvenile (non-spawning, sexually immature) shortnose sturgeon generally move lesser distances upstream for the spring and summer seasons and downstream for fall and winter; however, these movements usually occur above the salt/freshwater interface of the rivers they inhabit (Dadswell et al. 1984, Hall et al. 1991).

Age and Growth

Dadswell et al. (1984) reviewed shortnose sturgeon growth throughout the latitudinal range. Growth of all juveniles is rapid, attaining lengths of 14-30 cm during the first year. Fish in the southern portion of the range grow the fastest, but do not reach the larger size of fish in the northern part of the range that continue to grow throughout life. This phenomenon may be related to different bioenergetic styles of southern and northern shortnose sturgeon, but sufficient data are not available for conclusions. The land-locked shortnose sturgeon population located upstream of Holyoke Dam at river km 140 of the Connecticut River has the slowest growth rate of any surveyed (Taubert 1980); growth rates of the other land-locked population in Lakes Marion and Moultrie are not available for comparison. The slower growth rate of this land-locked population suggests bioenergetic consequences to foraging in freshwater habitat and advantages associated with foraging in the lower river or fresh/saltwater interface.

Length at maturity (45-55 cm FL) is similar throughout the latitudinal range of shortnose sturgeon, but growth rate, maximum age, and maximum size vary with latitude. Fish in the southern areas grow more rapidly and mature at younger ages but attain smaller maximum sizes than those in the north (Dadswell et al. 1984). Maximum age of shortnose sturgeon in the northern portion of the species' range is greater than the southern portion of the species' range (Gilbert 1989). The maximum age reported for a

shortnose sturgeon in the Saint John River in New Brunswick is 67 years (for a female), 40 years for the Kennebec River, 37 years for the Hudson River, 34 years in the Connecticut River, 20 years in the Pee Dee River, and 10 years in the Altamaha River (Gilbert 1989 using data presented in Dadswell et al. 1984).

Shortnose sturgeon also exhibit sexually dimorphic growth patterns across latitude: males mature at 2-3 years in Georgia, 3-5 years in South Carolina, and 10-11 years in the Saint John River, Canada; females mature at 4-5 years in Georgia, 7-10 years in the Hudson River, and 12-18 years in the Saint John River. Males begin to spawn 1-2 years after reaching sexual maturity and spawn every other year and perhaps annually in some rivers (Dadswell 1979, Kieffer and Kynard 1996, NMFS 1998). Age at first spawning for females is about approximately 5 years post-maturation (Dadswell 1979) with spawning occurring about every three years although spawning intervals may be as infrequent as every 5 years for some females (Dadswell 1979). Female shortnose sturgeon apparently grow larger than and outlive males (Dadswell et al. 1984, Gilbert 1989, COSEWIC 2005). Fecundity of shortnose sturgeon ranges between approximately 30,000-200,000 eggs per female (Gilbert 1989).

Shortnose sturgeon eggs are darkly colored, usually dark brown, black, or olive gray (Dadswell 1979, Hoff et al. 1988, Kynard 1997). Dadswell (1979) reported egg size from 3.00-3.20 mm in diameter. Eggs are negatively buoyant and not adhesive when first spawned; special protuberances on the egg membrane that maximize surface area available for attachment develop within a few minutes after water exposure (Dadswell et al. 1984). Once attached, the highly adhesive and demersal eggs adhere to the river substrate (Dadswell et al. 1984, Kynard 1997). Substrates commonly used by spawning shortnose sturgeon include gravel, rubble, large rock, sand, logs, and cobble (Dadswell 1979, Taubert 1980, Kieffer and Kynard 1996, Kynard 1997). Development of fertilized eggs is directly related to water temperature (Wang et al. 1985, Hardy and Litvak 2004).

At hatching, shortnose sturgeon are blackish-colored, 7-11 mm long, and resemble tadpoles (Buckley and Kynard 1981, Dadswell et al. 1984). Hatchlings have a large yolk-sac, poorly developed eyes, mouth, and fins, and are capable of only "swim-up and drift" swimming behavior (Richmond and Kynard 1995). They are ill-equipped to survive as free-swimming fish in the open river. In the laboratory, 1- to 8-day old shortnose sturgeon were photonegative, actively sought cover under any available material, often forming dense aggregations with other larvae, and swam along the bottom until cover was found (Richmond and Kynard 1995). Sheltering in dark substrate (i.e., in the crevasse of rocks/cobble at the spawning site) may enhance survival at this vulnerable life stage by allowing for some protection from predators (Richmond and Kynard 1995). Litvak observed that from a few days after hatching, they exhibit shoaling behavior, forming tight, well-spaced schools, and swim against the current; this shoaling behavior only exists when there is a flow (COSEWIC 2005).

Within 9-12 days, shortnose sturgeon absorb the yolk-sac and develop into larvae with a length of about 15 mm TL (Buckley and Kynard 1981). They experience a rapid change in sensory, feeding and locomotor systems (Bemis and Grande 1992). At this stage, the

larvae have well-developed eyes. Fins begin to develop allowing for swimming behavior that is more typical of juvenile and adult sturgeon, and larvae begin to feed exogenously. In the wild, these larvae are often found in the deepest water, usually within the channel (Taubert and Dadswell 1980, Bath et al. 1981, Kieffer and Kynard 1993). They also have a mouth with teeth which may aid in specialized larval feeding (Taubert and Dadswell 1980); the teeth are later absorbed during the juvenile phase. At about 15mm TL, larval coloration begins to resemble that of an adult with darker dorsal pigmentation and lighter lateral and ventral coloration (Taubert and Dadswell 1980). In the lab, larvae could become lighter or darker, corresponding with changes in light intensity (Buckley and Kynard 1981, Richmond and Kynard 1995, Kynard and Horgan 2002).

Research indicates that yearlings are the primary migratory stage (Kynard 1997), while juveniles (3-10 year olds) reside near the saltwater/freshwater interface in most rivers (Dadswell 1979, Pottle and Dadswell 1979, Dovel et al. 1992, Hall et al. 1991, Flournoy et al. 1992, Weber 1996). Juveniles regularly move throughout the saline portions (0-16 ppt) of the salt wedge during summer (Pottle and Dadswell 1979, Weber 1996) and are more active when water temperatures are cooler (<16°C) (Weber 1996). Juveniles have been found congregating in deeper sand/mud substrate in depths of 10-14 m (Hall et al. 1991). Due to their low tolerance for high temperatures, warm summer temperatures (above 28°C) may severely limit available juvenile rearing habitat in some rivers in the southeastern United States. Juveniles in the Altamaha and Ogeechee Rivers have been found in a single area with cool and deep water (Flournoy et al. 1992, Rogers and Weber 1994, Rogers and Weber 1995, Weber 1996). Telemetry studies have identified nursery habitats for juveniles, a primary example being just inside the mouth of the Middle River branch of the lower Savannah River, and near the Kings Island Turning Basin.

Little is known about young-of-the-year (YOY) behavior and movements in the wild but shortnose sturgeon at this age are believed to remain in channel areas within freshwater habitats upstream of the salt wedge for about one year (Dadswell et al. 1984, Kynard 1997). Residence of YOY in freshwater is supported by several studies on cultured shortnose sturgeon. Jenkins et al. (1993) found that salinity tolerances of young shortnose sturgeon improve with age; individuals 76 days old suffered 100 percent mortality in a 96-hour test at salinities ≥15 ppt while those 330 days old tolerated salinities as high as 20 ppt for 18 hours but experienced 100 percent mortality at 30 ppt. Jarvis et al. (2001) demonstrated that 16-month old juveniles grew best at 0 percent salinity and poorest at 20 percent salinity. Lastly, Ziegeweid et al. (2008b) demonstrated that salinity and temperature interact, affecting survival of YOY shortnose sturgeon. As salinity and temperature increased, survival decreased; however, as body size increased, individuals were better able to tolerate higher temperatures and salinities (Ziegeweid et al. 2008b).

Juveniles in the Saint John, Hudson, and Savannah Rivers use deep channels over sand and mud substrate for foraging and resting (Pottle and Dadswell 1979, Hall et al. 1991, Dovel et al. 1992). In most rivers, juveniles age one and older join adults and show similar spatio-temporal patterns of habitat use (Kynard 1997). In the upper segment of the Connecticut River, where some juveniles and adults are always in freshwater, there

was no macrohabitat segregation by age as both adults and juveniles used the same river reaches (Savoy 1991, Seibel 1993). In the Southeast, juveniles age one and older make seasonal migrations like adults, moving upriver during warmer months where they shelter in deep holes, before returning to the fresh/salt water interface when temperatures cool (Flournoy et al. 1992, Collins et al. 2002). Conversely, juveniles of this age in the Saint John River, Canada, preferred different habitat than adults. Dadswell (1979) reported these juveniles prefer freshwater habitats until they reach about 45 cm TL or age eight.

Researchers have noted that some shortnose sturgeon appear to aggregate with the same individuals within season and from year to year. Dadswell (1979) first observed these groupings in gillnet capture data on the Saint John River, Canada. Individuals that were recaptured were caught with the same group as in the original capture effort and often in the same order. The probability that pairs of fish would be recaptured together and removed from the gillnet in the same order by chance is extremely low (Dadswell, 1979). Decades later, students from Litvak's lab working on the Saint John River observed the same phenomenon (COSEWIC 2005).

Foraging

Adult shortnose sturgeon typically leave the spawning grounds soon after spawning and move rapidly to downstream feeding areas in the spring (Dadswell et al. 1984, Buckley and Kynard 1985a, Kieffer and Kynard 1993, O'Herron et al. 1993, Collins and Smith 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Shortnose sturgeon are benthic carnivores throughout their life who locate prey by using their barbels as tactile receptors and vacuuming either the substrate or plant surfaces with their protuberant mouth (Dadswell et al. 1984, Gilbert 1989). Shortnose sturgeon feed opportunistically on benthic insects, crustaceans, mollusks, and polychaetes (Dadswell et al. 1984). Studies of gut contents show that the diet of adult shortnose sturgeon typically consists of small bivalves, gastropods, polychaetes, and even small benthic fish (McCleave et al. 1977, Dadswell 1979, Marchette and Smiley 1982, Dadswell et al. 1984, Gilbert 1989, Moser and Ross 1995, Kynard et al. 2000, Collins et al. 2002), and they have also been observed feeding off plant surfaces and may take fish bait (Collins et al. 2002). Some reports indicate that female adult shortnose sturgeon have been found to feed throughout the year; however, Dadswell (1979) found that females ceased feeding nearly eight months before spawning. Conversely, males continue to feed throughout the fall and winter as long as they are located in saline waters (Dadswell et al. 1984). Dadswell (1979) documented individuals of both sexes actively feeding immediately after spawning. Limited observations indicate that feeding occurs primarily at night (Dadswell et al. 1984, Gilbert 1989). Juveniles feed indiscriminately, often ingesting large amounts of mud, stone, and plant material along with prey items (Dadswell 1979, Carlson and Simpson 1987). Because substrate type strongly affects composition of benthic prey, both juvenile and adult shortnose sturgeon primarily forage over sandy-mud bottoms, which support benthic invertebrates (Carlson and Simpson 1987, Kynard 1997).

In the southern part of their range, shortnose sturgeon are known to forage widely throughout the estuary during the winter, fall, and spring (Collins and Smith 1993, Weber

et al. 1998). During the hotter months of summer, foraging may taper off or cease as shortnose sturgeon take refuge from high water temperatures by congregating in cool, deep areas of rivers (Flournoy et al. 1992, Rogers and Weber 1994, Rogers and Weber 1995, Weber 1996). During winter months, adults in southern rivers spend much of their time in the slower moving waters downstream near the salt-wedge and forage widely throughout the estuary (Collins and Smith 1993, Weber et al. 1999). Older juveniles likely inhabit the same areas as adults, but younger juveniles primarily remain in freshwater habitats perhaps due to low salinity tolerances (Jenkins et al. 1993, Jarvis et al. 2001).

Hatchery fish

Approximately 97,483 hatchery-reared shortnose sturgeon were stocked into the Savannah River between 1985-1992. Few of the shortnose sturgeon released were tagged and fewer retained their tags. Tagged shortnose sturgeon stocked and released into the Savannah River have been captured in rivers adjacent to the Savannah in both South Carolina and Georgia. Beginning in 1995, shortnose stocked in the Savannah River were found in the Ogeechee River and were found to comprise 7.4 percent of the entire adult population between 1997 and 2000 (Smith et al. 2002). Likewise, 10.6 percent of the adults captured in the Edisto River between 1995 and 2000 were identifiable as fish stocked into the Savannah River (Smith et al. 2002). Given that only about 19 percent of the shortnose sturgeon stocked into the Savannah River were tagged coupled with low tag retention, it is likely that the stocked fish comprised a much larger part of these riverine populations. Shortnose sturgeon bearing tags indicating they were stocked into the Savannah River have also been detected in the Cooper River (M. Collins, SCDNR, pers. comm. 2008) and the Winyah Bay System (about 300 km to the north) in South Carolina. The emigration from the Savannah River may suggest the fish were released at an age too late to imprint on the Savannah River.

3.4.6 Population Structure and Characteristics: Riverine Populations and Metapopulations

Riverine Populations

The majority of shortnose sturgeon remain in their natal river or estuary throughout their lives, compared to other sturgeon species that migrate into marine waters to forage. The lack of marine movements by most adult shortnose sturgeon suggests that the recolonization rate of rivers from where they have been extirpated would be slow (Kynard 1997). Individuals that are infrequently captured in coastal waters could represent emigrants that colonize new rivers and maintain gene flow among populations. Previously most available information on marine captures indicated a greater incidence of marine emigrants in the north compared to the south (Kynard 1997); however, recent information indicates that coastal migrations also occur in the southeast. Because shortnose sturgeon populations in the northeast United States are generally larger than southern populations, there may be a relationship between population size and number of marine emigrants (Kynard 1997). Within natal rivers and estuaries, shortnose sturgeon populations have limited movements and show a high degree of site fidelity.

Sturgeon have been known to recolonize rivers, albeit slowly or after stocking of hatchery-reared fish. A period of greater than 100 years has been hypothesized for Atlantic sturgeon to recolonize a neighboring river (Secor and Waldman 1999).

Fragmentation of habitat via man-made barriers (i.e., dams) results in artificially isolated and range-constricted populations. Fragmentation is relatively easy to accomplish in rivers; a single damming event can isolate adjacent river segments and obstruct avenues of fish dispersal (Schlosser and Angermeier 1995). Fragmentation of rivers by dams further biases colonization rates by blocking upstream movement. Small isolated populations are more susceptible to extinction (both absolute and functional), and amphidromous species, such as sturgeon, are the first fish to subside (Poddubny and Galat 1995, Welcomme 1995).

Population Sizes

While historical population estimates for shortnose sturgeon are not available, fishery accounts indicate sturgeon were previously abundant in many river systems along the U.S. Atlantic coast.

North American sturgeon populations existed in enormous abundance prior to the 1880s based on both anecdotal observations (e.g., Catesby 1734) and historical catch data (e.g., McDonald 1887, Smith and Clugston 1997). In many Atlantic coast river basins, intensive exploitation of diadromous fish spawning migrations began to occur in the late 18th century: sturgeon caviar fisheries in mid-Atlantic states emerged rapidly in the 1870s (Cobb 1900) as processing and transportation improved. Because caviar was the principal marketable product, large females were targeted primarily using large mesh leaded gillnets that were drifted ahead of skiffs (Secor 2002).

Because all sturgeon along the Atlantic coast were called "common sturgeon" in the commercial catch statistics, it is difficult to estimate historic abundance of shortnose sturgeon as these records included both Atlantic and shortnose sturgeon until 1973 when the shortnose sturgeon was listed under the ESA (Murawski and Pacheco 1977). Consequently, the relative importance of the two species cannot be accurately ascertained from fisheries statistics. The Atlantic sturgeon, being of considerably greater maximum size, likely comprised the greatest percentage of the total weight of the overall catch. Statistical information on quantities of sturgeon harvested commercially first appeared in 1880; landings quickly peaked in 1890.

The current status of the shortnose sturgeon is mixed. Trends in abundance and population demographics vary by riverine populations. It is difficult to ascertain trends in abundance of shortnose sturgeon at a riverine scale, as few long-term data sets exist. Many historical records indicate only sporadic sightings, not abundance estimates. Direct comparison of available data sets to investigate abundance trends at a riverine scale can be misleading due to differences in survey methodologies and data analysis.

Although comprehensive population estimates are available for only a few rivers, most major river systems in the southeast United States are known to be inhabited by shortnose

sturgeon, as depicted in Table 2. It is difficult to obtain a population estimate as it requires expensive multi-year survey of netting in order to appropriately assess population size within statistical parameters.

River/Estuary		Source
Albemarle Sound, NC	Anecdotal	Moser et al. 1998
Chowan, NC	Juvenile specimen collected	1881
Roanoke, NC	Adult collected	1998
Pamlico Sound, NC	Anecdotal	Moser et al. 1998
Neuse, NC	Anecdotal	Moser et al. 1998
Black, NC	Adult at river mouth	1991
Cape Fear, NC	Adults	Moser and Ross, 1989, 1993, 1995
Waccamaw, SC	Adults	SCDNR
Pee Dee, SC	Adults	SCDNR
Black, SC	Adults	SCDNR
Sampit, SC	Adults	SCDNR
Winyah Bay, SC	Adults	SCDNR
Wateree, SC	Adults	SCDNR
Congaree, SC	Adults	SCDNR
Ashley, SC	Unknown	
Edisto, SC	Adults and Juveniles	SCDNR
Ashepoo, SC	Adults	SCDNR
Combahee, SC	Unknown	
Savannah, GA	Adults, Juveniles	SCDNR
Ogeechee, GA	Adults	GADNR/UGS
Altamaha, GA	Adults, Juvenile, Eggs	UGS
Satilla, GA	Adults	GADNR
St. Mary's, GA	Adults	GADNR
St. Johns, FL	Adult collected	FFWC

Table 2. List of rivers in the southeast United States known to support shortnose sturgeon. These rivers collectively comprise the Southern metapopulation of shortnose sturgeon.

Differentiation of Riverine Populations and Metapopulations

Since the 1998 shortnose sturgeon recovery plan identified 19 distinct shortnose sturgeon populations based on natal rivers, significantly more field data on straying rates to adjacent rivers has been collected, and several genetic studies (nDNA and mtDNA) have determined that coastal migrations and effective movement (i.e., movement with spawning) are occurring between adjacent rivers in some areas, particularly in the Gulf of Maine and the southeast United States. Despite sometimes extensive coastal movements, both field (tagging) and laboratory studies [indirect gene flow estimates from mtDNA (i.e., < 2 individuals per generation), genetic distance, and assignment results from nDNA] conclude that greater mixing of riverine populations occur in areas where the distance between rivers mouths is relatively close (Wirgin et al. 2000, King et al. 2001, Waldman et al. 2002, Wirgin et al. 2005, Wirgin et al. 2009), such as between the Ogeechee and Altamaha Rivers, Georgia.

To determine if inter-riverine movement was effective, King et al. examined gene flow estimates between individual riverine populations of shortnose sturgeon to determine variation. Gene flow estimates are effective metric of reproductive effectiveness as they

are based on the legacy of many generations (Wirgin et al. 2009). Greater than 30 reports indicate that most, if not all, shortnose sturgeon riverine populations are statistically different ($P < 0.05$) based on allelic/haplotype frequencies, and AMOVA and F_{ST} (and mtDNA equivalent) statistical tests using both mtDNA and nDNA genetic markers. That is, while shortnose sturgeon tagged in one river may later be recaptured in another, it is likely that the individuals are not spawning in those non-natal rivers, as gene flow is known to be low between riverine populations. Adult shortnose sturgeon are known to return to their natal rivers to spawn. Gene diversity estimates for shortnose sturgeon have been shown to be moderately high in both mtDNA (Quattro et al. 2002, Wirgin et al. 2000, Wirgin et al. 2005) and nDNA (King et al. in prep.) genomes, suggesting that dispersal is a very important factor in maintaining high levels of genetic diversity in populations within a metapopulation. Thus, although some shortnose sturgeon move between rivers, genetic analyses indicate that much of this movement is not effective.

Ample evidence exists indicating significant levels of genetic diversity are present in the shortnose sturgeon genome. Characterization of genetic differentiation (haplotype frequency) and estimates of gene flow (genetic distance) provide a quantitative measure to investigate population structure across the range of the shortnose sturgeon and reproductive connectiveness. By identifying zones of genetic discontinuity across the range, researchers have identified great genetic differentiation that indicates high degrees of reproductive isolation into at least three groupings (i.e., metapopulations). Both haplotype frequencies and the genetic distances between populations indicate population structure for shortnose sturgeon within their geographic range (Grunwald et al. 2002 and 2007, King et al. 2001, Wirgin et al. 2002, Waldman et al. 2002, Walsh et al. 2001, Wirgin et al. 2009). Notably, sturgeons are polyploid (the nucleus has 4 to 6 times the haploid number of chromosome sets), and so determining their evolutionary relatedness is challenging as the degree to which the nuclear genome exhibits disomic (having one or more chromosomes present in two copies) inheritance is unknown.

Three zones of genetic discontinuity translate into discrete functional groupings known as metapopulations (Wirgin et al. 2009; Figure. 19). Although some additional shallower patterns of discontinuity in the nDNA phenotypic variation were also identified in one grouping (labeled as the "Virginian Providence" in Figure. 19), data are lacking to conclude if this grouping is a single metapopulation or three distinct evolutionary lineages (King et al. in prep.). The presence of these demographically distinct zones of genetic discontinuity is consistent with the findings of researchers assessing behavioral patterns of shortnose sturgeon.

Figure 19. The North American Atlantic coast depicting three shortnose sturgeon metapopulations based on mtDNA control region sequence analysis. Figure from Wirgin et al. 2009.

Similar patterns of differentiation in the genomes among three metapopulations were found when 11 microsatellite DNA loci in 561 shortnose sturgeon from 17 geographic collections/rivers were surveyed to identify populations and phylogeographic structuring; notably the data were limited to include only YOY and spawning adults to reduce classification error by excluding migrating sub-adults (T. King, USGS, pers. comm.). Not only is the degree of congruence between the genetic variation qualitatively detectable, a strong quantitative relationship ($r = 0.83$, $P<0.00012$) exists between populations within a metapopulation, as supported by a Mandel analysis comparing the mtDNA F_{ST} values and nDNA φ_{PT} pair-wise distance for the 14 shortnose sturgeon collections used by Wirgin et al. (2009). Wirgin et al. (2009) proposed that the relatively shallow genetic differences among rivers within the Southern metapopulation, as compared to the Northern metapopulation(s), may result from one of a combination of two scenarios: (1) the movement of hatchery-reared individuals of Savannah River origin into non-natal rivers and their natural reproduction there led to significant alteration and

homogenization of haplotype patterns and frequencies; or (2) shortnose sturgeon within the southern metapopulation may naturally migrate to adjoining rivers more than northern.

Comparing results from the most recent and best available genetics data from 14 collections surveyed for patterns in both mtDNA (Wirgin et al. 2009) and nDNA (King et al. in prep.) variation, all indications are that the variation detected in the mtDNA control regions and at 11 polysomic DNA markers is highly phylographically congruent. Pair-wise distance matrices also supported structure into three major metapopulations. Network mapping of genetic sequences reveal that each metapopulation exists very much in reproductive isolation with the most similarity among adjacent populations located within a larger metapopulation.

The Savannah River population of shortnose sturgeon, together with the other populations inhabiting rivers in the southeast United States, constitute the Southern metapopulation of shortnose sturgeon. Of the four known spawning populations present in the Southern metapopulation of shortnose sturgeon, only the Pee Dee, Savannah, and Altamaha populations are viable and self-sustaining, having sufficient numbers and successful reproduction to maintain the population without immigration or human interaction. The Santee-Cooper population is not self-sustaining. The Altamaha and Savannah Rivers support the only populations numbering in the hundreds within the Southern metapopulation. If any of these populations become extirpated, recolonization would likely require a long period of time (cf. Atlantic sturgeon estimated to take 100 years) and be further hindered by the lack of local recruits.

3.4.7 Ecology of Metapopulations

A metapopulation is a population of populations (Levins 1969) in which distinct populations occupy separate patches of habitat separated by unoccupied areas. All patchy populations are not necessarily metapopulations (Hanski and Simberloff 1997). The amount and effectiveness of movement separates a metapopulation from a single large, patch population. Low rates of connectivity through dispersal, with little to no effective movement, allow individual populations to remain distinct as the rate of migration between local populations is low enough not to have an impact on local dynamics or evolutionary lineages and distinguishes a metapopulation from a patchy population (Harrison 1991). On the other hand, high rates of connectivity via dispersal lead to the unification of the population and genetic lineages and results in a patchy population. Each metapopulation cycles in relative independence of other metapopulations. A metapopulation can go extinct as a consequence of demographic stochasticity (fluctuations in population size due to random demographic events); the smaller the metapopulation (or population), the more prone it is to extinction. Anthropogenic impacts acting on top of demographic stochasticity further increase the risk of extinction.

Not all species form metapopulations and metapopulation structure varies among species. A metapopulation may have many small satellite populations surrounding a large source population: the satellite populations rely on the source for recruits as they are too small

and fluctuate too much to maintain themselves indefinitely. Elimination of the source population from this metapopulation usually results in the eventual extinction of the smaller satellite populations. Collectively metapopulations, or populations, constitute a species.

It is not unusual for lotic fishes to form metapopulations within coastal habitats. Separation into metapopulations is expected from sturgeon, and other anadromous fishes, given their likely stepping-stone sequential model of recolonization of northern rivers following post-Pleistocene deglaciation (Waldman et al. 2002).

3.4.8 (Meta)Population Stability, Viability, and Persistence

Populations of long-lived species tend to decline more rapidly and take much longer to recover than more productive species (Musick 1999). Because sturgeon are long-lived and slow-growing, stock productivity is relatively low. Although sturgeon employ the teleostean strategy of profligate spawning, with shortnose fecundity ranging between 27 and 208 thousand eggs per female, spawners within the action area are blocked from accessing appropriate spawning habitat above the dams.

Despite the longevity of sturgeon, the viability of sturgeon populations is highly sensitive to increases in juvenile mortality that result in chronic reductions in the number of sub-adults that recruit into the adult, breeding population (Anders et al. 2002, Gross et al. 2002, Secor et al. 2002). This relationship caused Secor et al. (2002) to conclude that sturgeon populations can be grouped into two demographic categories: populations that have reliable (albeit periodic) natural recruitment, and those that do not. The shortnose sturgeon populations without reliable natural recruitment are at risk of becoming critically endangered, extinct in the wild, or completely extinct.

Several authors have also demonstrated that sturgeon populations generally, and shortnose sturgeon populations in particular, are much more sensitive to adult mortality than other species of fish (Boreman 1997, Gross et al. 2002, Secor et al. 2002). These authors concluded that sturgeon populations cannot survive fishing-related mortalities that exceed five percent of an adult spawning run and they are vulnerable to declines and local extinction if juveniles die from fishing-related mortalities.

Using elasticity analysis, Gross et al. (2002) found that population growth in sturgeon is: (1) most sensitive to YOY and juvenile survival [on an age-specific basis]; (2) about equally sensitive to survival in the entire juvenile state and the entire adult stage; and (3) least sensitive to annual adult fecundity. The elasticity analysis by Gross et al. (2002) indicated that habitat improvements to increase survival of YOY, or any age-class within the juvenile life stage will make strong contributions to population growth. Conversely, habitat improvements that increase only fecundity or survival of a specific age-class, such as increased feeding opportunities for certain adults, will provide less of an increase in population growth (Gross et al. 2002).

Because a metapopulation is a population of populations, the stability, viability and persistence of individual populations affects the persistence and viability of the greater

metapopulation. The loss of any population will result in: (1) a long-term gap in the range of the species; (2) loss of reproducing individuals; (3) loss of genetic biodiversity; (4) potential loss of unique haplotypes; (5) potential loss of adaptive traits; (6) reduction in total number; and (7) potential for loss of population source of recruits. In turn, the loss of populations will negatively impact the persistence and viability of both the metapopulation and the species as a whole.

Metapopulation persistence depends on the balance of extinction and colonization in a static environment (Hanski 1999). Models and empirical observations suggest that very small populations are relatively likely to become extinct (Soule 1986, Lande 1988, Simberloff 1988, Thomas 1990, Kindvall and Alhlen 1992), and many local populations in remnant habitat fragments will remain small. Under the assumption that the environment does not change greatly, many empirical studies have shown that the expected lifetime of a population increases with its current size (Williamson 1981, Diamond 1984). However, for rare and declining species, Thomas (1994) argues that: (1) extinction is usually the deterministic consequence of the local environment becoming unsuitable (through habitat loss or modification, introduction of a predator, etc.); (2) that the local environment usually remains unsuitable following local extinction, so extinctions only rarely generate empty patches of suitable habitat; and (3) that colonization usually follows improvement of the local environment for a particular species. Therefore, if habitat remains suitable following local extirpation, recolonization via immigrants into now-empty habitat may replace at least some of those losses (Thomas 1994). However, if the cause of extinction is a deterministic population response to unsuitable conditions, the local habitat is likely to remain unsuitable after extinction and be unavailable for recolonization (Thomas 1994). Therefore, recolonization is dependent upon both immigration and habitat suitability.

It has been established that the relationship between migration rate and population size strongly affect the dynamics of a metapopulation (Saether et al. 1998). In non-territorial animals, like the sturgeon, emigration of recruits is positively density-dependent. That is, larger populations have more emigration. Density-dependent migration strongly influences both the establishment and rescue effects in the local dynamics of metapopulations (Saether et al. 1998). In contrast, the dispersal rate decreases with increasing density in many territorial mammals (see examples in Diffendorfer1998).

The distribution of populations within a metapopulation is determined by habitat availability. Commonly the habitat within the geographic range of a metapopulation can be divided into suitable and unsuitable parts. In heterogeneous landscapes, persistence of a population is determined by dispersal ability as animals must traverse unsuitable habitat when moving between patches of suitable habitat. Usually, dispersal rates are determined by observed movement of tagged individuals. Generally, more individuals move short distances while a few individuals move longer distances. The probability of recolonization within a metapopulation decreases with increasing distances from existing local populations (Hanski 1999).

Regional persistence of a species is dependent on the existence of a metapopulation. Hence, elimination of much of the metapopulation increases the probability of regional extinction of the species. Persistence of a metapopulation depends on probability of recolonization (Hanski and Simberloff 1997) and dictates the viability of populations and, in turn, the metapopulation. Immigrants must be present, within dispersal distance of available appropriate habitat. If appropriate habitat is not available, immigrants may disperse into the area but will not survive. If local immigrants disperse into the patch and appropriate habitat is available, then inter-population emigration can rescue a population from extinction (called the rescue effect). If nearby recruits are scarce and the linear distance to the nearest reproducing population exceeds normal dispersal rates, immigration will not occur regardless of habitat availability. Regional stability of the metapopulation is strengthened as individuals disperse to recolonize empty patches with appropriate habitat.

The status of the Southern metapopulation of shortnose sturgeon is mixed. The Altamaha River supports the largest known population with successful self-sustaining recruitment. Spawning is also occurring in the Savannah River, the Cooper River, the Congaree River, and the Great Pee Dee River. The Savannah River is facing many environmental stressors and the current spawning is limited to a small area. While active spawning is occurring in South Carolina's Winyah Bay complex (Black, Sampit, Pee Dee and Waccamaw Rivers) the population status is unknown. Status of the other riverine populations supporting the Southern metapopulation is unknown due to limited survey, with capture in some rivers limited to less than five specimens.

The persistence of a species is dependent on the existence of metapopulations. The three metapopulations of shortnose sturgeon should not be considered collectively but as individual units of management. Each of these three shortnose sturgeon metapopulations is reproductively isolated from the other and therefore, constitutes an evolutionary (and likely an adaptively) significant lineage. The loss of any metapopulation would result in the loss of evolutionarily significant biodiversity and would result in a significant gap(s) in the species' range. Loss of the Southern shortnose sturgeon metapopulation would result in the loss of the southern half of the species' range (i.e., no known reproduction south of the Delaware River). Loss of the Mid-Atlantic metapopulation (Virginian Province) would create a conspicuous discontinuity in the range of the species from the Hudson River to the northern extent of the Southern metapopulation. The Northern metapopulation constitutes the northernmost portion of the U.S. range. Loss of this metapopulation would result in a significant gap in the range that would serve to isolate the shortnose sturgeon residing in Canada from the remainder of the species' range in the United States. The loss of any metapopulation would result in a decrease in spatial range, biodiversity, unique haplotypes, adaptations to climate change, and gene plasticity. Loss of unique haplotypes that may carry geographic specific adaptations would lead to a loss of genetic plasticity and, in turn, decrease adaptability. Two metapopulations would be more vulnerable to recover from stochastic events than three; the loss of any metapopulation would increase species' vulnerability to stochastic events.

Threats
As noted in the shortnose sturgeon recovery plan, habitat degradation or loss (resulting from dams, bridge construction, channel dredging, and pollutant discharges), and mortality (from impingement on cooling water intake screens, dredging, and incidental capture in other fisheries) are principal threats to the species' survival.

A shortnose sturgeon population segment will remain listed as long as there is: 1) present or threatened destruction, modification, or curtailment of its habitat or range; 2) overutilization for commercial, recreational, scientific or educational purposes; 3) disease or predation; 4) inadequate existing regulatory mechanisms; or 5) other natural or anthropogenic factors affecting their continued existence (ESA, 1973).

Summary of Status of Shortnose Sturgeon
The shortnose sturgeon is a freshwater amphidromous fish inhabiting large coastal rivers along the eastern seaboard of North America from the Saint John River in New Brunswick, Canada, south to the St. Johns River in Florida. Clinal differences in growth and behavior are obvious for shortnose sturgeon: fish in the north grow slower but reach larger size, timing of spawning migration is earlier in the south, etc. Genetic analysis has indicated that population structure occurs across the range of shortnose sturgeon: at least two or perhaps three metapopulations of shortnose sturgeon exist. Within a metapopulation, individual populations interact at some level via movement, but not effectively (i.e., reproduction). Shortnose sturgeon from North Carolina south through Florida are part of a single metapopulation, the Southern (or, "Carolinian Province") metapopulation. There are markedly fewer shortnose sturgeon in the southern United States compared to the north. No recent population trend data exist.

3.4.9 Status of the Atlantic Sturgeon

Listing
Five separate distinct population segments (DPS) of the Atlantic sturgeon (*A. oxyrinchus oxyrinchus*) (Figure 20) were proposed for ESA listing by NMFS on October 6, 2010: from north to south these DPS groupings are the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic (75 FR 61872 and 61904) (Figure 21). The South Atlantic DPS is estimated to number less than 6 percent of its historical population size (ASSRT 2007), with all river populations except the Altamaha estimated to be less than 1 percent of historical abundance. Prior to 1890, Secor (2002) estimated there were 8,000 adult spawning females in South Carolina and 11,000 adult spawning females in Georgia. Currently, there are an estimated 343 spawning adults in the Altamaha and less than 300 spawning adults (total of both sexes) in each of the other major river systems occupied by the DPS, whose freshwater range occurs in the watersheds of the ACE Basin in South Carolina to the St. Johns River, Florida. The South Atlantic DPS was proposed for listing as endangered under the ESA as a result of a combination of habitat curtailment and alteration, overutilization in commercial fisheries, and inadequacy of regulatory mechanisms in ameliorating these threats and impacts. This represents NMFS' conference opinion on the South Atlantic DPS of Atlantic sturgeon.

Figure 20. Atlantic sturgeon

Range

The range of the South Atlantic DPS includes fish that spawn in the watersheds from the Ashepoo, Combahee, and Edisto Rivers (ACE Basin) in South Carolina, southward to the Satilla River in Georgia (Table 3). Sturgeon are still found within the St. Johns River in Florida, but this river is now believed to only serve as a nursery. The marine range of Atlantic sturgeon from the South Atlantic DPS extends from the Bay of Fundy, Canada, to the St. Johns River, Florida. While sturgeon are commonly captured 40 miles offshore (D. Fox, DSU, pers. comm.), the offshore range of Atlantic sturgeon is best investigated through fishery bycatch records that record data by depth rather than distance offshore. The vast majority of Atlantic sturgeon bycatch via gillnets is observed in waters shoal of 50 fathoms, but Atlantic sturgeon are recorded as bycatch out to 500 fathoms.

River/Estuary	Reproduction	Source
Ashepoo River, SC	Uncertain,	NMFS 2010
Combahee River, SC	Spawning, YOY	NMFS 2010
Edisto River, SC	Spawning, YOY	NMFS 2010
Savannah River, GA/SC	Spawning, YOY	NMFS 2010
Ogeechee River, GA	Spawning, YOY	NMFS 2010
Altamaha River, GA	Spawning, YOY	NMFS 2010
Satilla River, GA	Spawning, YOY	NMFS 2010
St. Johns River, FL	Uncertain	NMFS 2010

Table 3. List of rivers in the southeast United States known to support Atlantic sturgeon that comprise the South Atlantic Distinct Population Segment.

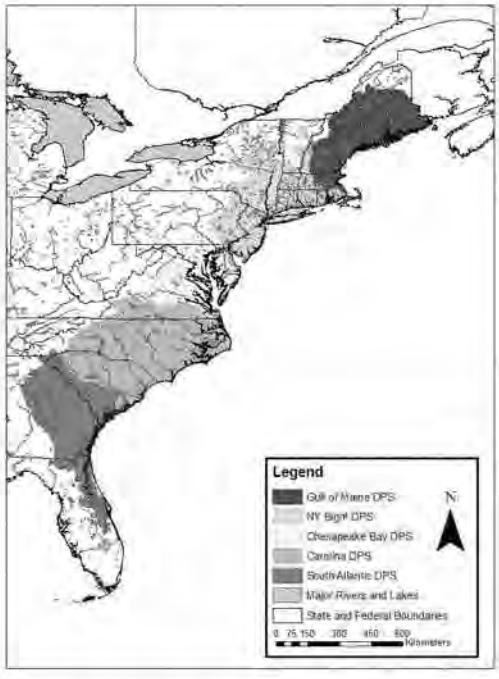


Figure 21. Map depicting the five Distinct Population Segments (DPSs) of Atlantic sturgeon: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic.

Life History

The scientific name for Atlantic sturgeon is *Acipenser oxyrinchus oxyrinchus*. *Acipenser* is Latin for sturgeon and *oxyrinchus* means sharp nose. Mitchell originally described the species from a New York specimen in 1815.

Although specifics vary across latitude, the general life history pattern of Atlantic sturgeon is that of a long-lived, late maturing, estuarine dependent, anadromous species. Atlantic sturgeon reach lengths up to 4.3 m and weigh over 363 kg. Atlantic sturgeon have been aged to 60 years (Mangin 1964); however, this should be taken as an approximation, as the only age validation study conducted to date shows variations of ±5 years (Stevenson and Secor 1999). Scott and Crossman (1973) report maximum age for the species as 30. Juvenile Atlantic sturgeon often resemble adult shortnose sturgeon; the species are sympatric. Atlantic sturgeon are distinguished by armor-like plates (scutes) and the presence of two sets of barbels below their long, sharply V-shaped snout, located in a transverse line midway between the end of the snout and the anterior edge of the protruding mouth. Coloration varies but adult Atlantic sturgeon are generally dark

bluish-black in color dorsally and lighter ventrally (white or yellow in color below lateral scutes).

Sturgeon are omnivorous benthic feeders (feed off the bottom) and filter quantities of mud along with their food. Adult sturgeon diets include mollusks, gastropods, amphipods, isopods, and fish. Juvenile sturgeon feed on aquatic insects and other invertebrates (ASSRT 2007). A recent investigation by Collins et al. (2006) indicated that sub-adult Atlantic sturgeon in both the Edisto and Savannah Rivers foraged mostly on invertebrates with a high percentage of amphipods and polychaetes. Although prey and foraging habitat overlap, Atlantic and shortnose sturgeon are not thought to compete for the same food items, as Atlantic sturgeon diet is more generalized comprised of invertebrates, and shortnose sturgeon having a more specialized diet of amphipods (Collins et al. 2006). In marine waters, Atlantic sturgeon feed on mollusks, polychaete worms, gastropods, shrimps, amphipods, isopods, and small fish (Scott and Crossman 1973). The presence of food in the stomachs of large (>1.25 m FL) Atlantic sturgeon captured in the Edisto and Savannah Rivers demonstrates that these fish do not fast while in freshwater as previously believed (Collins et al. 2006).

Atlantic sturgeon migrate seasonally between upstream freshwater spawning habitat, estuarine nursery habitat, and marine foraging habitat. Atlantic sturgeon likely do not spawn every year. Multiple studies have shown that spawning intervals range from 1–5 years for males (Smith 1985, Collins et al. 2000a, Caron et al. 2002) and 2–5 years for females (Vladykov and Greeley 1963, Van Eenennaam et al. 1996, Stevenson and Secor 1999). Sexual maturity varies across latitude, with faster growth and earlier age at maturation in southern rivers compared to northern. Atlantic sturgeon mature in South Carolina at 5–19 years (Smith et al. 1982), in the Hudson River at 11–21 years (Young et al. 1988), and in the Saint Lawrence River at 22–34 years (Scott and Crossman 1973). Thirty-nine adult Atlantic sturgeon were sexed in the Combahee and Edisto Rivers, South Carolina: females ranged between 180-234 cm TL and were aged 15-20 years; males ranged between 139-195 cm TL and were aged 7-15 years (Collins et al. 2000b).

To spawn, adult Atlantic sturgeon move from the sea to the estuary as the river water temperatures warm. This occurs earlier in southern rivers than in northern rivers. Atlantic sturgeon are known to return to their natal river to spawn as indicated from both tagging records (Collins et al. 2000b, K. Hattala, NYSDEC, pers. comm.) and the relatively low rates of gene flow indicated by population genetics studies (King et al. 2001, Waldman et al. 2002). During non-spawning years, adults use marine waters either year-round or seasonally (Bain 1997) and do not migrate upstream to the spawning areas.

Upstream migration to the spawning grounds is cued primarily by water temperature and velocity and therefore fish in the southern portion of the range migrate earlier than those to the north (Smith 1985, Kieffer and Kynard 1993). In Georgia and South Carolina, this begins in February or March (Collins et al. 2000b). Males commence upstream migration to the spawning sites when waters reach around 6°C (Smith et al. 1982, Dovel and Berggren 1983, Smith 1985) with females following a few weeks later when water temperatures are closer to 12°C or 13°C (Dovel and Berggren 1983, Smith 1985, Collins

et al. 2000b). In some rivers, predominantly in the south, a fall spawning migration may also occur (Rogers and Weber 1995, Moser et al. 1998) with running ripe males found August through October and spent females captured in late September and October (Collins et al. 2000a).

Atlantic sturgeon spawning behavior is also gender specific. Spawning females do not migrate upstream together as a group; rather, individual females make rapid spawning migrations upstream and quickly depart the area following spawning (Bain 1997). Spawning males appear to move upstream on incoming tides and then remain stationary for several hours (Dovel and Berggren 1983), meander back and forth across the channel remaining in water depth greater than 7.6 m, and usually arrive on the spawning grounds before any of the females have arrived and leave after the last female has spawned (Bain 1997). Presumably, this provides an opportunity for a single male to fertilize eggs of multiple females.

Spawning is believed to occur in flowing water between the salt front of estuaries and the fall line of large rivers, upstream to at least rkm 100, where optimal flows are 46–76 cm/s and depths are 11–27 m (Scott and Crossman 1973, Bain et al. 2000). Sturgeon eggs are highly adhesive and are deposited on the benthos, usually on hard substrates such as cobble (Gilbert 1989, Smith and Clugston 1997). Fecundity of female Atlantic sturgeon has been correlated with age and body size, with observed egg production ranging from 400,000 to 4 million eggs per spawning year (Smith et al. 1982, Van Eenennaam et al. 1996). The average age at which 50 percent of the maximum lifetime egg production is achieved is estimated to be 29 years (Boreman 1997).

Atlantic sturgeon eggs must be spawned upstream of the salt front due to their low tolerance for saline environments (Van Eenennaam et al. 1996). Atlantic sturgeon eggs have a low salt tolerance, with mortality documented at salinities as low as 5 to 10 ppt (McEnroe and Check 1985, Jenkins et al. 1993). After spawning, most studies indicate adult Atlantic sturgeon migrate to salt water (Vladykov and Greeley 1963), with down-estuary migrations occurring up to several months (Bain 1997), likely initiated by a combination of increased flow and temperature (Kieffer and Kynard 1993).

Eggs hatch approximately 94-140 hrs after fertilization and, once hatched, larvae assume a demersal existence (Smith et al. 1980). The yolksac larval stage is completed in about 8–12 days. Newly hatched larvae are active swimmers and, once the yolk sac is absorbed, the larvae exhibit benthic behavior (Smith et al. 1980) and initiate downstream movement (Kynard and Horgan 2002). Downstream larval migration is diel; larvae move only at night and use benthic structure (e.g., gravel matrix) as refuge during the day (Kynard and Horgan 2002). As the larvae mature, downstream movement occurs during both day and night. Larvae transition into the juvenile phase as they continue to move downstream into brackish waters, developing salinity tolerance with maturity. Juveniles eventually become residents in estuarine waters for months to years before migrating to open ocean as subadults (Dovel and Berggren 1983, ASSRT 2007, Schueller and Peterson 2010).

Juvenile Atlantic sturgeon eventually join adults in the upper estuarine habitat where they frequently congregate around the saltwater interface. Both of these life stages may travel short distances upstream and downstream throughout the summer and fall, and during late winter and spring spawning periods (Greene et al. 2009), between fresh and brackish waters, influenced by changes in water temperature (Van Den Avyle 1984) as they seek the cooler waters and avoid shallow areas with the highest water temperature (Bain 1997). These estuarine habitats are important for juveniles as they serve as a nursery area by providing abundant foraging opportunities, and thermal and salinity refuges while undergoing rapid growth. Some juveniles will take up residency in non-natal rivers that lack active spawning sites (Bain 1997). Residency time of these young Atlantic sturgeon in the estuarine areas varies between one (Secor et al. 2000b), three (Schueller and Peterson 2010), and six (Smith 1985) years before commencing outmigration to sea. Outmigration of adults from the estuaries out to the sea is cued by water temperature and velocity. Adult Atlantic sturgeon will then reside in the marine habitat during the non-spawning season and forage extensively. Coastal migrations by adult Atlantic sturgeon are extensive and are known to occur over sand and gravel substrate (Greene et al. 2009). Atlantic sturgeon remain in the marine habitat until the waters begin to warm, at which time developing adults migrate back to their rivers.

Few diet studies have been conducted on the Atlantic sturgeon. A recent investigation by Collins et al. (2006) indicated that sub-adult Atlantic sturgeon in both the Edisto and Savannah Rivers foraged mostly on invertebrates, with a high percentage of amphipods and polychaetes. In marine waters, Atlantic sturgeon feed on mollusks, polychaete worms, gastropods, shrimps, amphipods, isopods, and small fish (Scott and Crossman 1973). The presence of food in the stomachs of large Atlantic sturgeon sampled in freshwater river systems demonstrates that fish do not fast while in freshwater, as previously believed (Collins et al. 2006).

Distinct Population Segment Viability

The viability of sturgeon population growth is particularly sensitive to mortality, given their long lived, slow growing, and relatively low stock productivity. Because a DPS is a group of populations, the stability, viability, and persistence of individual populations affects the persistence and viability of the larger DPS. The loss of any population within a DPS will result in: (1) a long-term gap in the range of the DPS that is unlikely to be recolonized; (2) loss of reproducing individuals; (3) loss of genetic biodiversity; (4) potential loss of unique haplotypes; (5) potential loss of adaptive traits; and (6) reduction in total number. The loss of a population will negatively impact the persistence and viability of the DPS as a whole, as fewer than two individuals per generation spawn outside their natal rivers (Secor and Waldman 1999). The persistence of individual populations, and in turn the DPS, depends on successful spawning and rearing within the freshwater habitat, the immigration into marine habitats to grow, and then the return of adults to natal rivers to spawn.

The riverine spawning habitat of the South Atlantic population segment occurs within the South Atlantic Coastal Plain eco-region. TNC describes the South Atlantic Coastal Plain eco-region as fall-line sandhills to rolling longleaf pine uplands to wet pine flatwoods;

from small streams to large river systems to rich estuaries; from isolated depression wetlands to Carolina bays to the Okefenokee Swamp. Other ecological systems in the eco-region include maritime forests on barrier islands, pitcher plant seepage bogs and Altamaha grit (sandstone) outcrops. The primary threats to biological diversity in the South Atlantic Coastal Plain listed by TNC are intensive silvicultural practices, including conversion of natural forests to highly managed pine monocultures and the clear-cutting of bottomland hardwood forests. Changes in water quality and quantity, caused by hydrologic alterations (impoundments, groundwater withdrawal, and ditching), and point and nonpoint pollution, are threatening the aquatic systems. Development is a growing threat, especially in coastal areas. Agricultural conversion, fire regime alteration, and the introduction of nonnative species are additional threats to the eco-region's diversity. The South Atlantic DPS' spawning rivers, located in the South Atlantic Coastal Plain, are primarily of two types: brownwater (with headwaters north of the Fall Line, silt-laden) and blackwater (with headwaters in the coastal plain, stained by tannic acids). Therefore, the eco-region delineations support that the physical and chemical properties of the Atlantic sturgeon spawning rivers utilized by the South Atlantic DPSs are unique to the population segment. Since reproductive isolation accounts for the discreteness of each population segment, the South Atlantic population segment of Atlantic sturgeon are "significant" as defined in the DPS policy given that the spawning rivers for each population segment occur in a unique ecological setting. The loss of the South Atlantic population segment of Atlantic sturgeon would create a significant gap in the range of the taxon.

The concept of a viable population able to adapt to changing environmental conditions is critical to Atlantic sturgeon, and the low population numbers of every river population in the South Atlantic DPS puts them in danger of extinction throughout their range; none of the populations are large or stable enough to provide with any level of certainty for continued existence of Atlantic sturgeon in this part of its range. The South Atlantic DPS is estimated to number less than 6 percent of its historical population size (ASSRT, 2007), with all river populations except the Altamaha estimated to be less than 1 percent of historical abundance. Prior to 1890, Secor (2002) estimated there were 8,000 adult spawning females in South Carolina and 11,000 adult spawning females in Georgia. Currently, there are an estimated 343 spawning adults in the Altamaha and less than 300 spawning adults (total of both sexes) in each of the other major river systems occupied by the DPS, whose freshwater range occurs in the watersheds of the ACE Basin in South Carolina to the St. Johns River, Florida.

Their late age at maturity provides more opportunities for individual Atlantic sturgeon to be removed from the population before reproducing. While a long life-span allows multiple opportunities to contribute to future generations, it also increases the timeframe over which exposure to the multitude of threats facing the South Atlantic DPS can occur. These threats include the loss, reduction, and degradation of habitat resulting from dams, dredging, and changes in water quality parameters (such as depth, temperature, velocity, and dissolved oxygen).

Threats
Atlantic sturgeon throughout the South Atlantic DPS are exposed to a variety of habitat threats including: restricted access to riverine habitat; large portions of degraded habitat, which may result in high levels of tissue contamination and water quality standards that are below fish health standards; and/or poor quality of some benthic habitat. Without substantial mitigation and management to improve the habitat and water quality of these systems, Atlantic sturgeon subpopulations will likely continue to be depressed until suitable habitat and water quality conditions are achieved. This is evident in southern streams that are suspected to no longer support reproducing Atlantic sturgeon subpopulations, such as the St. Mary's and St. Johns rivers. Although these rivers are at the southern range of the species, the degradation of habitat via dredging and water pollution likely prohibit Atlantic sturgeon from recolonizing these systems. The recovery of Atlantic sturgeon along the Atlantic Coast, especially in areas where habitat and water quality is severely degraded, will require improvements in the following areas: 1) elimination of barriers to spawning habitat either through dam removal, breaching, or installation of successful fish passage facilities; 2) operation of water control structures to provide flows compatible with Atlantic sturgeon use in the lower portions of rivers (especially during the spawning season); 3) imposition of restrictions on dredging, including seasonal restrictions and avoidance of spawning/nursery habitat; and 4) mitigation of water quality parameters that are restricting sturgeon use of a river (i.e., dissolved oxygen). Additional data regarding sturgeon use of riverine and estuarine environments is needed.

The Atlantic sturgeon recovery team (SRT) evaluated the status of Atlantic sturgeon using the five-factor analysis described in section 4(a)(1) of the ESA. The SRT identified 15 stressors within these five factors and summarized their impacts on Atlantic sturgeon using a semi-quantitative extinction risk analysis (ERA), similar to that used by other status review reports (e.g. *Acropora*). Of the stressors evaluated, bycatch mortality, water quality, lack of adequate state and/or Federal regulatory mechanisms, and dredging activities were identified as the most significant threats to the viability of Atlantic sturgeon populations.

A review of the literature and potential threats to South Atlantic DPS revealed that dredging, water quality, and commercial bycatch were ranked as the greatest threats to the South Atlantic DPS - receiving ERA scores of 3 or moderate risk (<50% chance of becoming endangered over the next 20 years). While the median value associated with the risk for the DPS was moderate and did not meet the threshold of >50% chance of becoming endangered, the team recognized that three of the eight historic subpopulations are likely extirpated and data is lacking for many of the other subpopulations. As a result, the SRT determined that available science was insufficient to allow a full assessment of these subpopulations within the South Atlantic DPS.

Summary of the Status of Atlantic Sturgeon
The Atlantic sturgeon is an anadromous species inhabiting large coastal rivers along the Eastern seaboard of North America from the Saint John River in New Brunswick, Canada south to the St. Johns River in Florida. Clinal differences in growth and behavior are

obvious for Atlantic sturgeon: fish in the north grow slower, but reach larger size; timing of spawning migration is earlier in the south; etc. Genetic analysis has indicated that population structure occurs across the range of Atlantic sturgeon. Atlantic sturgeon between the Ashepoo, Combahee, and Edisto Rivers (ACE Basin) in South Carolina, southward to the Satilla River in Georgia, constitute the South Atlantic DPS that was proposed for ESA listing as endangered (75 FR 61904). The marine range of the Atlantic sturgeon South Atlantic DPS extends from the Bay of Fundy, Canada, to the St. Johns River, Florida.

3.4.10 Sturgeon Habitat Use and Requirements

Shortnose and Atlantic sturgeon habitat requirements are ontogenetic and clinal: water temperature, dissolved oxygen concentration, and water depth requirements change as they mature and vary across latitudes. Shortnose and Atlantic sturgeon require appropriate habitat throughout their life cycle. Atlantic sturgeon are anadromous and shortnose sturgeon are freshwater amphidromous, which means they differ mostly in their use of salt water habitat: while both shortnose and Atlantic sturgeon utilize freshwater systems extensively, only adult Atlantic sturgeon extensively utilize saltwater habitat, compared to shortnose sturgeon who rarely leave natal rivers/estuaries. Adult Atlantic sturgeon are generally present in southern rivers between February and October; they outmigrate and reside in the ocean during winter months and later return to spawn in their natal rivers. In contrast, shortnose sturgeon remain in the river system throughout their lives, only periodically utilizing saline water in the river's estuary (Buckley and Kynard 1985b, Kieffer and Kynard 1993); a few have been known to occasionally migrate short distances to a nearby river.

In free-flowing rivers, adults of both species migrate annually between upstream spawning areas and then downstream to estuarine areas. Within the project area, the New Savannah Bluff Lock and Dam blocks access to the majority of historical sturgeon spawning habitat. Apart from the spawning period, both species spend most of the time moving between fresh and brackish water areas to forage, or avoid high water temperatures.

Winter/Spawning
Water temperature cues sturgeon to initiate upstream movement to spawning sites. Therefore, upstream migration to spawning sites is earlier for sturgeon in southern rivers compared to the north. Both shortnose and Atlantic sturgeon spawning usually occurs during February and March in southern rivers. Because it is energetically expensive to migrate, non-mature and most non-spawning adults do not move upstream to spawn, rather they remain downstream year-round.

Male Atlantic sturgeon generally initiate upstream movement when waters reach about 6°C (Smith et al 1982, Dovel and Berggren 1983, Smith 1985) with females following when water temperatures are closer to 12°C or 13°C (Dovel and Berggren 1983, Smith 1985, Collins et al. 2000b). Atlantic sturgeon spawn in waters where temperatures range between 13°-26°C (Huff 1975, Smith 1985, Bain et al. 2000, Caron et al. 2002). Water

depth at spawning sites varies greatly and is dependent upon available depth range. Atlantic sturgeon have been reported to spawn in water depths from 3 to 27 m (Scott and Crossman 1973, Bain et al. 2000, Collins et al. 2000b, Caron et al. 2002). Benthic substrate at spawning sites must be hard bottom for successful egg attachment and incubation: these materials include silt-free boulder, bedrock, and cobble-gravel. These hard substrates often occur in the rapids complex with flowing water at velocities between 0.46 to 0.76 m/s. Ripe Atlantic sturgeon and shortnose sturgeon have also been found in the fall, indicating they may have a fall spawning run as indicated by histological examination of gonadal biopsies and directed upriver movements (Collins et al. 2000a).

Shortnose sturgeon have been documented to spawn when water temperatures range from 9°-15°C (Dadswell 1979, Taubert 1980, Kynard 1997, Collins et al. 2000a). Spawning sites have been found to consist of moderate river flows with average bottom velocities between 0.3 – 1.2 m/s (Buckley and Kynard 1985b, Hall et al. 1991, Kieffer and Kynard 1996, NMFS 1998). Water velocity is critical for sturgeon spawning; slow flow allows eggs to clump together while higher velocities may prevent eggs from adhering to the substrate (Taubert and Dadswell 1980, Buckley and Kynard 1985a, Kynard 1997). In populations that have free access to the total length of a river, shortnose sturgeon spawning areas are often located at the farthest accessible upstream reach of the river (Kynard 1997).

Shortnose and Atlantic sturgeon spawning usually occurs over gravel, rubble, and/or cobble or large rocks (Dadswell 1979, Taubert 1980, Buckley and Kynard 1985a, Kynard 1997), or timber, scoured clay and gravel (Hall et al. 1991). Shortnose sturgeon spawning sites have also been characterized as deep, scoured channels with hard substrates for eggs to adhere (Collins et al. 2000a). These sturgeon spawning areas are seemingly discrete, as fish return to specific areas over consecutive years (Kieffer and Kynard 1993).

Following spawning, downstream migration is quicker for spent shortnose sturgeon than spent Atlantic sturgeon. Shortnose move rapidly to downstream feeding areas (Dadswell et al. 1984, Buckley and Kynard 1985a, Kieffer and Kynard 1993, O'Herron et al. 1993, Collins and Smith 1993), while Atlantic sturgeon migration may occur over several months (Bain 1997). Kieffer and Kynard (1993) reported that post-spawning migrations of shortnose sturgeon were correlated with increasing spring water temperature and river discharge.

Few data are available describing the migratory pathways of shortnose and Atlantic sturgeon, as most data describe periodicity of sturgeon movement upstream or downstream but fail to describe habitat parameters such as depth or water temperature. Dovel and Berggren (1983) report migrating Atlantic sturgeon in depths greater than 7.6 meters. Migratory pathways of white sturgeon (*A. transmontanus*) are better described. Phylogenetically, shortnose sturgeon are very similar to white sturgeon (Birstein and Bemis 1997). Water depth is known to be a major factor to determine white sturgeon migratory pathways.

It has been noted that shortnose sturgeon will labor to migrate upstream during spawning season but will eventually abandon the migration and resorb eggs. Kynard (1998) noted the condition of shortnose sturgeon in shallow rapids as having severely worn and bleeding ventral scutes. Water depth is so important for spawning white sturgeon that it was identified as a primary constituent element of the Kootenai white sturgeon critical habitat (73 FR 39506, July 9, 2008).

Spring

Newly hatched sturgeon continue to migrate downstream in the spring to riverine rearing/nursery habitats where they join older juveniles. These young sturgeon require nursery habitats to grow and escape predation. Concentration areas of shortnose sturgeon are occupied year-round by mixed age individuals (Kynard et al. 2000). In both freshwater and estuarine environments, juvenile Atlantic sturgeon are widely dispersed (Schueller and Peterson 2010). Shortnose sturgeon larvae and juveniles have been reported from, and may prefer, deep river channels (Richmond and Kynard 1995) above the salt wedge. Bath et al. (1981) reported larvae occurring at depths of 9.1 – 9.8 m (29.9 - 32.1 feet) where water temperatures were 15.0 – 24.5 °C (59 - 76.1 °F), in salinities of approximately 0 – 22 parts per thousand (ppt).

Studies on the salinity exposure for shortnose sturgeon juveniles indicated that tolerance to increased salinity improved with age. Fish 76 days old experienced 100 percent mortality in a 96-hour test when exposed to salinities >15 ppt while 330-day-old fish tolerated salinities as high as 20 ppt for a duration of 18 hours but exhibited 100 percent mortality at 30 ppt. There is a large amount of variation in the salinity tolerance of juvenile Atlantic sturgeon, individual studies have observed salinity ranges between 0-16 ppt (Greene et al 2009). Younger fish were also more susceptible to low dissolved oxygen concentrations than older fish. In a 6-hour test, fish 64 days old exhibited 86 percent mortality when exposed to dissolved oxygen concentrations of 2.5 mg/liter. However, sturgeon >100 days old were able to tolerate concentrations of 2.5 mg/liter with <20 percent mortality (Jenkins 1993).

Adult shortnose sturgeon prefer lower salinity than pure seawater, typically in the range of 30 - 31 ppt (Holland and Yelverton 1973; Dadswell et al 1984). In areas where shortnose sturgeon occur with the Atlantic sturgeon, the two species apparently segregate the habitat according to salinity preferences, with Atlantic sturgeon preferring more saline areas. Gilbert (1990) suggested that though the shortnose sturgeon is capable of entering the open ocean, it is hesitant to do so. This factor may be the single largest consideration limiting extensive coastal migrations of this species.

Following spawning, both shortnose and Atlantic sturgeon begin foraging. Specific diet items of the shortnose and Atlantic sturgeon were discussed previously (Sections 3.4.3 and 3.4.4, respectively). Both species rely on sandy substrate that supports benthic invertebrates. Foraging occurs over three seasons that vary across latitude, apparently determined by extremes in water temperature and the need to reduce energetic expenditure. Kynard et al. (2000) found distinct seasonal shifts reflected in both foraging

activity and habitat change, with change in water temperature. Sturgeon will forage when water temperatures are optimal and find resting habitat when water temperatures become extreme. Therefore, in southern rivers sturgeon are foraging in the fall, winter, and spring and resting in the summer; and in the north they are foraging in spring, summer, and fall.

Shortnose sturgeon in Massachusetts distinctly shifted from summer foraging to fall/wintering resting (Kynard et al. 2000). To minimize energetic expenditure during the extreme cool winter water temperatures, shortnose sturgeon were not actively foraging and selected deep, slow water to minimize swimming while holding position (Kynard et al. 2000). Within southern rivers, that includes the Project area, shortnose sturgeon are known to forage widely throughout the estuary during the fall, winter, and spring (Collins and Smith 1993, Weber et al. 1999), and then significantly reduce or cease foraging completely in the summer as they take refuge from high water temperatures by congregating in cool, deep areas of the river (Flourney et al. 1992, Rogers and Weber 1994, Rogers and Weber 1995, Weber 1996). Both water depth and current velocity have been found to be important in selecting these resting areas, as both Atlantic and shortnose sturgeon have been found to select deeper, slow water during their periods of resting.

Summer

The fresh-brackish water interface area serves as the summer habitat for juvenile Atlantic sturgeon and all ages of shortnose sturgeon in the Southeast (Hall et al. 1991, Flourney et al. 1992, Smith et al. 1992, McCord 1998, Collins et al. 2000b). Juvenile shortnose sturgeon regularly move throughout the saline portions (0-16 ppt) of the salt wedge during summer (Pottle and Dadswell 1979, Weber 1996) and are more active when water temperatures are cooler (<16°C) (Weber 1996). Juveniles have been found congregating in deeper sand/mud substrate in depths of 10-14 m (Hall et al. 1991). As mentioned above, studies on the salinity exposure for shortnose sturgeon juveniles indicated that tolerance to increased salinity improved with age. Fish 76 days old experienced 100 percent mortality in a 96-hour test when exposed to salinities >15 ppt while 330-day-old fish tolerated salinities as high as 20 ppt for a duration of 18 hours but exhibited 100 percent mortality at 30 ppt (Jenkins 1993). Adult shortnose sturgeon prefer lower salinity than pure seawater, typically in the range of 23 - 30 ppt (Collins et al. 2001). Adult Atlantic sturgeon in South Carolina were found to utilize a wide variety of habitats in the summer, with salinities ranging between 0 and 28 ppt, dissolved oxygen between 3.4-8.3 mg/Liter, water temperatures as high as 33.1°C, and in substrates including fine mud, sand, pebbles and shell hash (Collins et al. 2000b). Adult Atlantic sturgeon were located through the summer in depths between 1.5 -13.0 m; however, in nearly all cases fish were in the greatest depth available in the immediate area (Collins et al. 2000b).

Considerable work has been conducted on temperature tolerances of sturgeon (Kynard 1997, Campbell and Goodman 2004, Van Eenennaam et al. 2005, Ziegweid et al. 2008). In recent work on critical thermal maximum, Ziegweid et al. (2008b) demonstrated hatchery–raised YOY shortnose sturgeon can tolerate between 28°-31°C. Kynard (1997) also notes empirical temperatures of 28°-30°C in summer months created unsuitable shortnose sturgeon habitat. Atlantic sturgeon experience lower survival when water

temperatures exceed 28°C (Niklitshek and Secor 2005). Summer water temperatures in southern estuaries commonly approach, and sometimes exceed, the maximum tolerable levels identified in the laboratory.

Temperatures in excess of 28°C are considered to have sub-lethal effects on Atlantic sturgeon (Niklitschek and Secor 2005). This low tolerance to temperature and low oxygen is of particular concern during the first two summers when juvenile Atlantic sturgeon are restricted to lower saline waters and are unable to seek out thermal refuge in deeper waters (Secor and Gunderson 1998, Niklitschek 2001, Niklitschek and Secor 2005). Juveniles have been reported in depths between 2-37 m, and water temperatures between 0.5°-27°C (Greene 2009). Summer habitats of Atlantic sturgeon in the Altamaha River were typically in the mid-channel where water temperatures varied between 25.4°-29.5°C (Peterson et al. 2006).

Because warm water holds less dissolved oxygen , high water temperatures coupled with low dissolved oxygen concentrations are known to have synergistic effects and lead to mortality of both shortnose and Atlantic sturgeon; this affects southern populations to a greater extent than those to the north, particularly in the summer months (Collins et al. 2000b). Effects of low dissolved oxygen vary with sturgeon age. Shortnose sturgeon less than 78 days old had 80 percent mortality when exposed to dissolved oxygen at 2.5 mg/Liter and 18-38 percent mortality at 3.0 mg/Liter. Slightly older fish experienced minimal mortality at nominal levels >2.5 mg/Liter; mortality at 2.0 mg/Liter increased to 24-38 percent. Young-of-the-year shortnose sturgeon experienced 96 percent mortality rate within 4 hours after exposure to dissolved oxygen levels ranging from 2.2 mg/Liter to 3.1 mg/Liter (Campbell and Goodman 2004). Bioenergetic and behavioral responses indicate that habitat for YOY (~30 to 200 days old) becomes unavailable with less than 60 percent saturation (Secor and Niklitschek 2001); this occurs at summertime temperatures of 22°-27°C with dissolved oxygen of 4.3-4.7 mg/Liter. Although tolerance for low dissolved oxygen increased with age, Flourney et al. (1992) reported physiological stress to adult sturgeon during periods of high water temperature and low dissolved oxygen levels.

Sensitivity of sturgeon and other fishes to temperature, oxygen, and their interaction has been evaluated experimentally through respirometry. Critical oxygen concentration is determined by melding the metabolic response curve to required dissolved oxygen concentration: oxygen levels below that point will constrain metabolism, growth, and swimming activity. As basal metabolism of fishes increases with water temperature, the critical concentration becomes higher and demand outpaces availability. At very low oxygen concentrations, metabolism decreases rapidly and the fish dies; this is termed threshold concentration. Both critical and threshold concentrations are substantially higher for sturgeons in comparison to freshwater fishes.

In comparison to other fishes, sturgeon are more sensitive to low dissolved oxygen conditions. Sturgeons have limited behavioral and physiological capacity to respond to hypoxia (multiple references reviewed and cited by Secor and Niklitschek 2001 and 2003). Their basal metabolism, growth, consumption, and survival are all very sensitive

to changes in oxygen levels, which may indicate their relatively poor ability to oxyregulate (EPA 2003). In summer, the coupling of low dissolved oxygen and water temperatures greater than 20°C amplify the effect of hypoxia on sturgeon and other fishes due to a temperature-oxygen habitat squeeze (Coutant 1987). Sturgeon often seek the temperatures they prefer in deeper waters, but those deeper waters may also occasionally have dissolved oxygen levels below the minimum required. In these instances, sturgeon may avoid the unsuitable areas and may be forced to occupy constricted habitats.

Jenkins et al. (1993) examined environmental tolerance of dissolved oxygen on shortnose sturgeon and found that younger fish were differentially susceptible to low oxygen levels in comparison to older juveniles. Shortnose sturgeon older than 77 days experienced minimal mortality at nominal levels >2.5 mg/Liter; mortality at 2.0 mg/Liter increased to 24-38 percent. Dissolved oxygen at 3.0 mg/Liter resulted in 18-38 percent mortality of fish less than 78 days old, increasing to 80 percent at 2.5 mg/Liter.

More rigorous testing using YOY shortnose sturgeon (77-134 days old) coupling temperature and dissolved oxygen values also found a high degree of sensitivity to low dissolved oxygen in acute tests at low salinities (Campbell and Goodman 2004). YOY shortnose sturgeon exposed to dissolved oxygen levels ranging from 2.2 mg/Liter to 3.1 mg/Liter experienced a mortality rate of 96 percent within 4 hours of exposure. Seventy-seven day old shortnose sturgeon had an estimated median lethal concentration (LC_{50}) at 2.7 mg/Liter at 25°C (Campbell and Goodman 2004); an LC_{50} of 2.2 mg/Liter was found for fish 104 and 134 days old at temperatures of 21.8° to 26.4°C. One-hundred-day-old fish exposed to 29°C were most sensitive to low dissolved oxygen, yielding a LC_{50} of 3.1 mg/Liter (Campbell and Goodman 2004).

Niklitschek (2001) observed poor survival of both shortnose and Atlantic sturgeon at dissolved oxygen concentrations of 40 percent versus 70 percent saturation, with the effects being conditional on temperature. The proportion of energy allocated to growth also decreased as dissolved oxygen concentration varied from normal. Bioenergetic and behavioral responses indicate that habitat for YOY (~30 to 200 days old) becomes unavailable with less than 60 percent saturation (Secor and Niklitschek 2001); this occurs at summertime temperatures of 22°-27°C with dissolved oxygen of 4.3-4.7 mg/Liter.

Laboratory experiments with YOY cultured shortnose sturgeon indicated thermal tolerances were significantly altered by temperature (Ziegeweid et al. 2008b). Fish activity increased with temperature, and at about 5°-6°C prior to lethal endpoint, fish began frantically swimming around the tank, then lost equilibrium as activity level decreased dramatically, and at about 0.3°C before lethal endpoint, most fish were completely incapacitated (Ziegeweid et al. 2008a).

Sub-lethal effects of low dissolved oxygen include impacted growth, metabolism, and foraging; a concurrent increase in water temperature amplifies effects of low dissolved oxygen. Laboratory results indicate that at water temperatures of 20°C and 40 percent saturation (i.e., 3.3 mg/Liter), effects to shortnose sturgeon included a reduction in growth by about 30 percent; a reduction in consumption by about 28 percent, and a

reduction in routine metabolism by about 20 percent (Niklitschek 2001). While keeping saturation constant at 40 percent and increasing temperature to 27°C (corresponding to 2.9 mg/Liter), growth was further reduced by 69 percent, consumption by 45 percent, and routine metabolism by 21 percent (Niklitschek 2001). Because the Niklitschek (2001) investigation reported routine rather than basal metabolism, estimates of critical concentrations are not available. In a separate laboratory study using Atlantic sturgeon, Secor and Gunderson (1998) reported about a 3-fold reduction in growth rate due to hypoxia at 26° compared to 19°C.

Beyond metabolic response, sturgeons undertake other physiological and behavioral responses to hypoxia. Signs of stress observed in shortnose sturgeon exposed to low dissolved oxygen included reduced swimming and feeding activity, coupled with increased ventilation frequency (Campbell and Goodman 2004). Niklitschek (2001) observed that egestion levels for Atlantic and shortnose sturgeon juveniles increased significantly under hypoxia, indicating that consumed food was incompletely digested. Behavioral studies indicate that Atlantic and shortnose sturgeon are quite sensitive to ambient conditions of oxygen and temperature. In choice experiments, juvenile sturgeons consistently selected normoxic over hypoxic conditions (Niklitschek 2001). Beyond escape or avoidance, sturgeons respond to hypoxia through increased ventilation, increased surfacing (to ventilate relatively oxygen-rich surficial water), and decreased swimming and routine metabolism (Nonnette et al. 1993, Crocker and Cech 1997, Secor and Gunderson 1998, Niklitschek 2001).

NMFS has identified and established safe environmental limits for capturing and handling sturgeon species (Kahn and Mohead 2010) and recommends that Atlantic and shortnose sturgeon not be captured or handled when dissolved oxygen concentrations are below 4.5mg/Liter or when water temperatures exceed 28°C.

To compensate for these habitat conditions, shortnose sturgeon throughout the Southeast are known to take refuge by congregating in cool, deep areas of rivers as water temperatures increase (i.e., 22°-27°C) through the summer (Flournoy et al. 1992, Rogers and Weber 1994, Rogers and Weber 1995, Weber 1996, DeVries 2006). These warm summer water temperatures severely limit available juvenile rearing habitat; juveniles in the Altamaha and Ogeechee Rivers have been found in a single area with cool and deep water (Flournoy et al. 1992, Rogers and Weber 1994, Rogers and Weber 1995, Weber 1996). Shortnose sturgeon will stay in these refugia areas until water temperatures begin to cool in the fall. All captures of shortnose sturgeon in the Altamaha River when water temperature exceeded 27°C were in areas deeper than the surrounding river stretches, with a maximum depth of 12.8 m (DeVries 2006). Similar behavior has been found in the Savannah River (Collins et al. 2001) and Ogeechee River (Weber 1996). The essential nature of this deep water habitat sought by sturgeon is further illustrated by patterns of capture during summer for shortnose sturgeon in the Altamaha (Flourney et al. 1992), Savannah (Hall et al. 1999), and the Edisto (Collins unpublished data) Rivers where juvenile shortnose sturgeon have been captured only in the vicinity of the salt-freshwater interface and in the deeper water.

Juvenile Atlantic sturgeon in the Cape Fear River have also been found to seek cooler refugia in the summer months (Moser and Ross 1995). McCord (1998) associated drastically reduced growth rates of juvenile Atlantic sturgeon during periods of warm water temperature to severe stress. Absence of such refugia habitat, especially in southern populations, has been attributed to high juvenile mortality and extirpation of some shortnose sturgeon populations (Collins and Smith 1993, Rogers and Weber 1994, Rogers and Weber 1995, Collins et al. 2000a). The early juvenile life stage is often found to be the most sensitive life stage of sturgeon, as it is spatially limited to habitat within estuaries (Munro et al. 2007).

Fall/Winter Foraging

Shortnose sturgeon subadults (3-10 year olds) occur at the saltwater/freshwater interface in most rivers during the winter (Dadswell 1979, Pottle and Dadswell 1979, Dovel et al. 1992, Hall et al. 1991, Flournoy et al. 1992, Weber 1996). Older juveniles likely inhabit the same areas as adults, but younger juveniles primarily remain in freshwater habitat, perhaps due to low salinity tolerance (Jenkins et al. 1993, Jarvis et al. 2001). Juvenile shortnose sturgeon were captured during winter in the Savannah River in water temperatures between 12.8°-21.1°C (Collins et al. 2000a) and in water depths between 6.1-13.4 m (Collins et al. 2000a).

Shortnose sturgeon forage widely throughout the estuary during the winter (Collins and Smith 1993, Weber et al. 1999). In the Altamaha River, just south of the action area, shortnose sturgeon were found year-round in presumed foraging areas comprised of sandy substrate at water depth of 3 to 7.6 m (Devries 2006). Foraging sturgeon (both shortnose and Atlantic) were targeted in the Savannah River at two locations: both locations were downstream of a deep hole (rkm 31.4 and 40.7) that is used for resting by sturgeon. Depth of the sampled sites ranged between 16.7-27.5 ft (Collins et al. 2006). Similarly in the Edisto River, depth in shortnose sturgeon foraging area ranged between 14.7-20.9 ft seasonally (Collins et al. 2006).

During fall, large juveniles and adult Atlantic sturgeon migrate out to sea. Outmigration of river-resident juvenile Atlantic sturgeon older than age 1 may be influenced by density dependence with younger cohorts (Schueller and Peterson 2010). These younger fish are salinity intolerant and are unable to seek alternative foraging habitats; on the other hand, older juveniles have no such constraints but may prefer the relatively predator-free environments of brackish estuaries as long as food resources are not limited (Schueller and Peterson 2010).

All adult Atlantic sturgeon moved out of the Combahee and Edisto Rivers during October through November (Collins et al. 2000b). In the spring, reproductively developing Atlantic sturgeon will return to spawn (mostly March in the Southeast) in their natal rivers and take up residence at the same sites utilized the previous year (Collins et al. 2000b).

4 ENVIRONMENTAL BASELINE

By regulation, environmental baselines for opinions include the past and present impacts of all state, federal, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02).

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 in the action area 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.

The proposed action occurs in the Atlantic Ocean, Savannah Harbor Entrance Channel, and the navigational channel of the Savannah River. The following analysis examines actions that may affect these species' environment specifically within this defined action area. The environmental baseline for this opinion includes the effects of several activities affecting the survival and recovery of ESA-listed sea turtle species, shortnose sturgeon, and Atlantic sturgeon (proposed for listing as endangered) in the action area. The activities that shape the environmental baseline in the action area of this consultation are primarily vessel operations and dredging.

4.1 Status and Distribution of Shortnose Sturgeon in the Action Area

The shortnose sturgeon inhabiting the Savannah River have been studied by, among others, Hall et al. (1991) and Collins et al. (1993). Hall et al. (1991) and Collins et al. (1993) used telemetry techniques to identify maximum upriver positions of shortnose sturgeon during the spawning season. In the Savannah River, these locations were between river kilometer 179 and river kilometer 278. Spawning locations have not been verified by collection of eggs. Historically, shortnose sturgeon likely utilized the entire Savannah River downriver of the fall line where the Clarks Hill Dam is now located upstream of the Augusta Shoals, in Augusta, Georgia, and above the New Savannah Bluff Lock and Dam. New and on-going research by the South Carolina Department of Natural Resources (Bill Post, pers. comm. 2011) and by The Nature Conservancy (Wrona et al. 2011, in prep.) also provide updated information on tracking of shortnose sturgeon in the lower Savannah River project area, which indicates sturgeon are currently using the project area in its existing (pre-project) state.

Shoals located below the New Savannah Bluff Lock and Dam currently serve as spawning habitat for the shortnose sturgeon (Wrona et al. 2011, in prep.). Spawning migrations are likely triggered by water temperatures above 8°C occurring in late winter/early spring, primarily during February and March. Spawning lasts for about three

weeks and ends when temperatures reach 12° to 15°C. Subsequent downstream migration post-spawning is rapid and direct, usually occurring from March to May. Females likely do not spawn every year. It is believed that the shortnose sturgeon within the action area do not interbreed with fish from any other population.

It is likely that the total number of shortnose sturgeon within the action area is greatly decreased from historic accounts. The previous abundance estimate for the project area had the population at 1,000 to 3,000 fish in the Savannah River (B. Post, SCDNR, 2003). A low catch rate of juveniles in 1999-2000 sampling indicated that natural recruitment was quite low in the Savannah River. In the southeastern United States low recruitment is often thought to be caused by poor water quality in the nursery habitat located at the fresh water/salt water interface (Collins et al. 2001). The Shortnose Sturgeon Status Review Team, in an ongoing review of the status of the species (to be completed in 2011), estimated the Savannah River population to be between 1,500 to 2,000 adults (S. Bolden, pers. comm.). Males were most abundant (3.5:1) in the available estimates for the Savannah River (Collins and Smith 1997). Sex ratio on the spawning ground may favor males, although spawning females are less mobile making them less susceptible to gillnet gear, which may skew estimates (Kieffer and Kynard in review-B). The size of the Savannah River population puts it at greater risk of extinction than larger populations occurring elsewhere (McElhaney et al. 2000) due to several processes. These processes include: (1) deterministic density effects including depensation (Allee effect) and increased predation; (2) inbreeding resulting in loss of diversity and accumulation of deleterious mutations; and (3) increased susceptibility to catastrophic events.

Within the project area, shortnose sturgeon are present in the lowest reaches of the Savannah River up to the first obstruction (Figure 22) located at the New Savannah Bluff Lock and Dam at river mile 187.5. The entire life cycle of the shortnose sturgeon population occurs within the action area: adults grow, mature, and forage in the area and migrate upstream to spawning habitat, but since passage is not possible they can only go as far as the base of the dam. The COE attempted two fish passage events at New Savannah Bluff Lock and Dam by increasing flows from J. Strom Thurmond to overtop the spill gates during the spawning season. This method of fish passage proved ineffective for shortnose sturgeon. The cold water released from Thurmond Dam may have cooled the water at the dam to the point where fish were no longer induced to spawn. Also, it is doubtful that shortnose sturgeon were able to negotiate the 8-foot-high support walls at the bottom of the dam. The lock and dam was constructed in 1937 to aid commercial navigation and was last used for commercial shipping in 1979. It is currently operated by the City of Augusta. As a requirement of the City of Augusta's lease, the COE requires them to lock fish through the dam twice a week during the spring spawning season. Some limited transmitter studies have been conducted to determine if sturgeon are successfully locked through (like shad and herring), but apparently there is no movement of sturgeon through the lock. The COE made a draft recommendation in the Section 216 Disposition Study of 2000 to remove the structure, but public outcry associated with the potential loss of the impounded pool occurring upriver resulted in Congress declaring in an amendment to the Section 216 Disposition Study that the dam would be repaired and may be turned over to a local government to maintain. The work

has not received funding, so the facility has not been rehabilitated. It has been operated to pass some migratory anadromous fish species, but it is thought that sturgeon are not able to pass because they are unable to overcome the vertical obstacles located at the base of the lock and dam.

Figure 22. New Savannah Bluff Lock and Dam

When they are not migrating, shortnose sturgeon are found residing in the lower reaches of the Savannah River, congregating near the freshwater/saltwater interface or mixing zone. The location of the interface is positioned upriver immediately above the area to be deepened, but within areas that would be modified by flow rerouting. Historically, the interface was previously located much closer to the mouth of the river, but with the successive dredging events and deepening of the river channel, the interface has shifted further upriver. Each deepening event has further compressed the available habitat of the shortnose sturgeon. In 2001, Collins et al. reported that habitat within the Kings Island Turning Basin, once used by juvenile sturgeon, as reported by Hall et al. in 1991, no longer supported juvenile shortnose sturgeon, probably due to the harbor modifications that occurred after the earlier study that resulted in higher salinity and caused the juveniles to avoid the area.

Within the project area, the Savannah River is divided into three interconnected sections: the Back River, Middle River, and Front River. The Back River is located adjacent to the boundary with South Carolina and borders much of the Savannah National Wildlife Refuge. The Back River depths are primarily shallow with most less than 10 feet deep; however, the sediment basin area has been reported to be much deeper. The Sediment Basin and the tide gate are located at the lower end of the Back River where it joins the Front River near river mile 11. As a part of the COE's proposed flow re-routing modification, the Sediment Basin would be allowed to fill in. The COE has proposed to place a submerged sill at the lower end of the basin to aid in the process of filling-in.

With the anticipated filling of the Sediment Basin, the depth there could become much shallower and may become too shallow for large sturgeon to pass through. Both upper portions of the Back River and the Middle River join the Front River in an area referenced as McCoy Cut. The lower arm of McCoy cut would be closed with the flow re-routing modifications under Plan 6A. Partial dredging of the upper reaches of the Back River and Middle River would also be conducted with Plan 6A. The lower end of the Middle River empties into the Front River just above the Kings Island Turning Basin. Other than having one area with a deep hole, most of the Middle River is less than 10 feet deep. The Front River depths vary depending on the depths needed to maintain the shipping channel. Throughout the project area up to the Kings Island Turning Basin near river mile 19.5, the depths are 42 feet with the Kings Island Turning Basin having depths up to 50 feet. Upriver from this turning basin, the depths are maintained at 36 feet to river mile 19.9 and then 30 feet to river mile 21.3 at the Port Wentworth Turning Basin. Beyond this point, the authorized channel is 9 feet deep, although it has not been maintained since 1978.

Juvenile and adult shortnose sturgeon use the estuarine areas in the lower Savannah River as a foraging area throughout the year. This unique habitat is only found within the estuary surrounding the freshwater/saltwater interface. Adult sturgeon can tolerate higher salinities than juveniles and have been found in the lowest reaches of the Savannah River in salinities up to 21.5 ppt. Research has indicated that juvenile shortnose sturgeon can be found during the year within the area from river mile 19.3 to 29.5 (river kilometers 31.2 to 47.5), and adult sturgeon from river mile 3.4 to 29.5 (river kilometers 5.5 to 47.5), respectively (Figure 22 and 23). Collins et al. (2001) found juvenile shortnose sturgeon in temperatures of 19.4° to 28.9°C and salinities of 0.1 to 17.6 ppt within depths between 2.1 and 14.9 meters. Adult shortnose sturgeon were found in temperatures of 7.5° to 29.8°C in salinities ranging from 0.1 to 21.5 ppt and depths between 1.5 and 16.7 meters.

Even though tolerance increases with age, juvenile shortnose sturgeon are stressed by reduced dissolved oxygen levels and even moderate salinities (Jenkins et al. 1993). Significant mortality was noted for fish approximately 2.5 months old when held in salinities as low as 11 ppt. Additionally, fish of that age began dying at dissolved oxygen levels of 3.0 mg/Liter and below. In the Savannah Harbor, juveniles were not captured in salinities greater than 14.9 ppt (although a telemetered fish was located very briefly in 17 ppt) or dissolved oxygen levels less than 4.0 mg/Liter. Field observations noted high stress at temperatures greater than 27°C.

Collins et al. (2001) noted that during warm months both adults and juveniles were concentrated in a very small (less than 1.5 kilometer) section of the river and especially seemed to prefer the area within the river kilometer 46.5 to 47.5 segment. During cool months, adults and juveniles used the area just below Houlihan Bridge (at river kilometer 34.3) down to the confluence of Front and Middle rivers (river kilometer 31.3), and during the coldest period they especially used the area at this confluence and up into the Middle River. During 1999 through 2000, shortnose sturgeon consistently utilized a 7.9-meter-deep hole in the Middle River near the confluence with the Front River. Recent and on-going telemetry studies confirm that this area is still being heavily utilized for

resting by adult and large juvenile shortnose sturgeon. Water quality data suggest that an existing low sill between this hole and the Front River may minimize salinity fluctuations associated with the tidal cycle. Adults were less concentrated than juveniles during winter. Adults were found in the Front River and appeared to wander extensively in the Middle River but were not found in the Back River. Recent and on-going telemetry studies conducted by the South Carolina Department of Natural Resources and The Nature Conservancy have found adult shortnose sturgeon using the middle part of the Back River near Rifle Cut, which connects the Back River to the Middle River.

In the southern part of their range, shortnose sturgeon are known to take refuge from high water temperatures in the summer by congregating in cool, deep areas of rivers (Flournoy et al. 1992, Rogers and Weber 1994, Rogers and Weber 1995, Weber 1996) and then forage widely throughout the estuary during the winter (Collins and Smith 1993, Weber et al. 1999). Seasonal movements of adults have been documented in the Savannah River. Shortnose sturgeon range widely during cooler winter months, and aggregate and become relatively sedentary during summer. Summer water temperatures in southern estuaries commonly approach, and sometimes exceed, the maximum tolerable levels identified in the laboratory for early juvenile shortnose sturgeon (Jenkins et al., 1993). Observations indicate that sturgeon seek relatively deep, cool holes, possibly to avoid warm temperatures and low dissolved oxygen. A second deep hole occurs upstream of the project area. It is 6.5 meters deep and is located at river mile 29.5 (river kilometer 47.5), just north of the confluence with Abercorn Creek. This location is also frequently used by sturgeon, especially during the summer and early fall, and tracking results have found individuals resting there over several hours to days (Collins et al. 2001). It is characterized as being a deep area located at a sharp bend in the river, adjacent to a large sand bar. It is unknown why this area is preferred, but it may be due to the synergistic effects of salinity, dissolved oxygen, and temperature.

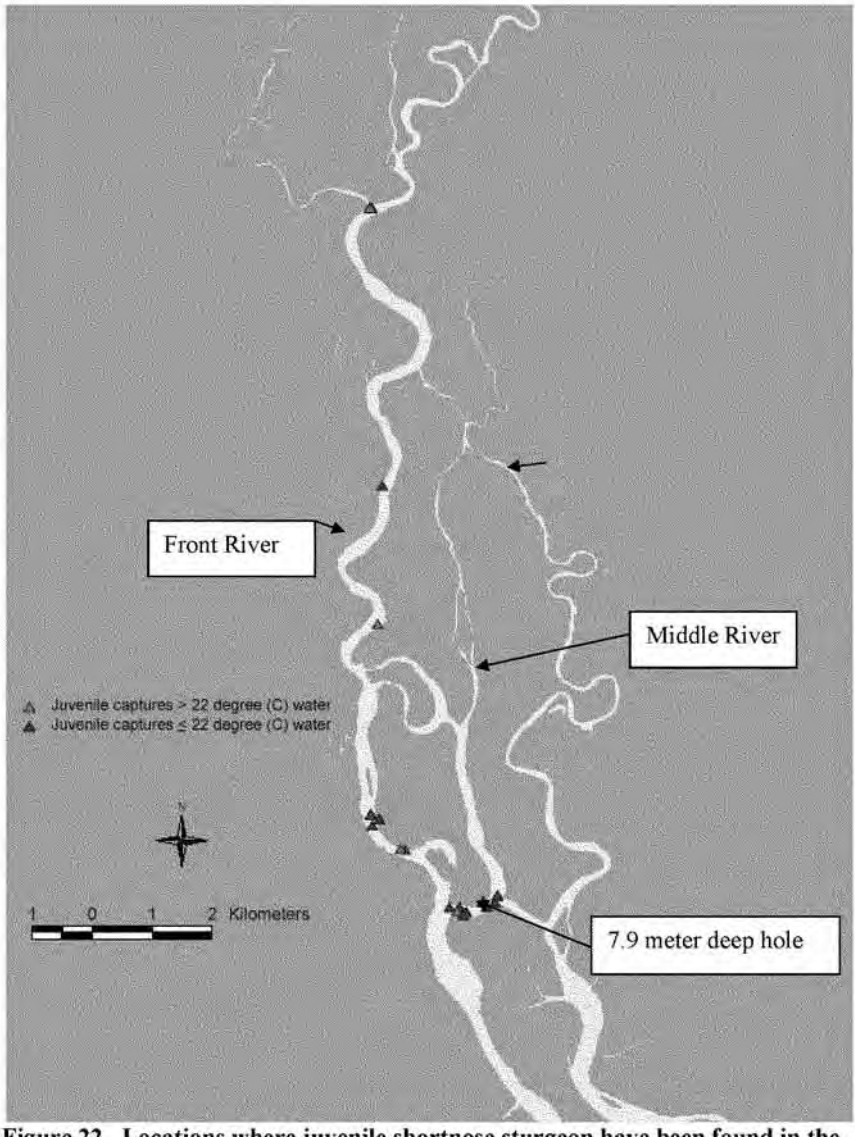


Figure 22. Locations where juvenile shortnose sturgeon have been found in the lower Savannah River.

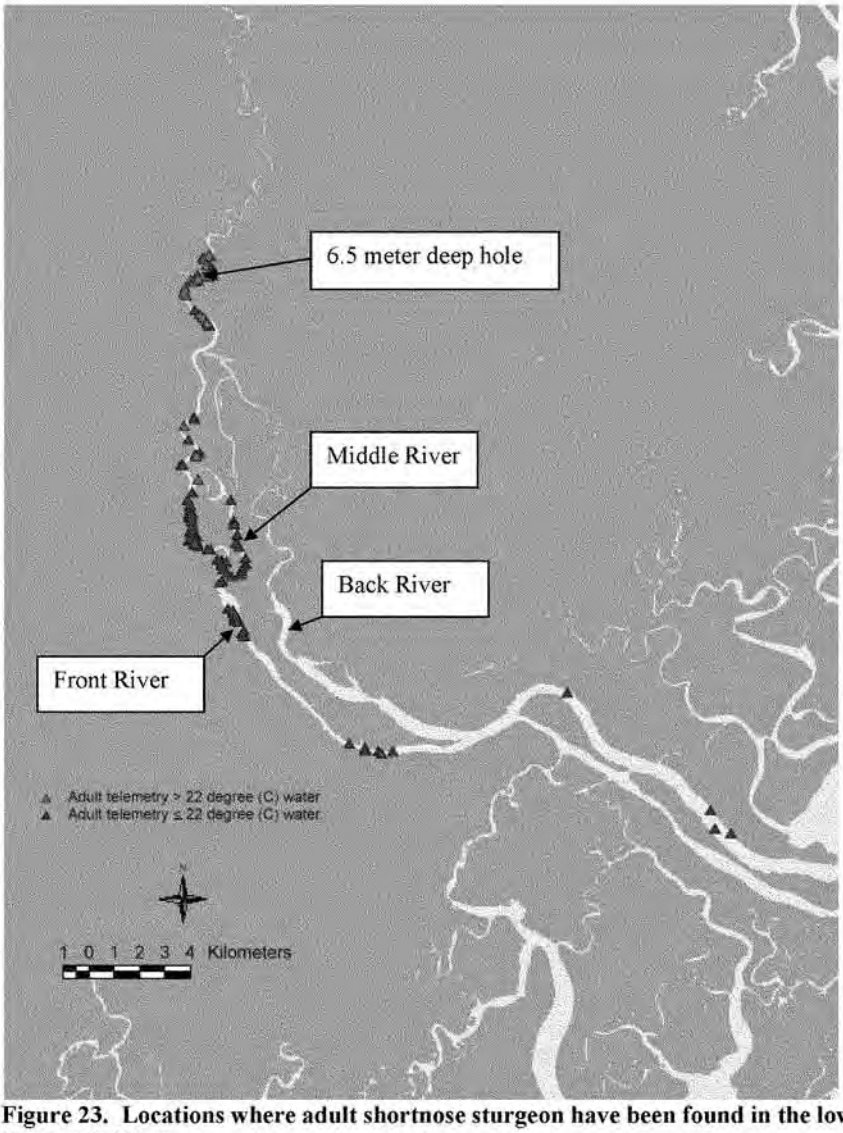


Figure 23. Locations where adult shortnose sturgeon have been found in the lower Savannah River

4.2 Status and Distribution of Atlantic Sturgeon in the Action Area

The Savannah River supports a reproducing subpopulation of Atlantic sturgeon (Collins and Smith 1997). According to NOAA's-National Ocean Service, 70 Atlantic sturgeon have been captured since 1999 (J. Carter, NOS, supplemental data 2006). Twenty-two of these fish have been YOY (< 410 mm TL). A running ripe male was captured at the base of the New Savannah Bluff Lock and Dam during the late summer of 1997, which supports the hypothesis that spawning occurs there in the fall. While spawning has been confirmed in the Savannah River, no spawning sites have been verified (Collins and Smith 1997). The fresh–brackish water interface area serves as the summer nursery habitat for Atlantic sturgeon (Smith et al. 1993, McCord 1998).

It is thought that overharvesting of sturgeon in the 1890s led to the dramatic decline in the population, and poor water quality since then has not been conducive to recovery. Secor and Gunderson (1998) showed that juvenile Atlantic sturgeon are less tolerant of summer-time hypoxia than juveniles of other estuarine species. The recent extirpations and severe population depressions of these species in the South is probably not coincidental; mortalities related to the synergistic effects of low dissolved oxygen levels and high summer temperatures would tend to affect southern populations to a greater extent than those further north.

Prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery in Georgia. Secor (2002) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present prior to 1890. While fishing occurred in the Savannah River, the sturgeon fishery was mainly centered on the Altamaha River, and in more recent years, peak landings were recorded in 1982 (13,000 lbs). Based on juvenile presence and abundance, the Altamaha seems to currently support one of the healthiest Atlantic sturgeon subpopulations in the Southeast (D. Petersen, UGA, pers. comm. 2006). Atlantic sturgeon are also present in the Ogeechee River, which is interconnected to the Savannah River at its lowest reaches; however, the absence of age-1 fish during some years and the unbalanced age structure suggests that the subpopulation is highly stressed (Rogers and Weber 1995). Spawning adults have been collected in recent years from the Satilla River (Waldman et al. 1996). Recent sampling of the St. Mary's River located sturgeon (D. Petersen, UGA, pers. comm. 2011), which changes previous reports by Rogers et al. (1994) that the subpopulation may be extirpated. In Georgia, Atlantic sturgeon are believed to spawn in the Savannah, Ogeechee, Altamaha, and Satilla rivers.

Previous studies in the nearby Ogeechee River have shown the continued persistence of Atlantic sturgeon in this river, as indicated by the capture of age +1 fish. Sampling efforts (including 1991-1994, 1997, and 1998) to collect age-1 sturgeon as part of the Savannah River genetics study suggest that juvenile abundance is rare, with high inter-annual variability, indicating spawning or recruitment failure. However, the Army's Environmental and Natural Resources Division (AENRD) at Fort Stewart, Georgia, which borders the Ogeechee River, collected 17 sturgeon in 2003 considered to be YOY (less than 30 cm TL) and an additional 137 fish in 2004, using a 30 m x 2 m experimental

gillnet (3.8, 7.7, 12.7, 15.2, 17.8 cm stretched mesh). Most of these fish were juveniles; however, nine of these fish measured less than 41 cm TL and were considered YOY. In 2003, 17 sturgeon captured in this survey were also considered YOY (reported as less than 30 cm TL). The AENRD survey provides the most recent captures of YOY in the Ogeechee.

4.3. Factors Affecting Sturgeon in the Action Area

4.3.1 General

In recent years, NMFS has undertaken several ESA Section 7 consultations to address the effects of federal actions on sturgeon in the Savannah River (Table 4). Because Atlantic sturgeon are not listed, there are no consultation records.

Date	Project
4/17/2003	Discharges from J. Strom Thurmond Dam
5/28-2003	FWS grant to GADNR CRD for marine fisheries surveys
7/03/2003	Chatham County dock construction for water ferry
12/07/2004	GPA Berth 8 construction
12/30/2004	COE advance maintenance dredging Savannah Entrance Channel
02/05/2005	Amendment 6 to Shrimp Fishery FMP
08/02/2005	GDOT repair of Back River bridge-Chatham County
03/12/2007	Savannah Economic Development Authority- North Port Project
08/02/2007	Southern LNG & Elba Express Elba III project
12/10/2007	NPS/FHA repair of Fort Pulaski bridge
08/05/2008	Southern Nuclear – Vogtle Electric Plant license renewal
01/12/2009	GDOT replacement of Back River bridge-Chatham County
01/28/2009	Drought Contingency Plan Savannah River
03/16/2009	SAD Non-capture relocation trawling demo project
07/15/2009	Bank stabilization at Cockspur Island Lighthouse
11/06/2009	Fall/Winter Flow Reduction- Savannah River (Thurmond Reservoir)

Table 4. Summary of ESA Section 7 consultations for sturgeon conducted in the Savannah River 2002-2010.

Through an ESA Section 6 cooperative agreement with Georgia and South Carolina, NMFS has supported numerous research projects within the project area to investigate the life history of the shortnose and Atlantic sturgeon.

Through issuance of ESA Section 10(a)(1)(A) permits, scientific and enhancement studies are conducted by researchers on captive shortnose sturgeon maintained at various quarantined research facilities. Researchers employed by USFWS, USGS, the University of Florida, and one private facility, are currently authorized to study captive shortnose sturgeon. These captive individuals are periodically conditioned and spawned and the

resulting gametes and progeny are used for scientific studies, such as cryogenics, disease transmission, nutrition, genetics, toxicology, fish passage, and fish culture techniques. Between 1985-1992, 97,483 shortnose sturgeon raised at Bears Bluff National Fish Hatchery were released into the Savannah River. The hatchery-produced individuals were stocked at various ages, locations, and across all seasons. The total estimated number of shortnose sturgeon stocked is great; most were stocked as larvae and early juveniles. Only 18,210 individuals were large enough to be tagged in some fashion. Survival of the very young sturgeon was probably low but unknown. Population estimates of adult shortnose sturgeon pre- and post-stocking suggest that the numbers had increased substantially, but many tags were shed, few fish were marked, and these estimates were never published as statistical assumptions were violated and the estimates were biased (but biased similarly). Some believe the stocking event was successful; however, without information on the survivability and emigration of both the wild and stocked fish, impacts and effects of the stocking event cannot be assessed. A few of the fish that retained their tags have been found in other rivers, suggesting they emigrated and may have been released at an age too late to imprint on the Savannah River. Straying of these hatchery-raised shortnose sturgeon into other rivers was confirmed with the capture of a tagged adult in the Ogeechee River (D. Peterson, University of Georgia, pers comm.).

There are currently 17 Section 10(a)(1)(A) scientific research permits issued to study shortnose sturgeon in the rivers of the United States. Some of the studies are near, or within, the project area (Table 5). Each permit approves sampling methodology and authorizes incidental take. Two of the ESA Section 10 permits allowing take of shortnose sturgeon include the Savannah River. Ongoing research involves collection of shortnose sturgeon from the Savannah River for ageing, and to attempt to generate an additional population estimate. Tagging and telemetry is occurring to identify upstream spawning location and the effects of reduced flow on spawning habitat. Incidental mortality of a total of twenty-seven shortnose sturgeon is currently permitted through research permits. The specific stressors to fish subject to NMFS-issued ESA permit conditions are capture in nets; handling and restraint during examinations; tagging using PIT, internal, and external tags; tissue sampling; anesthetizing; laparoscopy; blood sampling; and gonad biopsy.

Permit No.	Location	Authorized Take	Objectives and Research Activities
1420 University of Georgia Expires: 9/30/09	Altamaha River, GA	1,000 adult/juv. (2 lethal), 100 ELS	**1) Population Dynamics**; **2) Habitat**; **3) Genetics**; and **4) Contaminants:** Capture, handle, weigh, measure, PIT tag, transmitter tag, tissue sample, anesthetize, conduct laparoscopy, blood collection, fin ray section, collect ELS
10037 University of Georgia Expires: 4/30/2013	Ogeechee River, GA	150 adult/juv (2 lethal), 40 ELS	**1) Population Dynamics**; **2) Habitat**; **3) Genetics**; & **4) Contaminants:** Capture, handle, measure, weigh, PIT tag, tissue sample, fin-ray section, anesthetize, laparoscopy, blood collection, radio tag, collect ELS
10115 University of Georgia Expires 08/3/2013	Satilla & St. Mary's GA & FL	85 adult/juv 20 ELS	**1) Presence /Absence; 2) Genetics:** Capture, handle, measure, weigh, PIT tag, tissue sample, collect ELS
1447 South Carolina DNR Expires: 2/28/2012	South Carolina Rivers	100 adult/juv. (2 lethal), 100 ELS	**1) River Survey**; **2) Genetics**, and **3) Diet**: Capture, handle, measure, weigh, PIT and DART tag, transmitter tag, anesthetize, tissue sample, gastric lavage, collect ELS
1505 South Carolina DNR Expires: 5/15/2011	South. Carolina Rivers	98 adult/juv. (2 lethal), 200 ELS	**1) River Survey**; **2) Genetics**; and **3) Contaminants; and 4) Diet**: Capture, handle, measure, weigh, PIT and DART tag, transmitter tag, anesthetize, laparoscopy, blood collection, tissue sample, gastric lavage, collect ELS

Table 5. Current shortnose sturgeon research permits authorized for research activities utilizing wild fish under ESA Section 10 (a)(1)(A) permits in, or near, the project area.

NMFS finalized the Recovery Plan for the shortnose sturgeon in 1998 as required by ESA Section 4 with the following recovery objective:

> *"to recover shortnose sturgeon populations to levels of abundance at which they no longer require protection under the ESA, and for each population segment, the minimum population size will be large enough to maintain genetic diversity and avoid extinction."*

The Recovery Plan identified 19 discrete populations of shortnose sturgeon and determined the Savannah River population to be discrete (NMFS 1998). The 1998 shortnose sturgeon Recovery Plan also identified four main recovery actions: establish

listing criteria for shortnose sturgeon population segments; protect shortnose sturgeon and their habitats; rehabilitate shortnose sturgeon populations and habitats; and implement recovery tasks. To rehabilitate shortnose sturgeon habitats and population segments, the Recovery Plan specifically calls for actions to restore access to habitats, spawning habitat and conditions, and foraging habitat.

In 2007, NMFS initiated a shortnose sturgeon status review pursuant to ESA Section 4; a draft status review report has been peer-reviewed and is expected to be finalized during 2011. Once completed, NMFS will then consider if the current listing is appropriate. NMFS would propose any changes through the federal rule-making process outlined in 50 CFR 424. Once the shortnose sturgeon status review is complete, NMFS intends to designate a new recovery team and initiate a revision of the 1998 shortnose sturgeon recovery plan.

4.3.2 Commercial and Recreational Fisheries

Directed harvest of sturgeon is currently prohibited; however, sturgeon are taken incidentally in anadromous fisheries occurring within Georgia and South Carolina that deploy nets, and are likely targeted by poachers throughout their range (Dadswell 1979, Dovel et al. 1992, Collins et al. 1996). Impacts from poaching are unknown.

State Fisheries
During 1989-1991, the commercial shad gillnet fishery's bycatch included more endangered shortnose sturgeon than juvenile Atlantic sturgeon, which is considered unusual. The incidental capture of sturgeons in the Georgia and South Carolina gillnet fishery for American shad (*Alosa sapidissima*) and the trawl fishery for penaeid shrimp (*Penaeus* spp.) was summarized by Collins et al. (1996): the commercial shad fishery was active from approximately mid-January through mid-April along the South Atlantic coast; sturgeon captured in the shad gillnet fishery were primarily adults and accounted for 52 percent of Atlantic sturgeon bycatch and the shrimp trawl fisheries accounted for 39 percent. Collins et al. (1996) reported that two commercial fishermen collected 14 fish over the period of 1990-1992, averaging seven Atlantic sturgeon/fisher/year. It seems that Atlantic sturgeon abundance within the Savannah River is extremely low, as evident from low bycatch and reported captures over the last 15 years. Thus, bycatch may be an issue if abundance is low and fishing effort is high.

Entanglement of sturgeon in gillnets can result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations of sturgeon (Moser and Ross 1993 and 1995, Weber 1996, Collins et al. 2000a, Moser et al. 2000). In the Savannah River, adults were common in the bycatch from the lowest point in the river at which gillnet fishing was allowed (about river kilometer 43) up to river kilometer 278 (the uppermost of several sturgeon spawning areas), as reported by Collins and Smith (1993). Bycatch of sturgeon in the river was as high as 102 fish/fisher/yr, and immediate bycatch mortality of sturgeon for this gear type was 16 percent, with another 20 percent of fish being injured (Collins et al. 1996). In addition to such accidental mortality, intentional mortality of shortnose sturgeon captured in the shad fishery has been known to occur (McCord 1998).

Mandatory reporting of sturgeon bycatch was initiated in 2000 by the Atlantic States Marine Fisheries Commission; a summary of self-reported shortnose sturgeon bycatch in the Savannah River via the South Carolina shad gillnet fishery is presented in Table 6. In most cases, shortnose sturgeon captured as bycatch of the shad gillnet fishery are returned to the river unharmed; survival is expected to be greater early in the shad season when waters are cooler. These numbers should be considered a minimum estimate because fishers tend to greatly under-report bycatch, especially of endangered species. The possession of a commercial shad license permits the fishing of 10 nets; however, on average a licensee usually has 4-5 nets (B. Post, SCDNR, pers. comm.). Nets are usually 5 ½-inch stretch mesh and may not exceed 600 feet in length. No net may be set within 600 feet of any gillnet previously set.

Directed fisheries for sturgeon no longer occur, and incidental marine and estuarine hook-and-line fisheries have little impact, but sturgeons (especially juvenile and subadult Atlantics) do occur in the by-catch of trawl fisheries in South Carolina and Georgia, especially the inshore/nearshore segment of the penaeid shrimp trawl fishery during cool months. During the period from 1973 to 1975, commercial shrimp trawlers caught a total of 1,111 sturgeon off North Carolina, South Carolina, and Georgia (Keiser 1976). The report did not identify whether they were shortnose or Atlantic sturgeon. The shrimp trawl fishery produced 39 percent of 97 reported recaptures of Atlantic sturgeon tagged in a Georgia study conducted before use of turtle excluder devices became mandatory (Collins et al. 1996). Use of turtle excluder devices is thought, but not proven, to reduce by-catch of sturgeons.

Year	Shortnose sturgeon	Atlantic sturgeon
2009	21	15
2008	12	2
2007	16	6
2006	N/A	3
2005	7	0
2004	23	0
2003	1	3
2002	26	4
2001	N/A	N/A
2000	4	5

Table 6. Summary of self-reported effort and incidental bycatch of shortnose and Atlantic sturgeon by commercial shad gillnet fishery in the Savannah River as reported to the Atlantic States Marine Fisheries Commission by South Carolina. Mandatory reporting began in 2000. There are no data to separate total number of sturgeon into unique and recaptured individuals.

4.3.3 Dams

The Savannah River is segmented by several dams (USFWS et al. 2001) that adversely impact fish populations through: (1) the blockage and/or impairment of required

migration patterns of anadromous and diadromous species; (2) river ecosystem fragmentation; and (3) instream flow modifications that alter natural, seasonal hydrological conditions and river morphology. Habitat accessibility and location of dams throughout the Southeast river basins are inseparably linked; fish passage at one facility determines the passage potential at other dams. Access to traditional spawning grounds is now blocked by a series of six dams on the Savannah River. The construction of these dams and reservoirs has converted or blocked access to approximately half of 384 miles of historical anadromous fish spawning and nursery habitat. A major portion of high quality anadromous fish spawning habitat (rapids complex: boulder, bedrock, cobble and gravel substrate) that was once available has been blocked or inundated by large reservoirs above the Augusta Diversion Dam, which is located approximately 20 miles above the New Savannah Bluff Lock and Dam. The majority of the habitat that is no longer accessible was the most heavily used. It is estimated that 90 to 95 percent of the quality spawning habitat for rapids-dependent anadromous species has been lost. The New Savannah Bluff Lock and Dam currently impedes shortnose sturgeon from accessing important habitat areas. It is the first impediment encountered by all anadromous fish species migrating between estuarine/marine coastal waters into freshwater habitats of the Savannah River. The New Savannah Bluff Lock and Dam is an inactive navigation dam that precludes sturgeon access to valuable spawning habitat upstream at the Augusta Shoals, which is located just below the Augusta Diversion Dam (Figure 24). The COE has proposed construction of a fish passage bypass facility at the dam as mitigation for the effects of the deepening in the lower Savannah River. Establishing fish passage at the New Savannah Bluff Lock and Dam would enhance spawning potential at sites located upstream of this structure.

Establishing fish passage at the New Savannah Bluff Lock and Dam should also trigger the construction of fish passage at dams located upriver. In 1994, the USFWS, NMFS, SCDNR, and the GADNR completed development of a plan to restore access to a portion of historical anadromous fish spawning habitat in the Savannah River. The plan was filed by the FWS on behalf of the resource agencies in 1994, and was adopted by the Federal Energy Regulatory Commission (FERC) as a Comprehensive Plan pursuant to Section 10(a)(2) of the Federal Power Act. The plan is a guide for resource agency efforts and would restore access to approximately 35 miles of spawning and maturation habitat. The plan includes the following elements: (1) reliable passage of anadromous fish at the New Savannah Bluff Lock and Dam; (2) the design and implementation of an upstream fish passage mechanism and safe downstream (out-migrant) passage at the Augusta Diversion Dam; (3) the design and implementation of an upstream fish passage mechanism and safe downstream (out-migrant) passage at the Stevens Creek Dam; and (4) improvement of poor dissolved oxygen releases from the J. Strom Thurmond Dam during the summer months. Three of the four elements of the plan to restore access to the 35 miles of the Savannah River between the New Savannah Bluff Lock and Dam and the J. Strom Thurmond Dam are in place. In 2004, the NMFS and USFWS sent the FERC a joint prescription for fish passage at the Augusta Diversion Dam as well as minimum flow requirements necessary over the Augusta Shoals in regards to the proposed re-licensing of the Diversion Dam. When FERC issued the license for the Stevens Creek Hydropower Project in 1995, it reserved authority for the USFWS to prescribe a fishway

at that project once upstream passage was achieved at the Augusta Diversion Dam. Plans are in place to provide fish passage at the Augusta Diversion Dam and the Stevens Creek Hydroelectric Project when fish passage is achieved at the New Savannah Bluff Lock and Dam. Once fish passage is installed at the Augusta Diversion Dam, sturgeon would be able to pass above the dam and then pass back downstream into the Augusta Canal. If sturgeon entered the canal, they would have to pass through hydroelectric facilities to re-enter the Savannah River. NMFS is working with the Augusta Canal to implement measures that will keep sturgeon out of the canal once fish passage at the dams has been established.

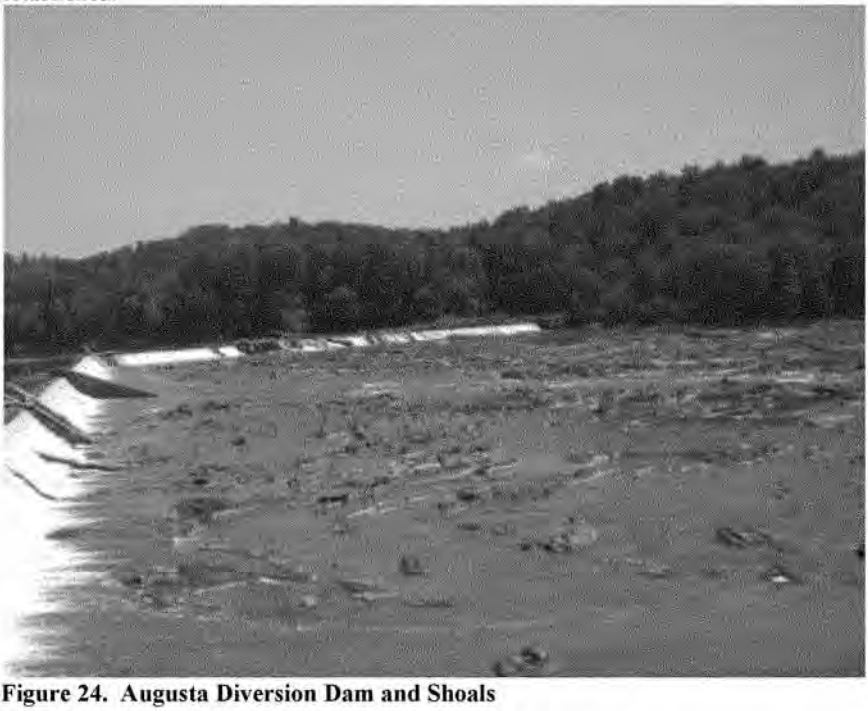


Figure 24. Augusta Diversion Dam and Shoals

Dams and their operations are also the cause of major instream flow alteration in the Southeast (USFWS et al. 2001). Hill (1996) identified the following impacts of altered flow to anadromous fishes by dams: (1) altered dissolved oxygen concentrations and temperature; (2) artificial destratification; (3) water withdrawal; (4) changed sediment load and channel morphology; (5) accelerated eutrophication and change in nutrient cycling; and (6) contamination of water and sediment. Activities associated with dam maintenance, such as dredging and minor excavations along the shore, can release silt and other fine river sediments that can be deposited in nearby spawning habitat. Dams may reduce the viability of sturgeon populations by removing free-flowing river habitat. Seasonal deterioration of water quality can be severe enough to kill fish in deep storage reservoirs that receive high nutrient loadings from the surrounding watershed (Cochnauer 1983). Important secondary effects of altered flow and temperature regimes include

decreases in water quality, particularly in the reservoir part of river segments, and changes in physical habitat suitability, particularly in the free-flowing part of river segments. The most commonly reported factor influencing year-class strength of sturgeon species is flow during the spawning and incubation period (Jager et al. 2002). Water temperature is another environmental factor that explains year-to-year variation in recruitment (Counihan et al. in press).

4.3.4 Water Quantity and Quality

Water Quantity

The headwaters for the project area originate in the Blue Ridge Mountains of North Carolina, pass through Georgia, and drain into the Atlantic Ocean through the Savannah River. Water flow is regulated by the COE through dams at Lake Hartwell, Lake Richard B. Russell and Clarks Hill Lake (known as J. Strom Thurmond Lake in South Carolina). Flow in the Savannah River is primarily controlled by releases from J. Strom Thurmond Dam. The gates at the New Savannah Bluff Lock and Dam are controlled remotely at the Thurmond Reservoir. Two nuclear sites—Plant Vogtle in Georgia and the U.S. Department of Energy's Savannah River Site in South Carolina—withdraw water for their facilities. The Vogtle Electric Generating Plant consists of two nuclear reactors and currently uses up to 64 million gallons per day (mgd) of water from the Savannah River to generate power. In March 2008, the Southern Nuclear Operating Company applied to the Nuclear Regulatory Commission for a license to build two additional nuclear reactors at the plant, increasing the potential water usage to 80 mgd. Numerous other large facilities positioned along the river also withdraw water for industrial uses. Up to 100 mgd (379,000 cubic meters per day) of Savannah River water may be withdrawn to support the growth of South Carolina communities located outside of the Savannah River basin, such as Greenville and Beaufort County (Spencer and Muzekari 2002). While Georgia has laws restricting interbasin transfers of water, South Carolina has yet to adopt stream flow protections and does not regulate surface water withdrawals (Rusert and Cummings 2004).

The Savannah National Wildlife Refuge (NWR), located adjacent to the project area in the coastal zone, receives freshwater from the river to seasonally flood wetlands to create, protect, and manage migratory waterfowl and shorebird habitat. Water flow directly affects water level management at the NWR; managed habitats are dependent upon adequate freshwater for maintaining vegetative diversity.

The State of Georgia designates the beneficial uses of the freshwaters within the project area as primary and secondary contact recreation, drinking water supply after conventional treatment in accordance with requirements, fishing, indigenous aquatic community habitat, and industrial and agricultural uses. The city of Savannah has a water intake in Abercorn Creek, located just upstream from the project site, primarily as a water supply for the city's municipal and industrial water uses. It has a 62.5 million gallon per day (mgd) capacity, but presently operates at around 30 mgd. Several industries located along the lower Savannah River also withdraw water for industrial uses. The Savannah Electric and Power Company is the largest industrial permittee and

had a maximum daily withdrawal of 267.0 mgd (reported in year 2000) at its Port Wentworth facility.

Water Quality
In October 2006, the EPA finalized a TMDL for Savannah Harbor and concluded that the Savannah River cannot withstand the introduction of anthropogenic, oxygen-demanding substances and still provide acceptable habitat for critical aquatic life that reside in the reaches of the river (EPA 2006). The finding meant that South Carolina and Georgia would have to revise their permits for point source discharges in those reaches as they expired and came up for renewal. As part of its analysis, EPA evaluated the dissolved oxygen requirements for several fish species and for natural conditions of the river. At that time, the applicable dissolved oxygen site-specific criteria for the Savannah Harbor, as established by Georgia, was a minimum instantaneous dissolved oxygen criteria of no less than 3.0 mg/Liter in June, July, August, September, and October; no less than 3.5 mg/Liter in May and November; and no less than 4.0 mg/Liter in December, January, February, March, and April. However, Georgia revised its dissolved oxygen standard for the Savannah Harbor in 2009 and it now requires a daily average of no less than 5.0 mg/Liter throughout the year, with an instantaneous minimum of 4.0 mg/Liter throughout the water column. The new standard matches the South Carolina standard for waters of the same use classification and applies throughout the water column.

The lower Savannah River is heavily industrialized, and nursery habitat for many species of fish in the lower river has been significantly impacted by diminished water quality and channelization. Contaminants in the Savannah River include those from both municipal (city of Savannah) and industrial effluents. The area adjacent to the Port is especially heavily developed by a wide variety of industries. Other contaminants arise from two nuclear facilities farther upriver; nuclear isotopes have been detected in the sediment downriver in the estuary. Point source discharges and compounds associated with discharges contribute to poor water quality and may also impact the health of adult sturgeon. Poor water quality can have substantial deleterious effects on aquatic life, including production of acute lesions, growth retardation, and reproductive impairment (Cooper 1989, Sindermann 1994). Ultimately, toxins introduced to the water column become associated with the benthos and can be particularly harmful to benthic organisms like sturgeon (Varanasi 1992). Available data suggest that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976).

Elevated levels of environmental contaminants, including chlorinated hydrocarbons, in several fish species are associated with reproductive impairment (Cameron et al. 1992, Longwell et al. 1992), reduced egg viability (von Westernhagen et al. 1981, Hansen 1985, Mac and Edsall 1991), and reduced survival of larval fish (Berlin et al. 1981, Giesy et al. 1986). Several characteristics of shortnose sturgeon (i.e., long lifespan, extended residence in estuarine habitats, benthic predator) predispose the species to long-term and repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants (Dadswell 1979). Chemicals and metals such as chlordane, DDE, DDT, dieldrin, PCBs, cadmium, mercury, and selenium settle to the

river bottom and are later consumed by benthic feeders such as sturgeon or macroinvertebrates, and then work their way into the food web. Some of these compounds may affect physiological processes and impede a fish's ability to withstand stress, while simultaneously increasing the stress of the surrounding environment by reducing dissolved oxygen, altering pH, and altering other physical properties of the waterbody. Exposure to sufficient concentrations of these chemicals can cause lethal and sub-lethal effects such as: behavioral alterations, deformities, reduced growth, reduced fecundity, and reduced egg viability (USFWS 1993, Ruelle and Keenlyne 1993).

To address concerns about the potential for contaminants in the project area, sediment core samples were collected and examined for sediment physical and chemical properties The sampling area covered the entire area proposed for harbor deepening, extending from deep water in the ocean to the Kings Island Turning Basin (Station 103+000). Parameters investigated included metals, PCBs, PAHs, petroleum hydrocarbons, phenols, pesticides, dioxin congeners, cyanide, organotins, and nutrients. The evaluation found that most of the sediments provided no reason for concern over potential contaminant-related impacts associated with the proposed dredging and dredged sediment placement. However, three potential issues were identified. One issue involved sediments near the old RACON Tower site, which were first sampled in 1997 during a comprehensive survey of the harbor. Subsequent sampling conducted in 2005 revealed that sediments at that location do not pose a potential for contaminant-related environmental impacts. The second issue pertained mostly to whether the sediment chemistry data for pesticides, PAHs and phenols, especially achieved detection limits, were adequate for comparison to screening criteria. That issue was also addressed during the 2005 sampling. The confirmatory sampling within the channel revealed there are no potential sediment contaminant concerns related to pesticides, PAHs, phenols, or metals other than cadmium. The final issue involved the concentration and distribution of cadmium within the new work sediments. Sampling was conducted in 2005 to address this issue. Cadmium was found to occur naturally in unusually high levels within Miocene clays that would be excavated during the SHEP dredging. Evaluation of the laboratory results could not rule out the potential for adverse impacts from sediments with elevated cadmium levels in some reaches of the channel. However, the location of the elevated cadmium levels is down river from known sturgeon habitat and should not present a concern for sturgeon. A more detailed discussion on the cadmium sediments is in Section 5.2.3.

Secor (1995) noted a correlation between low abundances of sturgeon during this century and decreasing water quality caused by increased nutrient loading and increased spatial and temporal frequency of hypoxic conditions. Based on the known effects of dissolved oxygen, temperature, and salinity during the critical summer months, a safe threshold for suitable habitat for shortnose sturgeon appears to be approximately 4.0 mg/Liter in the bottom meter of the water column when temperatures exceed 26°C, and 3.5 mg/Liter when they do not exceed that temperature threshold. The habitat suitability criteria used in modeling shortnose sturgeon habitat in the action area before and after the proposed action are presented in Table 7.

Life Stage	Adults	Adults	Juveniles
Time of Year	Winter	Summer	Winter
Salinity	<= 25 ppt	<= 10 ppt	<= 14.9 ppt
D.O. Exceedance	10 %	Same	Same
Dissolved Oxygen	3.5 mg/Liter	4.0 mg/Liter	3.5 mg/Liter
D.O. Exceedance	5 %	Same	Same
Dissolved Oxygen	3.0 mg/Liter	3.0 mg/Liter	3.0 mg/Liter
D.O. Exceedance	1 %	Same	Same
Dissolved Oxygen	2.0 mg/Liter	2.0 mg/Liter	2.0 mg/Liter
Temperature	Normal January	Normal August	Normal January
River Flow	Normal January	Normal August	Normal January
Location – depth	Bottom layer	Same	Same
Location – width	Where Hydrodynamic Model is 3 cells wide, use deepest cell; where >3 cells wide, use deepest 2 cells	Same	Same

Table 7. Summary of Shortnose sturgeon habitat suitability criteria in the Savannah River Estuary

4.3.5 Dredging

Dredging of navigation channels can adversely affect shortnose and Atlantic sturgeon due to their benthic nature. The Savannah River is home to one of the busiest ports on the Atlantic Coast and is maintenance dredged regularly up to the Garden City Terminal. A seasonal restriction on dredging operations has been imposed from March 16–May 31 to protect striped bass in the Savannah River. This spring closure likely benefits sturgeon as well (M. Collins, SCDNR, pers. comm. 1998).

Seasonal restrictions (hopper dredging "windows") are also placed on hopper dredging conducted offshore of Savannah Harbor in the shipping channel to protect sea turtles. Hopper dredges can also lethally harm sturgeon directly by entraining sturgeon in dredge drag arms and impeller pumps. Mechanical dredges have also been documented to kill shortnose, Atlantic, and Gulf sturgeon. Environmental impacts of dredging include the direct removal/ burial of organisms; turbidity/siltation effects; contaminant resuspension; noise/disturbance; alterations to hydrodynamic regime and physical habitat; and actual

loss of riparian habitat (Chytalo 1996; Winger et al. 2000). According to Smith and Clugston (1997), dredging and filling impact important habitat features of Atlantic sturgeon as they disturb benthic fauna, eliminate deep holes, and alter rock substrates. To reduce the impacts of dredging on anadromous fish species, most of the Atlantic states impose work restrictions during sensitive time periods (spawning, migration, feeding) when anadromous fish are present. Reduced dissolved oxygen levels and upriver movement of the salt wedge may result from channel deepening. Potential impacts from hydraulic dredge operations may be avoided by imposing work restrictions during sensitive time periods (i.e., spawning, migration, feeding) when sturgeon are most vulnerable to mortalities from dredging activity.

Dredging operations may impact sturgeon by destroying benthic feeding areas, disrupting spawning migrations, and re-suspending fine sediments in spawning habitat sediments that cover required substrate. Because shortnose sturgeon are benthic omnivores, the modification of the benthos could affect the quality, quantity, and availability of sturgeon prey species. During the study conducted by Hall et al. in 1985-1992, juvenile shortnose sturgeon were found to be concentrated in the Kings Island Turning Basin (river mile 18.7). No juvenile stages were found in that area during a study conducted later in 1999-2000 (Collins et al. 2001). Collins et al. surmised that the harbor modifications (e.g., harbor deepening from 38 to 42 feet) occurring after 1992 changed the hydrographic conditions and caused the fish to move from the area. The low catch rate of juveniles in the 1999-2000 study indicated that natural recruitment was quite low in the Savannah River. In the southeastern United States, low recruitment is often thought to be caused by poor water quality in the nursery habitat located at the fresh water/salt water interface (Collins et al. 2001).

Dredging Methods and Associated Impacts

Hopper dredges are used within known sturgeon habitat throughout the proposed project area, including the ocean bar channels. In the South Atlantic region, only 9 incidental takes have occurred during hopper dredging operations, all of which were Atlantic sturgeon. Considering that Atlantic sturgeon primarily lead a marine existence, with the exception of their spawning migration, and hopper dredges are often operated in ocean bar channels or offshore borrow areas, it is likely that the risk of entrainment by hopper dredges is higher for Atlantic sturgeon than shortnose sturgeon. It is often less economical to use a hopper dredge in upstream environments, where shortnose sturgeon predominantly spend their time. The unit of dredging effort with respect to hopper dredging in shortnose sturgeon habitat is less than Atlantic sturgeon habitat and; thus, the risk of shortnose sturgeon take with a hopper dredge is likely less than to Atlantic sturgeon in the South Atlantic region. The current best estimate (Collins et al. 2001, Collins et al. 2002) is that adult shortnose sturgeon can be expected throughout the year somewhere within the area from River Mile 3.4 to 29.5 (river kilometers 5.5 to 47.5) and juvenile sturgeon from River Mile 19.3 to 29.5 (river kilometers 31.2 to 47.5), respectively. Therefore, impacts from hopper dredges may occur if hopper dredges were used upstream of River Mile 3 (roughly Station 16+000). There have been no documented takes of shortnose sturgeon in the Savannah Harbor by dredge operations. Shortnose sturgeon are not likely to be present near the river's mouth (downstream of

Station 16+000) and in the entrance channel (from Station 0+000 to -98+600B); therefore, impacts to shortnose sturgeon from hopper dredges working in that portion of the channel are not anticipated to occur.

The use of the "turtle deflecting draghead" on hopper dredges reduces the potential for take of benthic oriented species (i.e., sea turtles and sturgeon) by creating a sand wave in front of the draghead that pushes animals out of the way that are at risk of entrainment. Though the use of the "turtle deflecting draghead" likely reduces potential risk of sturgeon entrainment based on the understanding of its operating conditions, takes can still occur due to dragtender operator error, uneven bottom contours, or difficult dredging conditions. Few studies exist that evaluate entrainment risk relative to sturgeon behavior, size class, life cycle, etc., though effects of entrainment on adult fish are presumed low (Dickerson et al. 2004).

Although the potential for significant numbers of adult and juvenile sturgeon being hit by a hydraulic cutterhead dredge is fairly low; five shortnose sturgeon takes have been documented. Adult and juvenile sturgeon are believed to be very mobile, even when occupying resting areas during the summer months (deep holes and other deep areas). However, the eggs and larvae of sturgeon are not as mobile, but most of those life stages occur over 100 river miles upstream from where hydraulic dredges are proposed for use in the project area. Therefore, no impacts to sturgeon eggs or larvae are expected with the project work in the harbor.

Though rare, documented incidental take of shortnose and Atlantic sturgeon by mechanical dredges have also been reported. Clamshell dredges operate by dropping an open bucket into the water column which plunges to the bottom where the bucket closes, ascends, and discards the dredged material into a scow or barge. Since 1990, dredging operations throughout the North Atlantic, South Atlantic, and Gulf waters have resulted in a total of three sturgeon (one shortnose and two Atlantic) being reported as captured by clamshell dredge operations. Of the three documented captures by a clamshell, one occurred in the South Atlantic region on December 3, 2000 while performing work for the Wilmington Harbor deepening project in the Cape Fear River, North Carolina. Though this sturgeon was cited in various reports as a lethal incidental take, the endangered species incident report prepared by Coastwise Consulting indicated that the "bucket brought up an Atlantic Sturgeon entangled in a net. The specimen was decomposing." Assuming that the specimen was killed by entanglement in a net prior to being captured by the bucket, this documented "take" can be discounted. Detailed information is not available for the other two mechanical dredge takes. Given the mobility of sturgeon, the lack of a suction field from mechanical dredging, and the small area of active dredging by a bucket during each load, the likelihood of mechanical dredging to incidentally take sturgeon species is small. Furthermore, compared to other hydraulic dredging techniques, mechanical dredging is often recommended by NMFS as the preferred dredging technique for minimizing incidental take of sea turtles and sturgeon. Though clamshell dredge operations have reported capture of larger sturgeon (adult/juvenile), it is unlikely that clamshell dredging operation would impact small

juvenile and larval sturgeon since there is no suction field generated by mechanical dredges.

4.3.6 Ship Strike

Commercial traffic can have an adverse effect on sturgeon through propeller and ship strike damage. Ship strikes pose a particular threat to sturgeon within shipping channels. Sturgeon are benthic feeders and spend most of their time on the bottom. Large vessels that transit shipping channels typically draft close to the bottom of the channel, thereby posing a threat to sturgeon. Multiple suspected ship strikes have been reported in rivers in the Mid-Atlantic States. A large number of the mortalities observed in these rivers from potential ship strikes have been of large adult Atlantic sturgeon. Between 2005 and 2008, a total of 28 Atlantic sturgeon mortalities were reported in the Delaware Estuary. Sixty-one percent of the mortalities reported were of adult size and 50 percent of the mortalities resulted from apparent vessel strikes (Brown and Murphy 2010). Analysis of the location and type of injury indicated that the encounters were most likely due to propeller strikes and not bow strikes. Vessels transit the Delaware Estuary through a shipping channel that extends 121 river miles from the mouth of Delaware Bay to near Bordentown, New Jersey. The relatively long distance vessels need to travel from the sea through the estuary to reach the ports is unusual as most of the other major Atlantic Coast ports, including Savannah Harbor, are located much closer to the sea. It is thought that the long distance that vessels transit through the Delaware Estuary allow for a greater chance of vessel interaction with sturgeon (Brown and Murphy 2010).

The James River, Virginia is similar to the Delaware River in that commercial vessels transit long distances (over 80 river miles) through a narrow channel to reach the ports. During 2005, five sturgeon were reported to have been struck by commercial vessels within the James River. Additionally, an average of one strike per five years has been reported in the Cape Fear River, North Carolina. No vessel strikes to sturgeon have ever been reported occurring in the Savannah River, which has a shipping channel that is shorter and wider than the aforementioned channels. The chance of a ship strike within the Savannah River is low as the populations of sturgeon are small, the distance from the mouth of the harbor to the port is short (less than 19 miles), and the channel is also wide, ranging from 500 to 2400 feet. In addition, according to the COE, there will be fewer (but larger) vessels entering the Savannah Harbor, which should decrease the chance of encounters with sturgeon. Therefore, NMFS believes that the chances of ship strikes to sturgeon that may result from the project is discountable because of the short shipping channel distance through the estuary combined with there being a small population of sturgeon, and a lower number of vessel transits. Also, while ships are transiting the estuary, the wide channel will allow highly mobile sturgeon to safely avoid ship traffic.

4.3.7 Climate Change/Sea Level Rise

Long-term observations confirm that climate is changing at a rapid rate. Over the 20th century, the average annual U.S. air temperature has risen by almost 0.6°C (1°F) and

precipitation has increased nationally by 5-10 percent, mostly due to an increase in heavy downpours (NAST 2000). These trends are most apparent over the past few decades.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next century. Both of the principal climate models used by the National Assessment Synthesis Team (NAST) project warming in the Southeast by the 2090s, but at different rates (NAST 2000): the Canadian model scenario shows the southeast United States experiencing a high degree of warming, which translates into lower soil moisture as higher temperatures increase evaporation; the Hadley model scenario projects less warming and a significant increase in precipitation (about 20 percent). The scenarios examined, which assume no major interventions to reduce continued growth of world greenhouse gases (GHG), indicate that temperatures in the United States will rise by about 3°-5°C (5°°-9°F) on average in the next 100 years which is more than the projected global increase (NAST 2000). A warming of about 0.2°C per decade is projected for the next two decades over a range of emission scenarios (IPCC 2007). This temperature increase will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions.

Sea-level rise (SLR) is one of the more certain consequences of climate change; it has already had significant impacts on coastal areas and these impacts are likely to increase. Since 1852 when the first topographic maps of the Southeast region were prepared, high tidal flood elevations have increased approximately 12 inches. During the 20th century, global sea level has increased between 15 and 20 cm (NAST 2000). Analysts attribute the coastal forest decline in the Southeast to salt water intrusion associated with sea level rise. Coastal forest losses will be even more severe if sea-level rise accelerates as is expected as a result of global warming.

Between 1985 and 1995, more than 32,000 acres of coastal salt marsh were lost in the southeastern United States due to a combination of human development activities, SLR, natural subsidence, and erosion (NAST 2000). Sea level is predicted to increase by 30-100 cm by 2100 (IPCC 2007). The vulnerability of tidal wetlands to accelerated SLR depends on geologic factors, such as tectonic uplift and glacial isostatic adjustment, which buffer shorelines from SLR, and subsidence, which accelerates it. Tide range also effects marsh vulnerability, as macro- (>4 m) and meso-tidal (2-4 m) marshes are less susceptible to SLR than micro-tidal (<2 m) marshes (Stevenson and Kearney in press). In some coastal areas, rising sea level may result in tidal marsh submergence (Moorehead and Brinson 1995) and habitat migration, as salt marshes transgress landward and replace tidal freshwater and brackish marshes (Park et al. 1991). Flood and erosion damage stemming from SLR rise coupled with storm surges are very likely to increase in coastal communities. Simulation modeling predicts that a 52-cm increase in SLR will lead to a decline in tidal marsh area and delivery of ecosystem services along the Georgia coast during this century (Craft et al. 2008): a 20 percent reduction in salt marsh, along with a small increase in tidal freshwater marsh (+2 percent), and a larger increase in brackish marsh (+10 percent). The decline in salt marsh is attributed to submergence and replacement by tidal flats and estuarine open water (Craft et al. 2008). Regionally, the

areas most vulnerable to future sea level change are those with low relief that are already experiencing rapid erosion rates, such as the Southeast and Gulf Coast (NAST 2000).

Many ecosystems are highly vulnerable to the projected rate and magnitude of climate change. While it is possible that some species will adapt to changes in climate by shifting their ranges, the degree of adaptation that may occur will likely be limited by human and geographic barriers and the presence of invasive non-native species. Losses in local biodiversity are likely to accelerate towards the end of the 21st century.

It is difficult to assess the potential effects of climate change over the next few decades on coastal and marine resources, especially as climate variability is a dominant factor in shaping coastal and marine systems. The effects of future change will vary greatly in diverse coastal regions for the United States. Warming is very likely to continue in the United States during the next 25 to 50 years regardless of reduction in GHGs, due to emissions that have already occurred (NAST 2000). It is very likely that the magnitude and frequency of ecosystem changes will continue to increase in the next 25 to 50 years, and it is possible that they will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods when they are of greatest concern (NAST 2000). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation (IPCC 2007).

A warmer and drier climate will reduce stream flows and increase water temperatures. Expected consequences would be a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch et al. 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer, wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants currently degrade water quality (Murdoch et al. 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources in the Southeast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. A global analysis of the potential effects of climate change on river basins indicates that due to changes in discharge and water stress, the area of large river basins in need of reactive or proactive management interventions in response to climate change will be much higher for basins impacted by dams than for basins with free-flowing rivers (Palmer et al. 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might

ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change. Within 50 years, river basins that are impacted by dams or by extensive development will experience greater changes in discharge and water stress than unimpacted, free-flowing rivers (Palmer et al 2008).

4.3.8 Drought

Large-scale factors impacting riverine water quality and quantity that likely exacerbate habitat threats to shortnose and Atlantic sturgeon include drought, and intra- and inter-state water allocation. Since 2007, the southeastern United States has experienced several years of drought. During this time, Georgia and South Carolina experienced drought conditions that ranged from moderate to extreme. From 2006 until mid-2009, Georgia experienced the worst drought in its history. Between November 2007 and November 2008, 50 to 100 percent of the state of Georgia experienced some level of drought ranging in intensity from "abnormally dry" to "exceptional," based on the drought intensity categories used by the U.S. Drought Monitor (NIDIS 2008). Meanwhile water allocation issues are increasing with population growth; a precedent may also be set by a United States Supreme Court decision in a case between Georgia, Alabama, and Florida and between North Carolina and South Carolina over water transfers out of the river basins found in these states (Chapman 2008, McMaster 2007).

Abnormally low stream flow can restrict access to habitat areas, reduce thermal refugia, and exacerbate water quality issues such as high temperature, low dissolved oxygen, and elevated nutrient and contaminant levels. Further reduction in flow would likely disrupt spawning cues, and upstream migration may occur earlier; a disparity between prey availability and demand by larvae could ensue. NMFS believes that reduced flow down the rivers coupled with rising sea level will push the salt wedge further upriver and likely result in constricting available shortnose sturgeon foraging habitat. Data from gauging stations indicate that periods when river flows are inadequate to protect the riverine environment from salt water intrusion are becoming more frequent. Human-induced modifications to free-flowing rivers also influence coastal and marine systems, often reducing the ability of the system to adapt to natural variability and change.

Drought and water allocation issues and their associated impacts on water quality will likely work synergistically with climate change impacts. While debated, researchers anticipate: (1) the frequency and intensity of droughts and floods will change across the Nation; (2) a warming of about 0.2°C per decade; and (3) a rise in sea level (NAST 2000). A warmer and drier climate will reduce stream flows and increase water temperature, resulting in a decrease of dissolved oxygen and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing. Sea level is expected to continue rising: during the 20th century global sea level has increased 15 to 20 cm, and between 1985 and 1995 more than 32,000 acres of coastal salt marsh was lost in the southeastern United States due to a combination of human development activities, sea level rise, natural subsidence and erosion. Rising sea level will likely drive the salt

wedge further upstream, possibly affecting the survival of drifting larvae and constricting available foraging habitat.

Maintenance of adequate flow in spawning areas is especially crucial to the survival of sturgeon. Studies on larval dispersal patterns compared behavior of larvae collected from Connecticut River to those spawned from Savannah River stock. All post-yolk-sac larvae made some downstream movement as yolk-sac larvae (observed more often in the Savannah River stock), dispersal downstream was more closely associated with the post yolk-sac larval stage. Dispersal rates differed as fish from the Connecticut River peaked on days 7–12 after hatching while Savannah River individuals had a longer dispersal with multiple, prolonged peaks, and a low level of downstream movement that continued for the entire larval and early juvenile period.

4.3.9 Impingement and Entrainment

Rates of impingement and entrainment are not known, but the death of one telemetered adult in the intake structure of a factory in the Port of Savannah has been documented. Larvae have been recorded from the intake canals at the Savannah River Site, a federal nuclear facility.

4.3.10 Conservation and Recovery Actions Benefiting Sturgeon

Many measures have been implemented to protect the sturgeon in the Savannah River estuary. Over-fishing, related to targeted fishing of sturgeon has been eliminated as a causative factor in the decline of the Savannah River sturgeon population. Since its ESA listing in 1967, it has been illegal to kill or possess shortnose sturgeon. In 1998, the Atlantic States Marine Fisheries Commission (ASMFC) instituted a coast-wide moratorium on the harvest of Atlantic sturgeon, which is to remain in effect until there are at least 20 protected age classes in each spawning stock (anticipated to take up to 40 or more years). NMFS followed the ASMFC moratorium with a similar moratorium for federal waters. Sturgeon that are caught incidentally as by-catch in shrimp trawls are to be released alive. The phasing out of the traditional method of catching American shad (gillnets in a coastal intercept fishery) has greatly reduced the number of sturgeon inadvertently caught by shad fisherman. In turn, this has greatly reduced the interruption of sturgeon migrations in the late winter and early fall.

Point source discharges in the Savannah River are regulated under the NPDES program by the Georgia DNR-EPD in coordination with the EPA. Since the NPDES is a federally-mandated program, all permits issued under the program are subject to review per the provisions of the ESA. The EPA established a total maximum daily load (TMDL) for the Savannah River to improve dissolved oxygen conditions in the Savannah Harbor. The TMDL requires a reduction in oxygen demanding substances (over time, as the various NPDES permits come up for renewal) in point source discharges. This impacts NPDES permit holders in the Augusta, Georgia, area as well, since their waste loads contribute to the dissolved oxygen deficiencies in Savannah Harbor.

4.3.11 Summary and Synthesis of Environmental Baseline for Sturgeon

In summary, juvenile and adult shortnose and Atlantic sturgeon occupy habitats likely to be affected by the proposed harbor deepening. Research shows that sturgeon likely move through all areas of a river system but often remain in important resting and feeding aggregations for extended time periods (Kieffer and Kynard 1993). The demersal nature of these fish makes them vulnerable to bottom water quality degradation (i.e., increased salinity and decreased dissolved oxygen) and the adults, because they may be found in the areas undergoing dredging, may be subject to direct mortality from dredging operations and ship strikes. The survival of juveniles and recruitment to the adult population has been identified as a potential limiting factor in population growth (Smith et al. 1992). Deterioration of water quality (especially dissolved oxygen) appears to be degrading the nursery function of these summer refugia, possibly creating a recruitment bottleneck (Collins et al. 2000a). However, spawning failure also contributed to recruitment limitation. The degradation of habitat due to dredging has been indicated as being detrimental to sturgeon in the Savannah River (Collins et al. 2001). The low catch rate of juveniles in the previous and on-going studies suggests that natural recruitment is low. In the Southeast, this is generally attributed to poor water quality in the nursery habitat surrounding the fresh/brackish water interface area (Collins et al. 2001).

4.4 Status and Distribution of Sea Turtles in the Action Area

Sea turtle species occurring in the project area that may be adversely affected by the proposed action are Kemp's ridley and loggerhead sea turtles. 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. These impacts outside of the action area are discussed and incorporated as part of the overall status of the species as detailed in Section 3 above. The following environmental baseline includes past and ongoing human activities in the action area that relate to the status of the species.

All of these species are highly migratory. The same individuals found in the action area may migrate into offshore waters and thus be impacted by activities occurring there; therefore, the species' statuses in the action area are considered to be the same as their range-wide statuses and supported by the species accounts in Section 3.

4.4.1 Factors Affecting Sea Turtles in the Action Area

As stated in Section 2.2 ("Action Area"), the proposed project is located off Georgia, within the Savannah Harbor, and within the extension of the Entrance Channel. The following analysis examines actions that may affect these species' environment specifically within the defined action area.

4.4.1.1 Federal Actions

In recent years, NMFS has undertaken several ESA Section 7 consultations to address the effects of federally-permitted fisheries and other federal actions on threatened and endangered sea turtle species, and when appropriate, has authorized the incidental taking of these species (Appendix A). The term "take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Each of those consultations sought to develop ways of reducing the probability of adverse effects of the action on sea turtles. Similarly, NMFS has undertaken recovery actions under the ESA that 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 includes only those federal actions in or near the action area that have already concluded or are currently undergoing formal Section 7 consultation.

Dredging
The construction and maintenance of federal navigation channels has 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. The COE has biological opinions from NMFS covering hopper dredging in the Atlantic and Gulf of Mexico. Along the Atlantic coast of the southeastern United States (North Carolina through Florida), NMFS estimates that annual observed injury or mortality of sea turtles from hopper dredging may total 35 loggerheads, 7 greens, 7 Kemp's ridleys, and 2 hawksbills (NMFS 1997a).

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 NMFS and individual states to enter into cooperative agreements 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. 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. As of January 2009, there were 10 active scientific research permits directed toward sea turtles. 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 NMFS must also be reviewed for compliance with Section 7 of the ESA to ensure that issuance of the permit does not result in jeopardy to the species.

4.4.1.2 Federally-Managed Fisheries Effects on Sea Turtles

Threatened and endangered sea turtles are adversely affected by several types of fishing gears used throughout the action area. Gillnet, longline, vertical hook-and-line gear, trawl gear, and pot/trap fisheries have all been documented as interacting with sea turtles. Available information suggests sea turtles can be captured in any of these gear types when the operation of the gear overlaps with the distribution of 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, impacts have been evaluated under Section 7. Formal Section 7 consultation conducted on the following fisheries, occurring at least in part within the action area, were found likely to adversely affect threatened and endangered sea turtles: coastal migratory pelagics, dolphin-wahoo, South Atlantic snapper-grouper, Southeast shrimp, and Atlantic HMS fisheries (i.e., swordfish, tuna, shark, and billfish). An Incidental Take Statement (ITS) has been issued for the take of sea turtles in each of these fisheries.

The FMP for the dolphin/wahoo fishery was approved in December 2003. NMFS conducted a formal Section 7 consultation to consider the effects of implementation of the FMP on sea turtles. The biological opinion concluded that loggerhead, leatherback, hawksbill, green, and Kemp's ridley sea turtles may be adversely affected by operation of the fishery. However, the proposed action was not expected to jeopardize the continued existence of any of these species. An ITS has been provided.

A Section 7 consultation on the South Atlantic snapper-grouper fishery (NMFS 2006) has also been completed by NMFS. The fishery uses spear and powerhead, pots (i.e., traps), longline, and vertical hook-and-line gear. The opinion determined that only longline and vertical hook-and-line gear is likely to adversely affect green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles. The consultation concluded the proposed action was not likely to jeopardize the continued existence of any of these species, and an ITS was provided.

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.

Atlantic pelagic longline fisheries targeting swordfish and tuna are also known to incidentally capture large numbers of loggerhead and leatherback sea turtles. The fishery mainly interacts with leatherback sea turtles and pelagic juvenile loggerhead sea turtles, thus, younger, smaller loggerhead sea turtles than the other fisheries described in this environmental baseline.

NMFS reinitiated consultation in 2004 on the pelagic longline component of this fishery as a result of exceeded incidental take levels for loggerheads and leatherbacks (NMFS 2004b). The resulting opinion (i.e., NMFS 2004b) stated the long-term continued operation of this sector of the fishery was likely to jeopardize the continued existence of leatherback sea turtles, but RPAs were implemented allowing for the continued authorization of the pelagic longline fishing that would not jeopardize leatherback sea turtles.

On July 6, 2004, NMFS published a final rule to implement management measures to reduce bycatch and bycatch mortality of Atlantic sea turtles in the Atlantic pelagic longline fishery (69 FR 40734). The management measures include mandatory circle hook and bait requirements, and mandatory possession and use of sea turtle release equipment to reduce bycatch mortality. The rulemaking, based on the results of the 3-year Northeast Distant Closed Area research experiment and other available sea turtle bycatch reduction studies, is expected to have significant benefits to endangered and threatened sea turtles by reducing mortality attributed to this fishery.

NMFS completed a Section 7 consultation on the continued authorization of Migratory Species (HMS) Atlantic shark fisheries. The commercial sector uses bottom longline and gillnet gear, while the recreational sector only uses hook-and-line gear. To protect declining shark stocks, the proposed action seeks to greatly reduce the fishing effort in the commercial component of the fishery. These reductions are likely to greatly reduce the interactions between the commercial component of the fishery and sea turtles. The opinion concluded that green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles may be adversely affected by operation of the fishery; however, the proposed action was not expected to jeopardize the continued existence of any of these species, and an ITS was provided.

NMFS completed a Section 7 consultation on the continued authorization of the coastal migratory pelagic resources fishery in the Gulf of Mexico and South Atlantic (NMFS 2007a). In the Gulf of Mexico and South Atlantic, commercial fishermen target king and Spanish mackerel with hook-and-line (i.e., handline, rod-and-reel, and bandit), gillnet, and cast net gears. Recreational fishermen use only rod-and-reel. Run-around gillnets are still the primary gear used to harvest Spanish mackerel, but the fishery is relatively small because Spanish mackerel are typically more concentrated in state waters where gillnet gear is prohibited. The 2007 opinion concluded that green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles may be adversely affected only by the gillnet component of the fishery. The continued authorization of the fishery was not expected to jeopardize the continued existence of any of these species and an ITS was provided.

4.4.1.3 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 (which permits these events) have consulted on some of these events in Florida, but a complete analysis has not been completed. Formal consultation is currently undergoing on the USCG Seventh District's marine events permitting program. NMFS has also consulted with other agencies, such as MMS and FERC, on vessel transit interactions with listed species.

The Sea Turtle Stranding and Salvage Network (STSSN) includes many records of vessel interaction with sea turtles. However, it was not possible to determine in many cases whether the vessel strike occurred before or after the turtle's death. Stranding information does not indicate where a potential mortality event (e.g., vessel strike) occurred, as a turtle could have been injured/killed at one location and then drifted with currents (i.e., generally northward with the Gulf Stream on the East Coast) for a considerable distance before coming ashore. The extent of the impact on sea turtles in the action area is not known at this time.

State Fisheries
Commercial state fisheries are located in the nearshore habitat areas that comprise the action area. Recreational fishing from private vessels also occurs in the area. Observations of state recreational fisheries have shown that loggerhead sea turtles are known to bite baited hooks and 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). Additionally, lost fishing gear such as line cut after snagging on rocks, or discarded hooks and line, can also pose an entanglement threat to sea turtles in the area. 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). In August of 2007, NMFS issued a regulation (72 FR 43176, August 3, 2007) to require any fishing vessels subject to the jurisdiction of the United States to take observers upon NMFS' request. The purpose of this measure is to learn more about sea turtle interactions with fishing operations, to evaluate existing measures to reduce sea turtle takes, and to determine whether additional measures to address prohibited sea turtle takes may be necessary.

4.4.1.4 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, anthropogenic marine debris, and acoustic impacts. The impacts from these activities are difficult to measure.

Where possible, conservation actions are being implemented to monitor or study impacts from these sources.

Marine Pollution
Sources of pollutants along the Atlantic 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. Issues of marine debris are also a concern for sea turtles as they have been known to ingest or become entangled in various forms of marine debris.

Acoustic Impacts
Acoustic impacts can include temporary or permanent injury, habitat exclusion, habituation, and disruption of other normal behavior patterns. NMFS and the U.S. Navy are working cooperatively to assess military acoustic impacts (e.g., mid-range sonar) along the east coast of the United States (i.e., primarily North Carolina through Florida). Although focused on marine mammals, sea turtles may benefit from increased research on acoustics and reduction in noise levels.

Climate Change
Climate change at normal rates (thousands of years) was not historically a problem for sea turtles species since they have shown unusual persistence over a scale of millions of years. However, there is a 90 percent probability that warming of Earth's atmosphere since 1750 is due to human activities resulting in atmospheric increases in carbon dioxide, methane, and nitrous oxide (IPCC 2007). All reptiles including sea turtles have a tremendous dependence on their thermal environment for regulating physiological processes and for driving behavioral adaptations (Spotila et al. 1996). In the case of sea turtles, where many other habitat modifications are documented (beach development, loss of foraging habitat, etc.), the prospects for accentuated synergistic impacts on survival of the species may be even more important in the long-term. Atmospheric warming creates habitat alteration which may change sex ratios, reproductive periodicity, marine habitats, or prey resources such as crabs and other invertebrates. It may increase hurricane activity leading to an increase in debris in nearshore and offshore waters, resulting in increase in entanglement, ingestion, or drowning. Atmospheric warming may change convergence zones, currents and other oceanographic features that are relevant to various sea turtles' life stages.

4.4.1.5 Conservation and Recovery Actions Benefiting Sea Turtles

Under Section 6 of the ESA, NMFS may enter into cooperative research and conservation agreements with states to assist in recovery actions of listed species. NMFS currently has

a Section 6 agreement with the State of North Carolina. Prior to issuance of these agreements, the proposal must be reviewed for compliance with Section 7 of the ESA.

NMFS and cooperating states have established an extensive network of Sea Turtle Stranding and Salvage Network (STSSN) participants along the Atlantic and Gulf of Mexico coasts that not only collect data on dead sea turtles, but also rescue and rehabilitate any live stranded sea turtles.

Other Actions
A revised recovery plan for the loggerhead sea turtle was completed December 8, 2008 (NMFS and USFWS 2008). The recovery plan for the Kemp's ridley sea turtle is 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. Five-year status reviews have recently been completed for green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles. These reviews were conducted to comply with the ESA mandate for periodic status evaluation of listed species to ensure that their threatened or endangered listing status remains accurate. Each review determined that no delisting or reclassification of a species status (i.e., threatened or endangered) was warranted at this time. However, further review of species data for the green, hawksbill, leatherback, and loggerhead sea turtles was recommended, to evaluate whether distinct population segments (DPS) should be established for these species (NMFS and USFWS 2007a-e). 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 STSSN participants along the Atlantic and Gulf of Mexico coasts that not only collect data on Dead Sea turtles, but also rescue and rehabilitate any live stranded sea turtles.

4.4.1.6 Summary and Synthesis of Environmental Baseline for Sea Turtles

In summary, several factors adversely affect sea turtles in the action area. These factors are ongoing and are expected to occur contemporaneously with the proposed action. Fisheries in the action area likely had the greatest adverse impacts on sea turtles in the mid to late 80s, when effort in most fisheries was near or at peak levels. With the decline of the health of managed species and economic pressure on the shrimp fishery, effort since that time has generally been declining. Impacts associated with fisheries have been reduced through the Section 7 consultation process and regulations implementing effective bycatch reduction strategies. However, interactions with commercial and recreational fishing gear are still ongoing and are expected to occur contemporaneously with the proposed action. Other environmental impacts including effects of vessel operations, additional military activities, dredging, permits allowing take under the ESA, private vessel traffic, and marine pollution have also had and continue to have adverse effects on sea turtles in the action area in the past, but to a lesser degree of magnitude.

5 EFFECTS OF THE ACTION

In this section of the opinion, we assess the effects of the proposed action on loggerhead sea turtles, Kemp's ridley sea turtles, shortnose sturgeon, and Atlantic sturgeon within the action area. The analysis in this section forms the foundation for our jeopardy analysis in Section 7.0. A jeopardy determination is reached if we would reasonably expect the proposed action to cause reductions in numbers, reproduction, or distribution that would appreciably reduce listed species' likelihood of surviving and recovering in the wild.

The proposed deepening is likely to adversely affect sturgeon and sea turtles. Impacts may include direct, short-term impacts from dredging and disposal operations to more long-term impacts caused by loss of habitat and habitat degradation. Although all dredging and sediment placement activities would be conducted well-below sturgeon spawning areas and downstream of juvenile/adult habitat near the freshwater interface, the effects of the activities will directly impact the habitat of sturgeon and their prey, and reduce the amount of habitat in which sturgeon can perform essential biological functions, such as feeding and maturing. The harbor deepening will impact both adult and juvenile shortnose sturgeon habitat in the upper harbor estuary due to increases in salinity levels and decreases in dissolved oxygen concentrations. Juvenile and adult sturgeon are dependent upon this unique estuarine habitat found near the freshwater/saltwater interface for foraging and resting. Offshore dredging of the Entrance Channel and disposal activities will affect sea turtles and adult Atlantic sturgeon. Restoration of access to spawning habitat at the Augusta Shoals with properly designed fish passage at New Savannah Bluff Lock and Dam would reduce the ongoing adverse effects of the dam's impedance of access to spawning habitat, improving spawning and recruitment success for both sturgeon species.

5.1 Effects of the Action on Sea Turtles

5.1.1 Dredging

The potential for adverse effects of dredging operations on sea turtles has been previously assessed by NMFS (NMFS 1991, 1995, 1997a, 1997b, 2003b) in the various versions of the SARBO and the 2003 (revised in 2005 and 2007) Gulf of Mexico RBO. Additionally, the COE has recently prepared a comprehensive analysis of data from Gulf and Atlantic hopper dredging projects to identify factors affecting sea turtle take rates (Dickerson et al. 2007). Furthermore, the COE maintains an on-line Sea Turtle Data Warehouse (USACE 2010) with historical records of dredging projects and turtle interactions. These are the primary sources, discussed further below, for our analysis of dredging effects on sea turtles.

Mechanical (Clamshell/Bucket Dredges) and/or Cutterhead Dredging
The project may affect sea turtles by injury or death as a result of interactions with equipment or materials used during dredging; however, NMFS believes the chance of injury or death from interactions with clamshell and/or hydraulic dredging equipment is discountable as these species are highly mobile and are likely to avoid the areas during

construction. NMFS has received very few reported sea turtle takes associated with these dredging methods. In the South Atlantic region two sea turtles have been taken by a clamshell dredge over the past 20 years, the most recent of which occurred on May 19, 2011, at Cape Canaveral, Florida, which routinely has very high local turtle abundance. Due to the infrequency of interactions with these gear types, NMFS believes that the likelihood of sea turtles being taken by a hydraulic cutterhead or a clamshell dredge is discountable.

Hopper Dredging

Hopper dredging was implicated in the mortality of South Atlantic endangered and threatened sea turtles as early as the late 1970s and in NMFS' opinions issued in 1979, 1980, and others leading to the RBO issued in 1991. This determination was repeated in the 1995 and 1997 SARBOs (NMFS 1995, 1997a, 1997b). The measures established in consecutive RBOs (NMFS 1991, 1995, 1997a) to avoid and minimize sea turtle interactions during hopper dredging operations permitted by the COE in the southeastern United States are included in this project, with the exception of modifications to dredge timing (i.e., "dredging window") and conditions of/requirements for capture-type relocation trawling.

To date, use of hopper dredges in COE activities in northeast Florida and Georgia has been limited under the 1997 RBO to operating between December 1 through April 15, except in emergency situations, due to the presumption that the potential for lethal and injurious take of sea turtles by hopper dredges would be lower during winter periods of lower seasonal abundance. However, recent data analysis of hopper dredging projects from 1995-2008 by the COE indicates that documented sea turtle take rates in projects from Georgia and the east coast of Florida are lower (on both a turtles-taken-per-project basis and turtles-taken-per-day basis) during May through November (when hopper dredging is discouraged) than during December through April, which is the NMFS-recommended dredging window. Turtles are typically more abundant during the warm summer months but may not spend large amounts of time on or in the bottom sediments and may need to surface more often to breathe due to increased activity. Turtles resting on or in bottom sediments are more vulnerable to dredge entrainment than turtles swimming in the water column above the draghead. Although increased numbers of sea turtles are known to be encountered between June and September (peak nesting season), they may be less vulnerable to entrainment because of their biological requirements (e.g., reproductive activities, reduced feeding, increased metabolism), mandating them to spend more time in the upper water column. Given this evidence and rationale, hopper dredging conducted during December 1 through March 31 may result in more takes than during the summer dredging.

To calculate the expected rates of turtle entrainment in hopper dredging for this project, NMFS consulted the Sea Turtle Data Warehouse (USACE 2011) to find the most applicable historic dredging information for the Savannah Harbor Entrance Channel.

Savannah Harbor Entrance Channel
From 2000 through 2010 (Table 8), maintenance dredging of the Savannah Harbor Entrance Channel generated approximately 7,306,635 cubic yards of material. During the same time period 10 sea turtles were taken in hopper dredges during these maintenance events. This equates to a catch per unit effort (CPUE) of 0.0000013 turtles per cubic yard dredged.

YEAR	QUANTITY OF DREDGED MATERIAL (CUBIC YARDS)	TURTLE TAKES	RELOCATION TRAWLING
2000	1,279,900	2 (1 loggerhead; 1 Kemp's)	N
2001	1,117,900	2 loggerhead	N
2002	446,850	2 loggerhead	N
2003	635,163	0	N
2004	620,642	0	N
2005	888,100	0	N
2006	88,194	4 (3 Kemp's; 1 loggerhead)	N
2007	973,463	0	Y
2008	484,607	0	N
2009	261,780	0	N
2010	510,036	0	N
TOTAL	**7,306,635**	**10**	**-**

Table 8. Dredged material removed and sea turtle takes during dredging of the Savannah Harbor Entrance Channel, 2000-2010 (USACE Sea Turtle Data Warehouse 2011).

Using the CPUE we can calculate the number of sea turtles expected to be adversely affected by hopper dredging activities during the proposed action by multiplying the estimated amount of material to be dredged by the CPUE. The proposed project has an estimated 13,325,513 cubic yards of material that would be dredged from the Ocean Bar Channel (Table 9); therefore, we estimate that 17 turtles (10 loggerhead and 7 Kemp's ridley sea turtles based on species composition reported in previous Savannah Harbor dredging projects) will be observed (and counted) by onboard protected species observers as lethally taken during the course of the proposed hopper dredging in the Savannah Harbor Entrance Channel. This estimate is based on the use of only hopper dredges for the entire project and represents only the sea turtle mortalities *detected* by onboard observers.

NMFS-approved observers monitor dredged material inflow and overflow screening baskets on many hopper dredging projects, and observers will be required to monitor the proposed action. Dredged material screening, however, is only partially effective, and observed takes likely provide only partial estimates of total sea turtle mortality. NMFS believes that some turtles killed by hopper dredges go undetected because body parts are

forced through the sampling screens by water pressure and are buried in the dredged material, or animals are crushed or killed but their bodies or body parts are not entrained by the suction and so the takes may go unnoticed. The only mortalities that are noticed and documented are those where body parts float, are large enough to be caught in the screens, and can be identified as sea turtle parts. Body parts that are forced through the 4-inch (or greater) inflow screens by the suction-pump pressure and that do not float are very unlikely to be observed, since they will sink to the bottom of the hopper and not be detected by the overflow screening. Unobserved takes are not documented, thus, observed takes may under-represent actual lethal takes. It is not known how many turtles are killed but unobserved. Because of this, in the Gulf of Mexico Regional Biological Opinion (NMFS 2003b), in making its jeopardy analysis, NMFS estimated that up to one out of two impacted turtles may go undetected (i.e., that observed take constituted only about 50 percent of total take). That estimate was based on region-wide (overall Gulf of Mexico) hopper dredging projects including navigation channel dredging and sand borrow area dredging for beach renourishment projects, year-round, including seasonal windows when no observers are required, times when 100 percent coverage is required, and times when only 50 percent observer coverage is required (i.e., at sand borrow sites). The proposed December 1 through March 31 dredging of the Savannah Harbor Entrance Channel will include 100 percent observer coverage for the duration of work. Since the 100 percent observer coverage that will be required for the proposed dredging action is twice as intensive (and theoretically, twice as effective) as the 50 percent observer coverage requirement of the 2003 Gulf of Mexico Regional Biological Opinion, NMFS believes that a significantly greater number of turtles will be detected with 100 percent observer coverage than with just 50 percent observer coverage (i.e., one of two turtles), but that a significant number of turtle parts will still pass through the screens undetected. In NMFS' January 7, 2009, Mayport ship channel hopper dredging biological opinion to the U.S. Navy, under similar circumstances to the proposed action (i.e., it also required 100 percent observer coverage year-round), NMFS estimated that approximately 66 percent (two out of three entrained turtles or turtle parts) would be observed/documented by shipboard protected species observers. More recently, NMFS' biological opinion to the COE's Galveston District on the Freeport Harbor navigation channel widening and deepening project (also with 100 percent observer coverage) again anticipated that approximately 66 percent of entrained turtles would be detected. Now, similarly, NMFS estimates that observers on the proposed project will detect approximately two of every three turtles entrained. This estimate is based on the use of 100 percent observer coverage, the best available empirical evidence, years of hopper dredging experience and observer reports, and the commonality of the 100 percent observer requirement with previous dredging consultations under similar conditions. This opinion estimates that observers will detect and record approximately 66.6% of total mortality (i.e., two of every three turtles killed by the dredge will be detected, observed, and tallied by onboard observers), resulting in an additional estimated 6 loggerheads and 4 Kemp's ridleys taken, but not detected, for a total of 27 sea turtles taken.

As with previous NMFS biological opinions on hopper dredging, our subsequent jeopardy analysis is necessarily based on our knowledge (in this case, our best estimate) of the total number of turtles that will be lethally taken, which includes those that are

killed but not observed. Our best estimate of turtles lethally taken will be the sum of the observed and unobserved takes, i.e., those observed and documented by onboard protected species observers, plus those unobserved, undocumented lethal takes (because the turtles/turtle parts were either not entrained, or were entrained but were not seen/counted by onboard protected species observers). For example, the 2003 Gulf of Mexico Regional Biological Opinion on hopper dredging estimated that 80 loggerhead sea turtles would be killed by hopper dredges each year, but that only 40 would be detected by onboard observers.

Our ITS, is based on observed takes, not only because observed mortality gives us an estimate of unobserved mortality, but because observed, documented take numbers serve as triggers for some of the reasonable and prudent measures, and for potential reinitiation of consultation if actual observed takes exceed the anticipated/authorized number of observed takes. Furthermore, our ITS level of anticipated/authorized lethal takes is based on the implementation of relocation trawling, since it is an integral and important part of the proposed action. Without the implementation of relocation trawling, mortalities resulting from hopper dredge activities could be higher.

Station	Total by Station in Cubic Yards
-98+600B to -60+000B	4,212,500
-60+000B to -57+000B	401,409
-57+000B to -53+500B	469,252
-53+500B to -40+000B	1,959,186
-40+000B to -30+000B	1,573,800
-30+000B to -20+000B	1,628,379
-20+000B to -10+000B	1,594,871
-10+000B to -0+000B	1,110,713
0+000B to 4+000B	375,403
TOTAL	13,325,513

Table 9. Estimated New Work Sediment by Reach for the Outer Harbor (Ocean Bar Channel)

A very few turtles (over the years, a fraction of a percent) survive entrainment in hopper dredges, usually smaller juveniles that are sucked through the pumps without being dismembered or badly injured. Often they will appear uninjured only to die days later of unknown internal injuries, while in rehabilitation. Experience has shown that the vast majority of hopper-dredge impacted turtles are immediately crushed or dismembered by the violent forces they are subjected to during entrainment. Therefore, we are conservatively predicting that all takes by hopper dredges will be lethal.

In addition to the initial project impacts, an estimated 1,181,000 cubic yards of material would be removed during annual maintenance dredging of the Entrance Channel; annual maintenance dredging events are covered under the 1997 SARBO, which is currently under reinitiation.

5.1.2 Modified Bed-leveling Activities

Bed-leveling is often associated with hopper dredging (and other types of dredging) operations, and may be utilized in this project. Bed-leveling "dredges" do not use suction; they redistribute sediments, rather than removing them. Plows, I-beams, or other seabed-leveling mechanical dredging devices are often used for cleanup operations, i.e., to lower high spots left in channel bottoms and dredged material deposition areas by hopper dredges or other type dredges. Leveling devices typically weigh about 30 to 50 tons, are fixed with cables to a derrick mounted on a barge pushed or pulled by a tugboat at about one to two knots. Some evidence indicates that bed leveling devices may be responsible for occasional sea turtle mortalities (NMFS 2003e). Sea turtles may be crushed as the leveling device passes over a turtle which fails to move or is not pushed out of the way by the sediment "wave" generated by and pushed ahead of the device. Sea turtles in Georgia waters may have been crushed and killed in 2003 by bed-leveling which commenced after the hopper dredge finished its work associated with the Brunswick Harbor Entrance Channel dredging. The local sea turtle stranding network reported documented stranded crushed sea turtles in the area where the bed-leveler dredge was working, within days after the dredge was in the area. Brunswick Harbor is also one of the sites where sea turtles captured by relocation trawlers sometimes show evidence of brumating (over-wintering) in the muddy channel bottom, which could explain why, if sea turtles were in fact crushed by bed-leveler type dredges (there is no proof, but it is the most likely explanation), they failed to react quickly enough to avoid the bed-leveler. Bed-leveler use at other dredging operations has not resulted in observed or documented sea turtle mortalities; therefore, the best available evidence points to occasional potential interactions to brumating sea turtles at Brunswick. All things considered, the use of bed-levelers is probably preferable (less likely to result in sea turtle interactions) to the use of hopper dredges for cleanup operations, since turtles foraging, resting, or brumating on irregular bottoms are probably more likely to be entrained by suction dragheads than crushed by bed-levelers, because: (1) sea turtle deflector dragheads are less effective on uneven bottoms; (2) hopper dredges move considerably faster than bed-leveler "dredges;" and (3) bed-levelers do not use suction.

The project proposes to authorize their use only in the Bar Channel. Furthermore, their use would be restricted to the leveling of high spots in the channel or placement area, where the use of a hopper dredge for such work would be expected to result in equal or greater take of endangered species. Proposed modifications (i.e., integrated deflector configurations) to traditional bed-levelers are expected to reduce their unknown (but thought to be insignificant) potential to impact non-brumating sea turtles. NMFS believes it is unlikely that turtles may be adversely affected by potential bed-leveling activities during "high-spot cleanup" during the proposed action. However, if injurious or lethal bed-leveler interactions appear to have occurred, based on reports of stranded turtles, they shall be immediately reported to NMFS. Any such takes shall not be counted against the total lethal takes allowed by the Incidental Take Statement of this opinion. In addition, unobserved takes have already been accounted for in our total take estimates (see RPMs, Term and Condition No. 6), as discussed in the preceding section (5.1.1).

5.1.3 Relocation Trawling

The function and purpose of capture relocation trawling is to capture sea turtles that may be in the dredge's path. By reducing the sea turtle density immediately in front of the dredge's suction dragheads, the potential for draghead-turtle interactions is reduced. The relocation trawler typically pulls two standard (60-foot headrope) shrimp trawl nets, as close as safely possible in front of the advancing hopper dredge. The trawler also continues sweeping the area to be dredged (channels or borrow areas) even while the hopper dredge is not actively dredging, e.g., when it is enroute to the ODMDS or pumpout station. Relocation trawling has been successful at temporarily displacing Kemp's ridley, loggerhead, leatherback, and green sea turtles from channels in the Atlantic Ocean and Gulf of Mexico during periods when hopper dredging was imminent or ongoing (Dickerson et al. 2007). Historically, relocation trawling has been used to reduce turtle take by capturing the turtle in a modified shrimp net, bringing it onboard the trawler, and transporting it approximately 3-5 miles from the dredging where it is released into the ocean. Dickerson et al. (2007) analyzed historical data for COE dredging projects in the Atlantic Ocean and Gulf of Mexico and concluded that relocation trawling is effective at reducing the rate of sea turtle entrainment by hopper dredges. Dickerson et al. (2007) also found that the effectiveness of relocation trawling was increased: (1) when the trawling was initiated at the beginning or early in the project, and (2) by the intensity of trawling effort (i.e., more time trawling per hour). Dickerson (pers. comm. 2008) noted that when a relocation trawler is used – whether or not turtles are actually captured – the incidence of lethal sea turtle take by hopper dredges decreases. Dickerson concluded that the action of the trawl gear on the bottom results in stimulating turtles off the bottom and into the water column, where they are no longer likely to be impacted by the suction draghead of a hopper dredge. The effects of relocation trawling on sea turtles will be further discussed below.

Effects of Recapturing of Sea Turtles during Relocation Trawling
Some sea turtles captured during relocation trawling operations return to the dredge site and subsequently are recaptured. For example, sea turtle relocation studies by Standora et al. (1993) at Canaveral Channel, Florida, relocated 34 turtles to six 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. The observed return times from the southern release sites suggested a direct correlation between relocation distance and likelihood of return or length of return time to the channel. 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.

Over a 7-day period in February 2002, REMSA, a private company contracted to conduct relocation trawling, captured, tagged, and relocated 69 turtles (55 loggerheads and 14 greens) from Canaveral Channel, Florida, with no recaptures; turtles were relocated a minimum of 3 to 4 miles away (T. Bargo, REMSA, pers. comm. to Eric Hawk, NMFS

SER, 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, resulted in the relocation of 71 turtles (56 loggerheads, 15 Kemp's ridleys, and 1 leatherback) between 1.5 and 5 miles from the dredge site, with 3 recaptures, all loggerheads (T. Bargo, REMSA, pers. comm. to Eric Hawk, NMFS SER, July 24, 2003). One turtle released on June 14, 2003, approximately 1.5 miles from the dredge site, was recaptured four days later at the dredge site; another turtle captured June 9, 2003, and released about 3 miles from the dredge site was recaptured nine days later at the dredge site. Subsequent releases occurred five miles away. Of these 68 subsequent capture/releases, one turtle released on June 22, 2003, was recaptured 13 days later (REMSA Final Report, Sea Turtle Relocation Trawling, Aransas Pass, Texas, April-July 2003) at the dredge site. Over 15 days of dredging and associated turtle relocation trawling conducted between July 9 and 23, 2010, for the construction of 35 miles of oil-barrier sand-berms at Hewes Point, Chandeleur Islands, Louisiana, resulted in 194 sea turtle trawl-captures and relocations (185 loggerheads, 8 Kemp's ridleys, and 1 green), with 11 turtles recaptured (all loggerheads) at the sand borrow site after being relocated at least 3 miles away from the dredge site (L. Brown, COE, pers. comm. via e-mail to E. Hawk, NMFS, February 22, 2011). Table 10 below compares the various recapture rates for relocation trawling. More recently, from April 11-June 11, 2011, at the Longboat Key beach nourishment project, 23 sea turtles were captured and relocated (20 loggerheads, two Kemp's, and one green). One, a large, sexually-mature male loggerhead, was captured at the borrow site (and relocated) three times, released each time at least 3-5 miles away from the capture site, each time in a different compass direction from the borrow site. The last time, the turtle was released with a satellite transmitter attached (E Hawk, NMFS, pers. comm. June 13, 2011).

Number of Turtles Released/Relocated	Relocation Distance from dredge site	Number of Turtles Recaptured	Recapture Timing	Citation
34	43 miles (Southern release site)	10	> 30 days	Standora et al. (1993)
69	Minimum 3-4 miles	0	N/A	T. Bargo, REMSA, pers. comm. to Eric Hawk, NMFS SER, June 2, 2003
71	1.5-5 miles	3	4-13 days	REMSA Final Report, Sea Turtle Relocation Trawling, Aransas Pass, Texas, April-July 2003
194	Minimum 3 miles	11	15 days	L. Brown, COE, pers. comm. via e-mail to E. Hawk, NMFS, February 22, 2011

Table 10. Comparison of Recapture Rates for Relocation Trawling

The capture and handling of sea turtles can result in raised levels of stressor hormones, and can cause some discomfort during tagging procedures; based on past observations obtained during similar research trawls for turtles, these physiological effects are expected to dissipate within a day (Stabenau and Vietti 1999). During the course of 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, Coastwise Consulting, Inc., successfully captured, tagged, and released over 770 loggerhead, Kemp's ridley, green, and hawksbill, and leatherback sea turtles (C. Slay, Coastwise Consulting, pers. comm. via e-mail to E. Hawk, NMFS, January 25, 2007). Only one leatherback mortality was documented and attributed to illegal artificial reef material deployed within a designated borrow area (the trawl net that captured the leatherback got entangled on the reef material and the trawler was unable to haul its nets timely (within 42 minutes, as required by the GRBO); the turtle drowned before the net was able to be freed and brought to the surface). On the Atlantic coast, REMSA 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. In the Gulf of Mexico, REMSA captured, tagged, and relocated 71 turtles at Aransas Pass, Texas, with no apparent long-term ill effects to the turtles. Three injured turtles captured were 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 (T. Bargo, REMSA, pers. comm. to E. Hawk, NMFS, June 2, 2003. Given that sea turtle recaptures are relatively infrequent, and recaptures that do occur typically happen several days to weeks after initial capture, cumulative adverse effects from recapture are not expected.

Relocation Trawl Tow-Time Effects on Sea Turtles

The Gulf and South Atlantic Fisheries Development Foundation's August 31, 1998, "Alternatives to TEDs: Final Report" study presents data on 641 South Atlantic shallow trawl 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 trawl tows conducted under the same tow-time restrictions of 55 and 75 minutes. 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 (time-restricted) South Atlantic efforts, and 30 in the Gulf efforts (24 in nearshore time-restricted tows and 6 in offshore time-unrestricted tows). Of the 293 South Atlantic turtles (219 loggerhead, 68 Kemp's 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, a 2.2 percent fatality rate (6 divided by 274).

For the Gulf efforts, 30 turtle observations/interactions (24 nearshore and 6 offshore) were recorded but just 26 turtles were included in the study's CPUE analysis (21 in nearshore and 5 in offshore), since some may have been previously dead (i.e., non-trawl-related). These 26 captures (8 loggerhead, 16 Kemp's ridley, and 2 green) resulted in three mortalities (1 loggerhead nearshore, 1 loggerhead, and 1 green offshore). The nearshore restricted tow-time mortality rate was 1 of 21 nearshore captures, or 4.8 percent; the offshore non-restricted tow-time mortality rate was 2 of 5 offshore captures, or 40 percent. The latter figure is unsurprising, given the long, unrestricted tow times.

For purposes of our effects of relocation trawling analysis, we excluded all the offshore tows and mortalities because they occurred under prolonged, non-restricted tow times which are not comparable to time-restricted relocation trawling methods. This leaves 1,225 time-restricted tows (584 in the nearshore Gulf of Mexico + 641 in the nearshore South Atlantic), resulting in 295 trawl-captured turtles (274 [South Atlantic nearshore]+ 21 [Gulf of Mexico nearshore]) resulting in seven mortalities (six in the South Atlantic and one in the Gulf of Mexico), i.e., 2.4 percent of the interactions (295 divided by 7) resulted in death. However, it must be remembered that the COE-authorized relocation trawling tow time limit for conservation trawling in association with hopper dredging is much more conservative (in terms of allowable tow times) than the above study which used 55- and 75-minute allowable tow times. Those trawl tow times greatly exceed currently allowed trawl tow times. The COE hopper dredging/relocation trawling protocol established by the COE's South Atlantic Division limits allowable tow times to 30 minutes or less, which results in significantly lower sea turtle mortalities than 2.4 percent, as discussed below.

Since 1991, the COE has documented more than 65 hopper-dredging projects in the South Atlantic and Gulf of Mexico where a trawler was used as part of the project, consisting of thousands of individual tows of relocation trawling nets. In addition, the COE has also conducted or permitted abundance assessments and/or project-specific relocation trawling of sea turtles in navigation channels and sand borrow areas in the Southeast and Gulf of Mexico using commercial shrimp vessels equipped with otter trawls (Sea Turtle Warehouse Data; D. Dickerson 2007). On eight occasions a turtle has been lethally or injuriously taken by a relocation trawler (six in the Gulf of Mexico and two in the South Atlantic) over the same 20-year period (COE Sea Turtle Warehouse; pers. comm., T. Jordan, COE, to E. Hawk, NMFS, May 23, 2011). Some of these incidents are described below.

Rarely, properly conducted relocation trawling can result in accidental sea turtle deaths, as the following examples illustrate. Henwood 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 (T. Henwood, pers. comm. to E. Hawk, December 6, 2002) 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 that appeared much healthier and robust.

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 by drowning occurred after the trawler encountered and entangled its trawl net on a large section of uncharted bottom debris, and was unable to retrieve it from the bottom for several hours (C. Slay, pers. comms. and e-mails to E. Hawk, December 4, 2006; see also Dickerson et al. 2007). Over 15 days of dredging and associated turtle relocation trawling conducted between July 9 and 23, 2010, for the construction of 35 miles of oil-barrier sand-berms at Hewes Point, Chandeleur Islands, Louisiana, 194 sea turtles were trawl-captured, with 3 mortalities in 584 thirty-minute tows, or a 1.5 percent mortality rate (R. Crabtree, NMFS, letter to COE, dated January 14, 2011). NMFS considers that this rate is unusually high, given the last two decades of relocation trawling experience. The reason for the unusually high level of relocation trawler turtle mortalities associated with the berm project is unknown. At Mayport Channel dredging in April 2011, a green turtle was drowned when it entangled in an improperly designed non-capture trawl net (non-capture trawl nets have typical tow times of 3-4 hours).

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.

Current NMFS SER opinions typically limit 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"). This approximates 30 minutes of bottom-trawling time. As previously stated, the COE limits authorized relocation trawling time in association with hopper dredging and its limit is at least as conservative (in terms of allowable tow times) as NMFS'; the COE's current hopper dredging/relocation trawling protocol limits capture-trawling relocation tow times to 30 minutes or less, doors in to doors out. Overall, the significantly reduced tow times used by relocation trawling contractors, compared to those used during the 1998 studies on the effects of unrestricted, 55-minute, and 75-minute tow times leads NMFS to conclude that current relocation trawling mortalities occur (and will continue to occur) at a much lower rate than 2.4 percent. Recent relocation trawling data bears this out strikingly: from October 1, 2006, to June 14, 2011, COE dredging projects relocated 1,216 turtles in the Gulf of Mexico and South Atlantic. There were 5 documented mortalities during those relocation events, or 0.4 percent overall (COE Sea Turtle Data Warehouse, queried June 14, 2011).

Total Impact of Relocation Trawling on Sea Turtles

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 (i.e., injury or death) to sea turtles. As discussed above, NMFS estimates that, overall, sea turtle trawling and relocation efforts will result in considerably less than 0.5 percent mortality of captured turtles, with any mortalities that do occur being primarily due to the turtles being previously stressed or diseased or struck by trawl doors or suffering accidents on deck during codend retrieval and handling. On the other hand, hopper dredge entrainments invariably result in injury, and are almost always fatal.

Even though relocation trawling involves the capture and collection of sea turtles, it has constituted a legitimate RPM in past NMFS biological opinions on hopper dredging because it reduces the level of almost certain injury and mortality of sea turtles by hopper dredges, and it allows the sea turtles captured non-injuriously by trawl to be relocated out of the path of the dredges. Without relocation trawling, the number of sea turtles mortalities resulting from 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 pages 4-54. Therefore, NMFS will in this section evaluate the expected number of sea turtles collected or captured during required relocation trawling, so that these numbers can be included in the evaluation of whether the proposed action will jeopardize the continued existence of the species.

The number of sea turtles collected or captured by trawlers in association with hopper dredging projects varies considerably by project area, amount of effort, and time of year Additionally, sea turtle distribution can be very patchy, resulting in significant differences in number of turtle captures by relocation trawler, and in some areas, one

species may dominate the captures. For example, Canaveral, Florida, is known for its abundance of green turtles; Calcasieu, Louisiana, for its almost exclusive capture of Kemp's ridleys; Brunswick, Georgia, and Mississippi-River Gulf Outlet, Louisiana, captures are predominantly loggerheads (E. Hawk, NMFS, pers. comm., June 13, 2011).

Since October 2011, of the 1,216 turtle captures by relocation trawler, the majority (1,145) occurred in the Gulf of Mexico, while 71 occurred in the South Atlantic (COE Sea Turtle Data Warehouse, June 14, 2011 data). Dickerson et al. (2007) evaluated the effectiveness of relocation trawling for reducing incidental take of sea turtles by analyzing incidental take recorded in endangered species observer reports, relocation trawling reports, and hopper dredging project reports from 1995 through 2006. From 1995 through 2006, 319 hopper dredging projects throughout the Gulf of Mexico (n = 128) and Atlantic Ocean (n = 191) used endangered species monitoring and a total of 358 dredging-related sea turtle takes were reported (Regions: Gulf =147 sea turtles; Atlantic = 211 sea turtles). During the 70 projects with relocation trawling efforts, 1,239 sea turtles were relocated (Regions: Gulf=844; Atlantic=395). Loggerhead is the predominant species for both dredge take and relocation trawling take of sea turtles. Kemp's ridleys rank second. Green turtles have been captured in trawls only during December through March in the Gulf of Mexico. Although 2 hawksbills and 6 leatherbacks were relocated during 1995-2006, neither of these species has ever been killed by a dredge. However, during the Destin-Ft. Walton Beach, Florida, beach nourishment project in December 2006, one leatherback was drowned accidentally when the relocation trawl net in which it was captured got entangled in bottom debris (it took the crew several hours before they were able to free the net and lift it to the surface) (Dickerson et al. 2007).

Based on these data, Dickerson et al. (2007) calculated the average CPUE for dredging projects within the South Atlantic as 1.19 sea turtles per project. This does not account for the volume of sediment dredged during each project. Dickerson et al. (2007) then compared the CPUE of takes per dredge day between dredging periods with and without relocation trawling to evaluate the effectiveness of relocation efforts for reducing incidental take of sea turtles. For projects utilizing relocation trawling, the lowest overall CPUE (0.0222 takes/dredge day) was seen when relocation began at the onset of dredging and continued throughout the entire dredging project. The next lowest take rates were found for projects that either initiated relocation trawling prior to the start of dredging (0.0667 takes/dredge day) or early in the first third of the dredging project (0.0642 takes/dredge day) and continued relocation throughout the remaining dredging project. Smallest reductions in take rates were seen when relocation trawling was initiated either late (during second third) (0.1070 takes/dredge day) or very late (during last third) (0.1808 takes/dredge day) in the dredging project (Dickerson et al. 2007). Table 11 below summarizes the varying CPUE of takes per dredge in relation to when relocation trawling is initiated during a dredge project.

CPUE of takes per dredge day	Initiation of Relocation Trawling
0.0222 takes/dredge day	at onset of dredging and continued throughout the entire dredging project
0.0667 takes/dredge day	Prior to the start of dredging and continued throughout the entire dredging project
0.0642 takes/dredge day	early in the first third of the dredging project and continued throughout the entire dredging project
0.1070 takes/dredge day	during second third of dredging project
0.1808 takes/dredge day	during last third of dredging project

Table 11. CPUE of takes per dredge day in relation to when relocation trawling is initiated during a dredge project.

Dickerson et al. (2007) concluded that relocation trawling is an effective management option for reducing incidental take of sea turtles during hopper dredging in some locations, provided aggressive trawling effort is initiated either at the onset of dredging or early in the project. It is reasonable to assume that, for the proposed action analyzed in this opinion, in the absence of relocation trawling the number of sea turtle mortalities would increase, but predicting a precise number would be problematic due to the fact that the COE has not been consistent in using relocation trawling as a standard practice for the maintenance dredging of the Savannah Harbor Entrance Channel.

The number of sea turtles captured by relocation trawlers does not directly translate into potential mortalities by hopper dredges in the absence of relocation trawling, due to the differences in footprint between the two gear types. The spread of a relocation trawler's net is much greater than the width of a hopper dredge's dragheads; therefore, the trawler will encounter a significantly greater number of sea turtles. Non-injurious takes may be expected with the implementation of relocation trawling. Review of the only relocation data available for the Savannah Harbor where a take occurred, indicates that 159 tows conducted over 7 days (March 28-April 4, 2006) resulted in the take of 1 Kemp's ridley sea turtle. From this, we estimate that during the 121 days of the December 1 to March 31 hopper dredging window (which is the only time period ("window") when hopper dredging is normally allowed by the COE, in accordance with the COE South Atlantic Division's hopper dredging protocol, and is the time frame proposed by the COE for hopper dredging for the currently proposed action), relocation trawling may result in the non-lethal take of up to 17 turtles (of non-specific genera) each year (121 divided by 7 = 17.3). The relocation trawling may result in sea turtle capture, but this type of take is 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) and required safe-handling procedures. It cannot be ruled out that injury or mortality could occur, but such events are rare. As previously explained, based on past experience, 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 from accidents occurring during handling in the water and on deck. Over the last 5.5 years, mortality associated with relocation trawling in the Gulf of Mexico and South Atlantic has averaged 0.4 percent.

Flipper Tagging
Flipper tagging of captured turtles is not expected to have any detrimental effects on captured 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 hopper dredging activities. 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 prior scanning for pre-existing tags).

Genetic Sampling
Analysis of genetic samples may provide information on sea turtle populations such as life history, nesting beach identification, and distribution/stock overlap. This may ultimately lead to enhanced sea turtle protection measures. Tissue sampling is performed to determine the genetic origins of captured sea turtles, and learn more about turtle nesting beach/population origins. This is important information because some populations, e.g., the northern subpopulation of loggerheads nesting in the Southeast Region (i.e., the proposed endangered Northwest Atlantic loggerhead DPS), 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.

Dredged Material Disposal
NMFS believes the proposed dredged material (approximately 13.3 mcy) disposal activities over the 3-4 year life of the project are not likely to adversely affect sea turtles. Sea turtles may be attracted to ODMDS sites, to forage on the bycatch that may be occasionally found in the dredged material being dumped. As such, turtles could be potentially impacted by the sediments being discharged overhead. However, NMFS has never received a report of an injury to a sea turtle resulting from burial in, or impacts from, hopper-dredge-released sediments, neither from inshore or offshore disposal sites, anywhere the COE conducts dredged material disposal operations. Sea turtles are highly mobile and apparently are able to 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. Even if temporarily enveloped in a sediment plume, NMFS believes the possibility of injury, or burial of normal, healthy sea turtles by dredged material (i.e.,

sand and silt) disposal, is discountable or its effects insignificant. NMFS believes that foraging habitat for sea turtles is not likely a limiting factor in the action area, and thus the loss of potential sand bottom foraging habitat adjacent to, or on the surface of, the disposal areas (compared to remaining foraging habitat) from burial by dredged material sediments will have insignificant effects on sea turtles. The risk of injury to sea turtles from collisions with dredge-related vessels is also considered discountable, considering the species' mobility and the slow speed of the hopper dredge vessels and associated barges and scows.

5.1.4 Deepening of Harbor Entrance Channel

Hopper dredges can lethally harm sturgeon by entraining them in dredge drag arms and impeller pumps. The use of the "turtle deflecting draghead" on hopper dredges reduces the potential for take of benthic oriented species (i.e., sea turtles and sturgeon) by creating a sand wave in front of the draghead and pushing animals out of the way that are otherwise at risk of entrainment. However, a review of hopper dredging activity since 2000 in the Savannah Harbor Entrance Channel, approximately 7,306,635 cubic yards of material has been dredged with documented incidental takes of Atlantic sturgeon (n=2) occurring during 2007 and 2009. In addition, eleven Atlantic sturgeon were taken during 2006-2007 in relocation trawling and released alive. The amount of material to be dredged (13,325,513 cubic yards) is slightly less than two times greater than that dredged since 2000. Based on this information and the anticipated amount of dredging, NMFS believes that four Atlantic sturgeon will be killed as a result of hopper dredging and up to 20 will be taken in relocation trawls but released alive.

Considering that Atlantic sturgeon primarily lead a marine existence, with the exception of their spawning migration, and hopper dredges are often operated in ocean bar channels or offshore borrow areas, it is likely that the risk of entrainment by hopper dredges is higher for Atlantic sturgeon than shortnose sturgeon. To date, no shortnose sturgeon have been taken by hopper dredges working in the Savannah Harbor Entrance Channel. Shortnose sturgeon have a low tolerance for fully marine water and are not expected to be in locations where hopper dredging will occur; therefore, impacts to shortnose sturgeon from hopper dredges are not anticipated to occur.

The potential for adult and juvenile sturgeon being hit by a hydraulic cutterhead dredge is low. Even when occupying resting areas, adult and juvenile sturgeon are believed to be very mobile and would not be expected to be impacted by cutterhead dredges. There have been rare, documented incidental takes of shortnose and Atlantic sturgeon by mechanical (clamshell) dredges, with one occurring in the South Atlantic region (Wilmington Harbor). However, given the mobility of sturgeon, the lack of a suction field from mechanical dredging, and the small action area when dredging by a bucket, the likelihood that mechanical dredging will incidentally take sturgeon species is small. It is also unlikely that clamshell dredging operation would impact small juvenile and larval sturgeon since there is no suction field generated.

5.2 Project Effects within the Inner Harbor

Development of Sturgeon Habitat Criteria
The COE applied hydrodynamic and water quality models to assess potential impacts associated with the project (primarily within the estuary). Development and approval of the models was initiated in 1999 and completed in 2005. As the models were being developed, the COE consulted with natural resource agencies to determine the type of information to be evaluated. During meetings held in 2001, the Fisheries Interagency Coordination Team provided guidance on fisheries issues and developed a conservative set of parameters for modeling habitat suitability for the endangered shortnose sturgeon. The Fisheries Interagency Coordination Team determined the conditions which the water quality and hydrodynamic models would use to identify acceptable and unacceptable habitat. The Team defined suitable habitat for shortnose sturgeon during January when dissolved oxygen was not less than 3.5 mg/Liter for more than 10 percent of the time, not less than 3.0 mg/Liter for 5 percent of the time, and not less than 2.0 mg/Liter for more than 1 percent of the time. For August conditions, the Team defined suitable habitat for adult shortnose sturgeon when dissolved oxygen was not less than 4.0 mg/Liter for more than 10 percent of the time, not less than 3.0 mg/Liter for 5 percent of the time, and not less than 2.0 mg/Liter for more than 1 percent of the time. River flow rates and time of year were also specified for the modeling. The median (or 50th percentile) river flows of the long-term conditions of the river were used to model the average conditions (Table 12). Drought conditions were also modeled in sensitivity analyses for comparison with average conditions.

While the models were designed with criteria developed primarily for shortnose sturgeon, it is assumed that habitat identified as suitable for shortnose sturgeon will also be suitable for Atlantic sturgeon. Because Atlantic sturgeon have a much higher tolerance of salinity and therefore a wider range of habitat, this assumption would be protective of Atlantic sturgeon. They are routinely found not only in riverine and estuarine habitats, but also offshore in marine waters while migrating along the East Coast.

Life Stage	Simulation Period	Freshwater Flow Conditions	Habitat Criteria
Shortnose sturgeon Adult	January	50%-tile of Long Term	Suitable habitat when DO >= 3.5 mg/Liter at 90% (10th %ile), >=3.0 at 95% (5th %ile), and >=2.0 at 99% (1 %ile) Suitable habitat when max salinity <= 25 ppt
Shortnose sturgeon Adult	August	50%-tile of Long Term	Suitable habitat when DO >= 4.0 mg/Liter at 90% (10th %ile), >=3.0 at 95% (5th %ile), and >=2.0 at 99% (1 %ile) Suitable habitat when max salinity <= 10 ppt
Shortnose sturgeon Juvenile	January	50%-tile of Long Term	Suitable habitat when DO >= 3.5 mg/Liter at 90% (10th %ile), >=3.0 at 95% (5th %ile), and >=2.0 at 99% (1 %ile) Suitable habitat when 50% exceedance of the max salinity <= 14.9 ppt

Table 12. Habitat Suitability Criteria for Adult and Juvenile Shortnose Sturgeon Developed by the Fisheries Interagency Coordination Team.

Once modeling criteria were selected, the tools were applied and the modeling was performed. The models' calibrations were approved by an interagency team including members of EPA Region 4, the USGS, the US Army Corps of Engineers' Engineering Research and Development Center (ERDC), the South Carolina Department of Health and Environmental Control (DHEC), and the Georgia Department of Natural Resources (GADNR) (NMFS was not a member of this team).

Environmental Fluid Dynamic Computer Code (EFDC) model runs were used to predict hydrodynamic model salinity outputs and the Water Quality Analysis Simulation Program (WASP) model was used to predict dissolved oxygen levels. The Post-Processor Habitat Analysis Module combined the output from the EFDC and WASP models to determine habitat suitability based on criteria for each life stage and time of year. The EFDC hydrodynamics model was originally developed at the Virginia Institute of Marine Science and is maintained by TetraTech under contract to the EPA. The model uses a finite difference solution scheme and a sigma-stretched vertical grid. The water quality model (WASP) was originally developed in 1983 and includes the time-varying processes of advection, dispersion, point and diffuse mass loading, and boundary exchange. Both the water column and the underlying benthos can be included. These models are available to the public through the Total Maximum Daily Load (TMDL) Modeling Toolbox maintained by EPA Region 4 and are considered by the EPA to be the best way to model for these parameters. TetraTech applied the models to the Savannah River estuary and developed an enhanced grid which extends 61 miles upriver and 17 miles oceanward of the harbor entrance. Point source loads in the Savannah Harbor were also used in the model simulations for shortnose sturgeon habitat (Table 13).

Facility	May-October 2004 Loads (lbs/day)	May-October 1999 Loads (lbs/day)	January 2004 Loads (lbs/day)
Beaufort-Jasper Water & Sewer Authority	13.0	25.0	19.1
Georgia-Pacific	5,873.0	3,810.5	7599.5
Weyerhaeuser Co., Port Wentworth	6,797.0	809.9	10,142.9
Garden City Water Pollution Control Plant	32.0	122.0	346.5
Savannah Water Pollution Control Plant Travis Field	27.0	129.0	254.1
Savannah Water Pollution Control Plant President Street	1,489.0	4,399.0	3,915.1
International Paper Co.	143,448.0	86,669.8	102,170.9
TOTAL	157,679.0	95,965.2	124,448.1

Table 13. Point source loads in Savannah Harbor (CBODu lbs/day) – January 2004 loads were used in model simulations.

Different life stages of sturgeon have specific requirements for particular dissolved oxygen levels and tolerance for salinity; when these tolerances are exceeded they will not feed or survive. Benthic-dwelling sturgeon occupy the bottom layer of the water column that is most susceptible to low dissolved oxygen and it is also where the higher salinities are found. In addition, sturgeon often find the temperatures they prefer in these deeper waters that consequently may have undesirable dissolved oxygen or salinity levels. The requirements for classifying habitat as suitable for shortnose sturgeon must consider all of these parameters. Habitat suitability maps showing the areas of suitable and unsuitable habitat, based on salinity and dissolved oxygen criteria for adult and juvenile shortnose sturgeon were prepared for each deepening scenario during winter and summer conditions. Figures 25, 26, and 27 show the existing conditions during the winter for juvenile shortnose sturgeon within the estuarine environment located in the lower Savannah River and during the winter and summer for adult shortnose sturgeon. Habitat criteria for juvenile shortnose sturgeon during the summer was not identified by the Team and therefore not modeled. It is thought that the Team believed most juvenile sturgeon would be found well upriver from the project area, beyond the effects of the deepening during the summer.

The COE's original models used all of the habitat criteria first identified by the Team, but NMFS later adjusted the habitat suitability criteria for salinity ranges tolerated by juvenile shortnose sturgeon. This was done to reflect better agreement between the models and field observations of captured juvenile shortnose sturgeon. In general, NMFS accepted the modeled habitats for shortnose sturgeon to be representative of field observations. There were a few small discrepancies, particularly noted for adult shortnose sturgeon during August conditions, and these are noted later in this section.

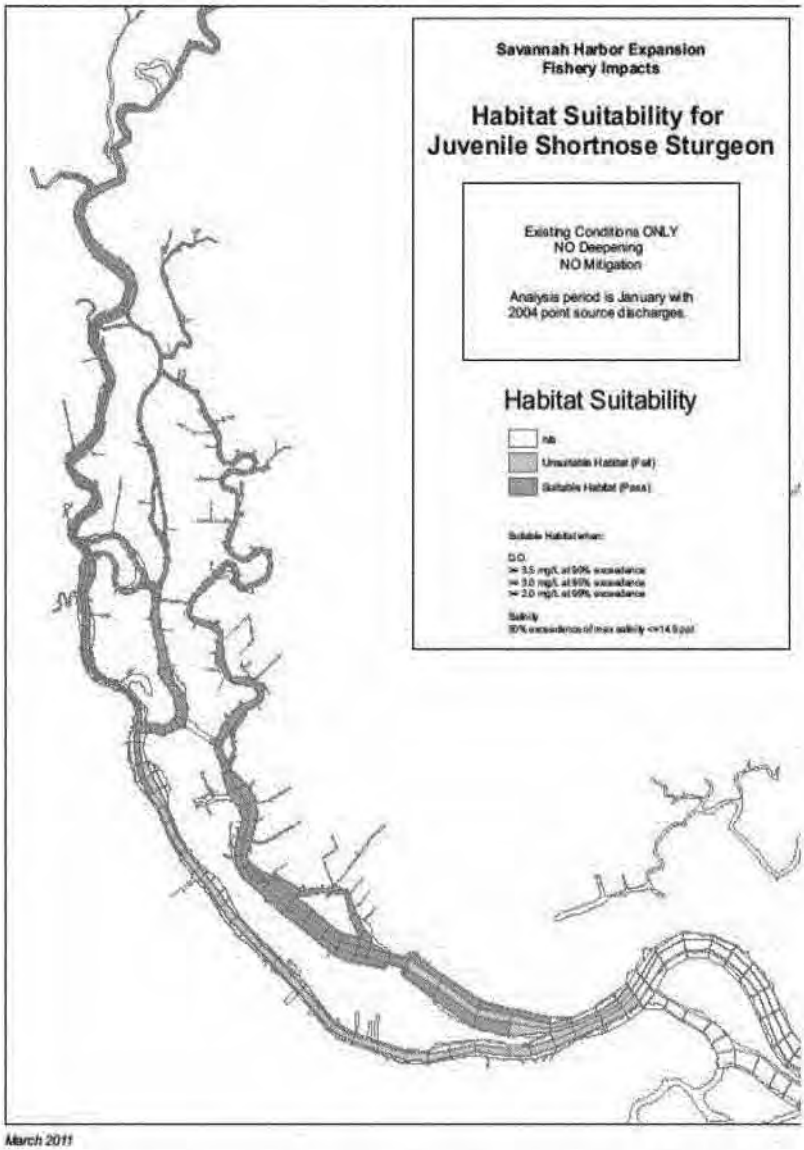
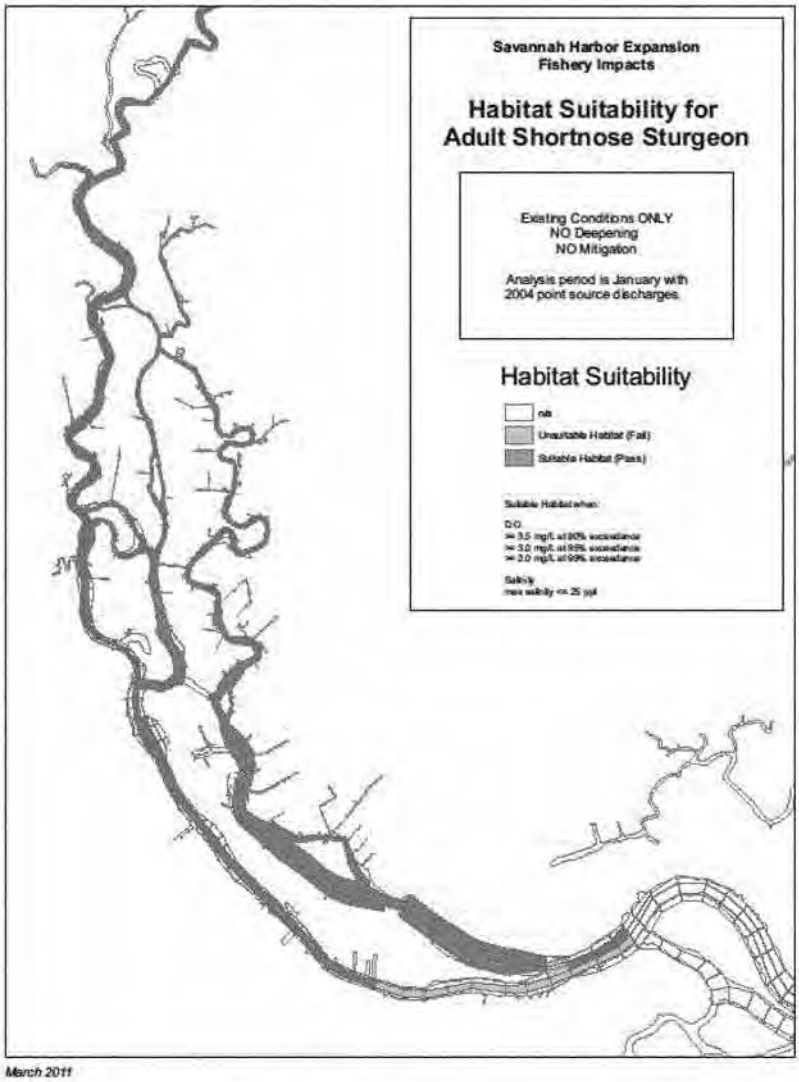


Figure 25. Model of Existing Conditions for Juvenile Shortnose Sturgeon (Winter Conditions).



March 2011

Figure 26. Model of Existing Conditions for Adult Shortnose Sturgeon (Winter Conditions).

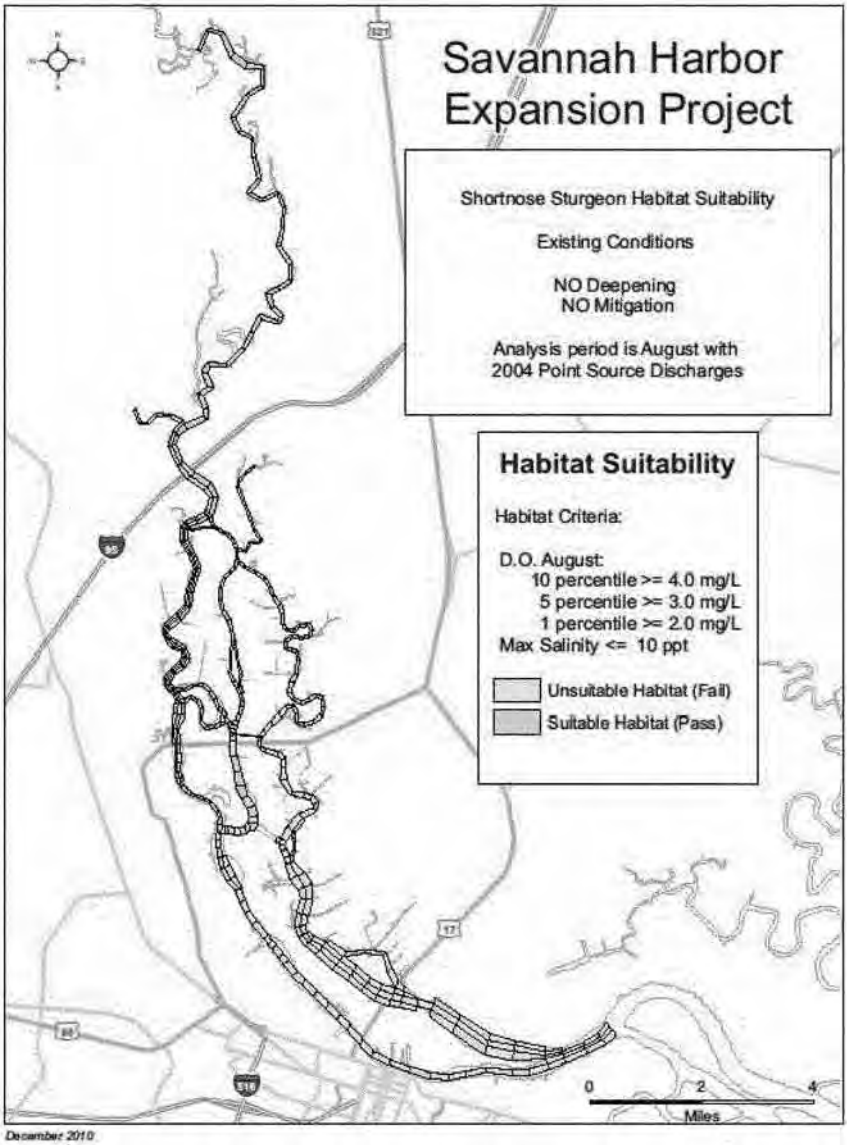


Figure 27. Model of Existing Conditions for Adult Shortnose Sturgeon (Summer Conditions).

Effects of Freshwater Flow Re-routing Modification
The COE used the hydrodynamic and water quality models to evaluate ways to reduce impacts associated with increased salinity and low dissolved oxygen expected to result from the proposed action. A freshwater flow re-rerouting plan (i.e., Plan 6A/6B - described in Section 2.1.2) was developed for each depth alternative that minimized impacts to freshwater tidal wetlands, which the USFWS had identified as being most at risk from this project. The hydrodynamic-related impacts for shortnose sturgeon habitat predicted from the various alternatives are summarized in Table 14. The impacts are related to the diversion of freshwater flow to the Back River to protect freshwater tidal wetlands. The diversion of the freshwater away from the Front River would result in salinity increases in the Front River and lower Middle River, in areas identified as shortnose sturgeon habitat.

Each incremental depth increase would result in larger impacts to sturgeon habitat as more habitat is lost due to salinity increases. There would be a loss of sturgeon habitat with all of the deepening alternatives, except for the 44-foot deepening for adult shortnose sturgeon during August. The losses would be greater during the winter because juvenile sturgeon would be found further down in the estuary foraging and resting in areas of the Front River and lower Middle River directly adjacent to where the deepening would occur. During the winter, adult sturgeon would be found within the areas to be deepened (i.e., lower Front River) or in adjacent areas within the Front River and lower Middle River. During the summer, sturgeon would primarily be located higher in the estuarine environment above the area to be deepened, so there would be less impact to their summer habitat from the deepening and also from the re-routing of freshwater associated with the hydrological modifications. Modeling indicated that without the flow re-routing modifications the salinity increases in the Front River would be less.

It is expected that, as the salt wedge moves further upriver due to the deepening, the estuarine habitat will be transformed from a slightly brackish environment to one with higher salinity. With the transition from lower salinities to higher salinities, the estuarine species (vegetation and benthos) currently found in the area will shift further upriver. Plants will die off and be replaced by more salt-tolerant species. Organisms unable to adapt to the higher salinities will relocate upriver to areas with salinity levels similar to those of their former habitat or will die and be replaced by species with higher salinity tolerance. While the actual deepening will only take a few months to complete, the total transformation of the estuarine vegetation and benthic organisms affected by the deepening may take several months to a few years. NMFS expects a very gradual transformation of the new foraging habitat to occur as the prey species of sturgeon colonize the new areas. This transition will temporarily affect the carrying capacity of the river to support sturgeon, as the amount of foraging habitat will be limited during this time. It is thought that once the estuarine environment has stabilized to the new, higher salinity, the carrying capacity of the river to support sturgeon will return to a pre-project state. It is expected that sturgeon will adjust their behavior and use the new areas for foraging once the appropriate prey species have become established. During this transition, sturgeon will become stressed due to lack of sufficient foraging habitat and weak individuals will be harmed.

Habitat Loss (-)	44-Foot (Plan 6B)	45-Foot (Plan 6A)	46-Foot (Plan 6A)	47-Foot (Plan 6A)	48-Foot (Plan 6A)
Shortnose sturgeon adult (January)	-3.9% (-153.0 acres)	- 4.6 % (-179.0 acres)	-6.2 % (-240.0 acres)	-6.9% (-266.0 acres)	-8.4 % (-326.0 acres)
Shortnose sturgeon adult (August)	0.2 % 2.0 acres	- 0.1 % (- 1.0 acres)	- 3.7 % (-50.0 acres)	-5.6 % (-76.0 acres)	- 6.8 % (-93.0 acres)
Shortnose sturgeon juvenile (January)	-6.7 % (-220.0 acres)	-7.0 % (-231.0 acres)	-7.3 % (-238.0 acres)	- 7.6 % (-251.0 acres)	- 11.5 % (-376.0 acres)

Table 14. Summary of Hydrodynamic-related Impacts with Flow Re-routing Plans 6A/6B.

Injection of Dissolved Oxygen as Mitigation

Studies conducted by EPA as part of its 2006 TMDL assessment for Savannah Harbor indicated that construction of the existing project (42-foot channel, turning basins, Sediment Basin, etc.) has impacted the dissolved oxygen regime. The hydrodynamic models estimated that the dissolved oxygen concentration in Savannah Harbor is 1 mg/Liter lower because of deepening that has occurred since the baseline year and condition (i.e., 1854 and a 12-foot controlling depth). The COE's models have shown that water quality will be impacted by higher salinity and lower predicted dissolved oxygen associated with the deepening. In general, the models showed that there would be upstream shifts of lower dissolved oxygen zones in bottom and surface layers of the estuary as the channel deepening increased in magnitude. Analysis of the effects of adding dissolved oxygen to the river shows the most benefit occurs within the Back River. The studies also indicated that deteriorations of the lowest dissolved oxygen values along critical cells[6] (the cell with the lowest dissolved oxygen concentration during specified simulation period) of major parts of the estuary increase proportionately to the amount of deepening. The COE's data reflected conditions in the bottom half of the water column (i.e., bottom 3 layers of the 6-layer model), where dissolved oxygen levels are lower. Using the selected flow re-routing plans (Plan 6A or 6B), the water quality model was evaluated to determine the best placement of the dissolved oxygen injection systems (i.e., Speece cones) described in Section 2.1.3.

Table 15 summarizes the effects of injecting dissolved oxygen into the estuary during the summer. According to the models, new areas, not previously available to sturgeon during the summer because of low dissolved oxygen, would become suitable habitat with the

[6] A thorough description of the COE's use of critical cells is included in Section 5 of the DEIS "Environmental Consequences of the Proposed Action."

injection of dissolved oxygen. These areas are shown as gain in the table below and on the habitat suitability maps. The injection of dissolved oxygen would also be conducted only during the summer when the combination of higher temperatures and low dissolved oxygen can be detrimental to fish.

Habitat Gain	**44-foot (Plan 6B)**	**45-foot (Plan 6A)**	**46-foot (Plan 6A)**	**47-foot (Plan 6A)**	**48-foot (Plan 6A)**
Shortnose sturgeon adult (August)	5.84% 80.0 acres	6.86% 94.0 acres	3.28% 45.0 acres	2.33% 32.0 acres	-0.07% -1.0 acres

Table 15. Summary of Hydrodynamic-related Modifications with Mitigation (Dissolved Oxygen Injection).

Juvenile shortnose sturgeon habitat

According to the COE's models of project effects on suitable habitat, the juvenile shortnose sturgeon life stage would have the largest proportional amount of habitat lost with all of the deepening scenarios. Acreage loss (as shown in Table 14) would range from 220 to 376 acres, or 6.7 to 11.5 percent of the available habitat as calculated by the COE models for the incremental deepening from 44 to 48 feet. The acreage loss for the COE's preferred deepening alternative (47 feet) would be 251 acres or 7.6 percent of the available habitat as predicted by the COE models (Figure 28). The loss of suitable habitat in the Front River could also affect juvenile sturgeons' ability to access the lower Middle River deep hole via the Front River. Research has not indicated that juvenile sturgeon would use an alternate route through the estuary (i.e., moving down from the upper Middle River) to access the preferred habitat located at the deep hole in the lower Middle River. There has also been no evidence of juvenile sturgeon using the Back River, although it is indicated as suitable habitat in the model of existing habitat. It is also not known whether juvenile shortnose sturgeon would alter their normal activity to travel higher in the water column to avoid the undesirable high salinities in the bottom layer of the salt wedge in the Front River after the deepening. Since the area that would be lost also occurs in a highly industrialized area with heavy vessel traffic, sturgeon may not be inclined to seek the lower salinity in the upper water column in order to travel within the Front River. It is also important to note that with the 47-foot deepening scenario, additional side cells of the model, which would include the entire width of the Front River (including the side slopes) becomes unsuitable habitat, essentially blocking any pathway to downstream habitat that could be utilized by juvenile shortnose sturgeon There is much uncertainty associated with the sturgeon habitat models due to the numerous factors involved in calculating predicted change in the habitat. However, it is expected that juvenile shortnose sturgeon will probably abandon this area of the Front River, just as they did when the salinity increased in the Kings Island Turning Basin, which is located just downriver of this area and was formerly utilized by juvenile shortnose until it was deepened in 1994. Hall et al. (1991) detected juvenile shortnose in

the Kings Island Turning Basin during their research, but they were not detected later by Collins et al. during their 1999-2000 study. The model of existing habitat indicates that there is suitable habitat within the Kings Island Turning Basin, but it is believed that high salinity in the deeper basin may prevent young juvenile sturgeon from using the area.

The juvenile stages of shortnose sturgeon have the most constricted range of habitat in the estuarine areas of the Savannah River due to their low tolerance of high salinities. The deepening would allow salinity to increase upriver to levels which juvenile shortnose sturgeon cannot tolerate causing further constriction of their habitat, particularly affecting foraging habitat in the Front River and preferred resting habitat in the lower Middle River. The COE, working in concert with the resource agencies, was unable to identify any mitigation measures that would compensate for the unavoidable loss of this unique foraging and resting habitat found in the estuarine environment of the Savannah River. As stated above, it is expected that environmental conditions currently found in the estuarine portions of the river that are utilized by juvenile shortnose sturgeon for foraging and resting will shift upriver over a period of several months to years.

Juvenile Atlantic sturgeon habitat

While there was no modeling of Atlantic sturgeon habitat conducted, due to the proposed listing of Atlantic sturgeon occurring after the COE had concluded all of its data analyses prior to the listing, it is generally believed that suitable habitat as determined for juvenile shortnose sturgeon would also be suitable for juvenile Atlantic sturgeon. Information provided by Vladykov and Greeley (1963) indicates that habitat requirements for juvenile Atlantic sturgeon would overlap with those of juvenile shortnose sturgeon when they migrate to the salt water interface. Juvenile Atlantic sturgeon are residents in estuarine waters for months to years before migrating to open ocean as subadults (Holland and Yelverton, 1973; Dovel and Berggen 1983, Waldman et al. 1996a, Dadswell 2006, ASSRT 2007, Schueller and Peterson 2010). Therefore, it expected that juvenile Atlantic sturgeon will likely be affected by the same loss of estuarine habitat in the lower river as juvenile shortnose sturgeon.

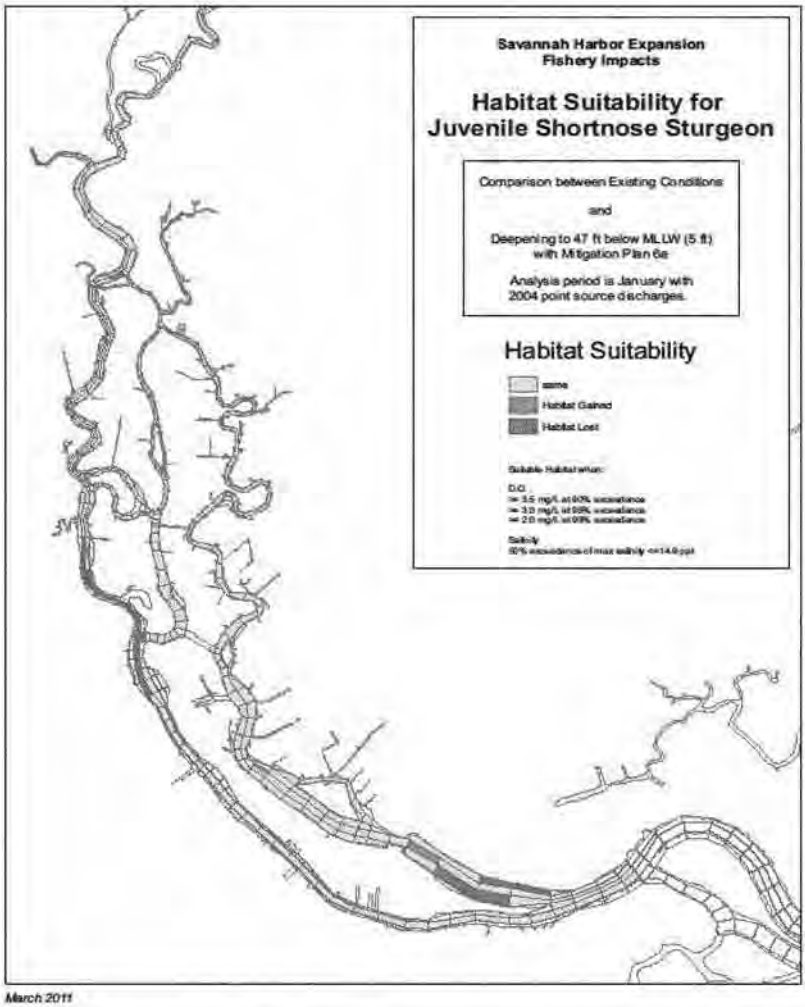
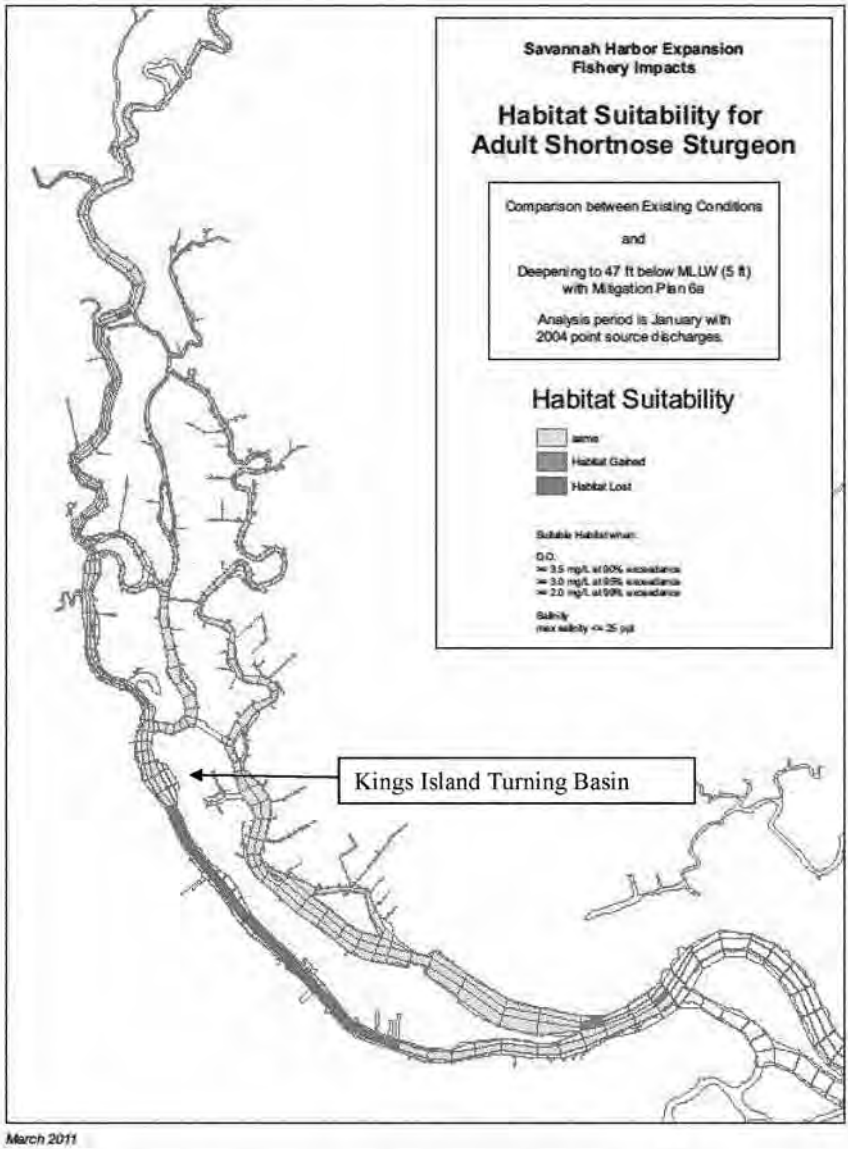


Figure 28. Model of Juvenile Shortnose Sturgeon Habitat during January with the 47-foot Deepening Alternative. Foraging habitat would be lost in the Front River. Habitat lost in the lower Back River has not been documented as being used by juvenile shortnose. Previous research by SCDNR has documented that the lower Middle River is regularly used by shortnose sturgeon. The peak of use appears to be during the late fall, winter, and spring, but a few fish have also been observed there during the summer.



March 2011

Figure 29. Model of Adult Shortnose Sturgeon Habitat during January with the 47-foot Deepening Alternative.

Adult shortnose sturgeon habitat during winter
Adult shortnose sturgeon would also have a large amount of habitat loss with all of the deepening scenarios. The loss of foraging habitat in the Front River would increase with each depth scenario. Acreage loss, as calculated by the COE models, would range from 160 to 326 acres, or a loss of 4.1 to 8.4 percent of the available habitat, with the incremental deepenings from 44 to 48 feet. The loss of habitat with the COE's preferred deepening alternative (47 feet) would be 266 acres or 6.9 percent loss. The loss of habitat within the Front River would occur up to the location of the Kings Island Turning Basin (Figure 29). The loss of this estuarine habitat would prohibit access to the lower Back River from the Front River, as the area having high salinity would be significantly lengthened. It is thought adult sturgeon may tolerate very brief exposure to high salinities, but not conditions of prolonged exposure such as would be needed to traverse several miles of the lower Front River to reach the lower Back River. Research has not indicated that adult sturgeon would use an alternate route (i.e., traveling down from the upper Back River) to access deep-water habitat at the lower end of Back River. New data indicates that fish have been tracked using Rifle Cut, which connects the Middle River and Back River to access the lower Back River; however, this corridor will no longer be possible after Rifle Cut is closed as a part of the freshwater flow re-routing modifications being implemented to protect freshwater marsh within the Savannah National Wildlife Refuge. As with juvenile shortnose sturgeon, it is also not known whether adult shortnose sturgeon would alter their normal activity to travel higher in the water column to avoid the undesirable high salinities in the bottom layer of the Front River after the deepening. Telemetry tracking has not indicated that sturgeon would travel extensive distances in the upper half of the water column.

While much of the lower Front River estuarine habitat may be lost to sturgeon, research from tracking of shortnose sturgeon performed after the issuance of the DEIS in November 2010 indicates that there is new evidence that adult shortnose sturgeon may use the shallow upper Middle River, which has an average depth of less than 6 feet MLLW, to access the deeper areas in the lower Middle River (Wrona et al. 2011 unpublished data). This is an important discovery, because it could indicate that sturgeon would be able to continue using the deep hole in the lower Middle River as a refuge from high temperature waters. Because of the lack of information documenting sturgeon using the Back River for foraging or resting habitat, NMFS is uncertain whether sturgeon will use these areas even though the areas may possess the appropriate habitat characteristics as defined by the Interagency Fisheries Habitat Committee. According to bathymetry data provided by the COE, the upper Back River contains shallow habitat ranging from 1.8 to 10 feet MLLW. Sturgeon are known to prefer deeper water depths within estuaries, so they may be avoiding use of the area because it does not have the attributes that are preferred by sturgeon. However, during spring tides and upstream flood conditions (due to rain) the Back River may become much deeper. Recent surveys have indicated portions of the upper Back River include depths to 18 feet during these conditions. The irregular or inconsistent nature of the area with its depth (and possibly salinity) extremes may make it unsuitable for sturgeon prey. In the absence of suitable prey, sturgeon would be less likely to use the area for foraging. It is important to note

that Atlantic sturgeon, because of their larger body size, may be even more unlikely to use the Back River as habitat when the area is undergoing lower than normal tides or drought conditions. Adult Atlantic sturgeon, which can reach lengths greater than 4 feet, need sufficient water depths for migrating. While the modeling indicates all of the Back River is suitable habitat in all of the deepening scenarios, the fact that there is very little evidence that adult sturgeon actually use the area for foraging or resting suggests that the area should be considered lower priority in evaluating habitat needs of sturgeon. The few new accounts of sturgeon being detected in the Back River are showing limited movement beyond the area immediately adjacent to Rifle Cut. The tracking of these fish is ongoing and SCDNR will be providing data as it is collected (Bill Post, SCDNR, pers. comm.).

Preliminary assessment of new tracking results of shortnose sturgeon obtained by SCDNR in the Middle River are showing that fish reside in preferred locations for extended amounts of time. The new telemetry work, which began in November 2010, has shown that some fish stayed in the vicinity of the Middle River deep hole over a 65-day time period (or until the data was retrieved in January 2011), often moving back and forth within the area over a 1.5-mile radius but always returning to the deep hole. Sturgeon also showed a preference for an area in the Front River located approximately halfway between the confluence with the lower Middle River and Steamboat Creek. Fish remained in the vicinity of the tracking receiver for up to 38 days. This new data provides additional support to the previous data, obtained during 1999-2000, on the importance of the Front River and lower Middle River to both juvenile and adult phases of shortnose sturgeon.

Adult Atlantic sturgeon habitat

While there was no modeling of adult Atlantic sturgeon habitat conducted, due to the proposed listing of Atlantic sturgeon occurring after the COE had concluded all of its data analyses, it is generally believed that suitable habitat as determined for adult shortnose sturgeon would also be suitable for adult Atlantic sturgeon. Adult Atlantic sturgeon are able to tolerate a much wider range of salinity, so habitat that is unsuitable for adult shortnose sturgeon, due to salinity changes, may still be suitable for adult Atlantic sturgeon during the winter and summer. However, they would likely be affected by the lower dissolved oxygen in the same way that adult shortnose sturgeon would be affected. Both adult and juvenile Atlantic sturgeon frequently congregate around the saltwater interface. They may travel short distances upstream and downstream throughout the summer and fall, and during late winter and spring spawning periods (Greene et al. 2009), between fresh and brackish waters influenced by changes in water temperature (Van Den Avyle 1984) as they seek the cooler waters and avoid shallow areas with the highest water temperature (Bain 1997). Outmigration of adults from the estuaries out to the sea is cued by water temperature and velocity. Adult Atlantic sturgeon reside in the marine habitat during the non-spawning season and forage extensively until the waters begin to warm at which time adults migrate back to their rivers to spawn.

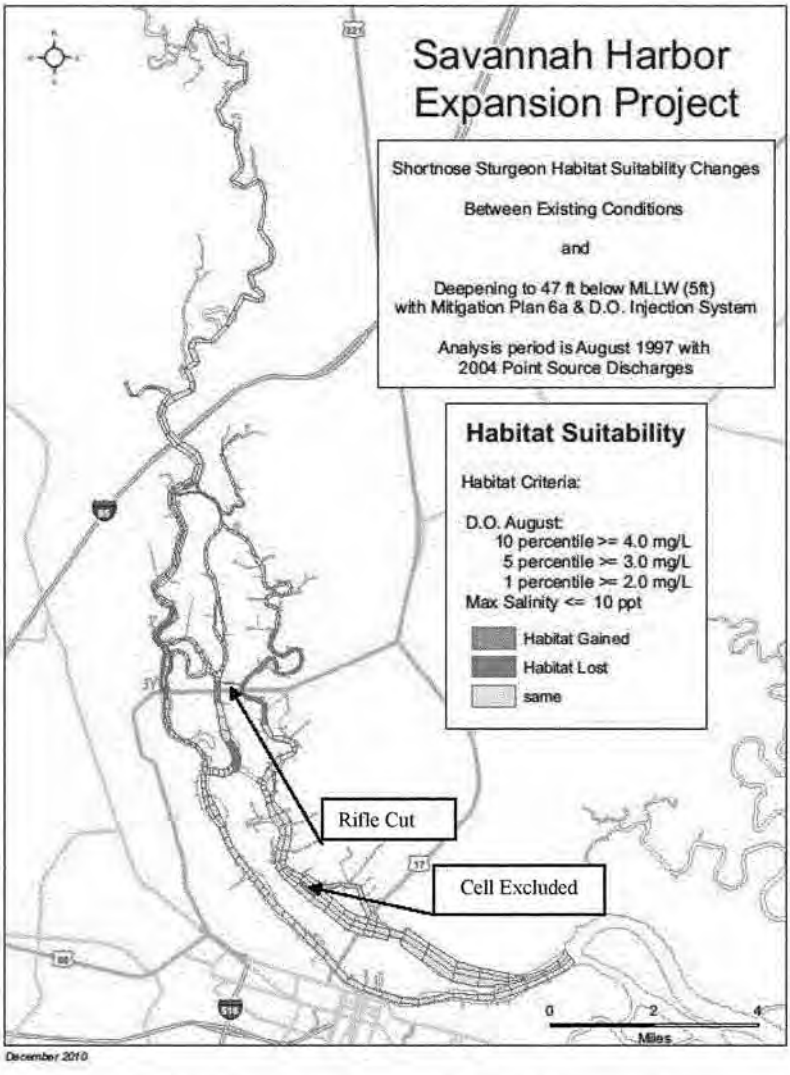


Figure 30. Model of Adult Shortnose Sturgeon Habitat during the Summer with the 47-foot deepening.

Adult shortnose sturgeon habitat during summer conditions
According to the COE's models of summer conditions, there would be a net gain of suitable habitat for adult shortnose sturgeon with all of the deepening scenarios due to the injection of dissolved oxygen. The COE had calculated acreage gain would range from 245 to 24 acres, or a gain of 17.8 to 1.7 percent of habitat, for the incremental deepenings from 44 to 48 feet. However, when NMFS calculated the acreage change, we found there would be a gain of 80 acres, or 5.84 percent with the 44-feet deepening, and a range of 94 to -1 acres, or 6.86 to -0.07 percent of habitat change for the incremental deepenings from 45 to 48 feet. NMFS also found that a single, isolated cell (indicated as gain) within the lower Back River should be excluded from the total acreage gain since it would be completely surrounded by unsuitable habitat.

The cause of the gain (primarily occurring in the Back River) is associated with the placement of dissolved oxygen injection system (Speece cones) within the lower Front River and lower Back River on Hutchinson Island. The gain of suitable habitat would occur in areas not previously identified as suitable for sturgeon. The system is described in Section 2.1.3 and the modeling of the dissolved oxygen injection is described below. The system is designed to mitigate for dissolved oxygen impacts within the harbor. Additional cones are needed for each of the incremental deepenings. The 47-feet deepening would require the use of 10 Speece cones that would add approximately 40,000 pounds of dissolved oxygen per day. The system would operate during the summer months when dissolved oxygen values are usually the lowest. The injection of dissolved oxygen does not affect the loss of habitat in the upper Front River. It does result in a gain within the Back River, (Figure 30) but adult sturgeon have not been documented using this area during the summer. The habitat suitability models show significant gains of suitable habitat in the Back River near Rifle Cut, but with the closure of Rifle Cut, it is unknown whether sturgeon will have access to the area indicated as gained habitat.

5.2.1 Effects of Disturbances during Construction

Turbidity, associated with the disturbance of sediments from construction activities in relation to the flow re-routing modifications (Plan 6A or 6B), would occur within shortnose sturgeon habitat. Dredging activities in the upper Middle and Back River, located less than a kilometer from McCoy Cut, could result in disturbances to sturgeon located within these areas. In addition, the activities associated with the closing of the western arm of McCoy Cut and the construction of a diversion structure (e.g., sheet pile driving, placement of rip rap) in the Front River at McCoy Cut could disturb sturgeon and cause them to avoid these areas. During the summer and early fall, sturgeon appear to be concentrated in the Savannah River above the project area in a deep hole located upstream of the lower entrance to Abercorn Creek and in an area located just below the Abercorn Creek confluence. However, during the late fall through winter, they are found in the area of the proposed diversion structure moving between the deep hole and foraging areas in the Front River and Middle River. In order to minimize impacts to sturgeon, it is important that the construction activities such as those associated with the construction of the diversion structure are conducted while sturgeon are less likely to be found in the area. The impacts to sturgeon would be minimized by conducting

construction of the diversion structure while most sturgeon are congregated upstream of the construction area between May 15 and November 1.

Within the lower Front River, the dredging associated with the project deepening will occur up to the Kings Island Turning Basin. In addition, there will be construction activity within Kings Island Turning Basin as it is widened to accommodate larger ships These areas are located downstream from juvenile shortnose sturgeon foraging habitat, but are within documented habitat used by adult shortnose sturgeon primarily during the winter. The potential for interruption of the movement of sturgeon through the project due to increased turbidity associated with the dredging is an issue of concern. It is important that the construction activities use best management practices.

While sedimentation and turbidity could be elevated during dredging actions, the effects are expected to be localized and temporary. Studies performed by Dr. D.F. Hayes in 1986 on a hydraulic cutterhead dredge operating in Savannah Harbor indicated that average suspended sediment concentrations within 1,600 feet of the dredge were generally raised less than 200 mg/Liter in the lower water column and less than 100 mg/Liter and 50 mg/Liter in the middle and upper water column, respectively. More recent data indicate that present-day dredging operations are conducted in ways that do not increase suspended sediment concentrations to such a degree. The Savannah River has a naturally high suspended sediment load which during storm events increase well beyond the 200 mg/Liter increase created by a hydraulic dredge.

5.2.2 Effects of Dredging on Sturgeon Prey

The deepening within the inner harbor will result in impacts to shortnose sturgeon foraging habitat and the foraging base found there. This directly impacts the entire Savannah River population of shortnose sturgeon that is believed to reside only within the action area. While initial loss of benthic resources within the transitional areas are likely to occur, a quick recovery is expected (Van Dolah et al. 1979, Van Dolah et al. 1984, and Clarke and Miller-Way 1992) within 6 months to two years (Bonsdorff 1980, Ray 1997). Previous benthic studies in Savannah Harbor, conducted just prior to annual maintenance dredging, have shown primarily healthy benthic communities both inside and outside the navigation channel. Average abundance and biomass were found to be higher inside the channel compared to locations outside the channel, with the exception of silt-sand substrates. Areas with soft mud bottoms and oligohaline or mesohaline salinities recovered quickly, likely due to the dominance of opportunistic species assemblages (e.g., *Streblospio benedicti, Capitella capitata, Polydora ligni*) (Ray 1997). Recovery in dredged sites occurs by four basic mechanisms: remnant (undredged) materials in the sites, slumping of materials with their resident fauna into the site, adult immigration, and larval settlement. Remnant materials—sediments missed during the dredging operation—act as sources of "seed" populations to colonize recently defaunated sediments. Adult immigration can occur as organisms burrow laterally throughout the sediments, drift with currents and tides, or actively seek out recently defaunated sediments (Ray 1997). Likewise, materials slumping or falling into the site from channel slopes provide organisms for colonization (Kaplan et al. 1975).

The colonization of prey species into the transitional areas after the deepening has been completed is contingent on there being suitable water quality conditions and bottom substrates for these organisms to survive. However, while prey may be available, it will be of no benefit to shortnose sturgeon if the area has become unsuitable habitat for shortnose sturgeon due to higher salinity, or if access to the foraging habitat is no longer possible due to isolation of the foraging habitat related to the flow re-routing modifications, as may occur with the closing of Rifle Cut.

Dial-Cordy and Associates (2010) conducted a study for the COE to identify the bottom substrates in the Front River between Middle River and Interstate 95. This is the transitional area where the saltwater/freshwater interface will be shifting as a result of the deepening. The study found the bottom substrate to be primarily sand, which they considered to be acceptable habitat capable of supporting benthic populations. The study did not sample for benthic organisms.

Cadmium-laden Sediment Removal

The dredging and subsequent removal of cadmium-laden sediments could negatively influence water quality and affect potential prey species consumed by shortnose sturgeon. Contaminated sediments may be present within the areas where adult shortnose sturgeon forage. Sediment sampling and analysis were performed and the conclusions from that evaluation were that the only sediment contaminant of concern for this project is naturally-occurring cadmium found in Miocene clays.

The sediments containing cadmium would be dredged and/or exposed during construction. The highest concentrations of cadmium (average 21.45 mg/kg) are found between Stations 16+000 and 45+000 (river mile 3.0 to 8.5) and medium concentrations (average 6.67 mg/kg) are found between Stations 45+000 to 94+000 (river mile 8.5 to 17.8). Initially, dredging of the navigation channel may expose sturgeon prey/food species to cadmium. If prey/food species uptake cadmium from Stations 16+000 to 45+000, then it could adversely affect the adult shortnose sturgeon. Several factors could influence the degree to which cadmium might move from channel bottom sediment to benthos to the aquatic food chain. Important related questions that need to be answered are: (1) Do the Miocene clays with elevated cadmium levels support benthic organisms?, and (2) If so, would these benthic organisms growing in the Miocene clays with the elevated cadmium levels bioaccumulate cadmium and pass it through the food chain?

To address these questions, EA Engineering, Science, and Technology (EA 2008) conducted a benthic community assessment of the river bottom both inside and outside of the channel. They found a substantial benthic community within the channel bottom. In addition, they found that the coarse sand/gravel/clay substrate was used by benthic organisms, although they were unable to determine to what extent benthic organisms might burrow into the clay. They found that the substantial presence of benthic organisms within the channel maintenance sediments indicates that the impact of maintenance dredging is temporary. Although EA found that the clay substrate does support benthic organisms, this substrate presently comprises less than 28 percent of the channel bottom between Stations +16+000 and +60+000. This finding indicates that

benthic organisms residing in exposed Miocene clays should present a relatively small fraction of the benthic organisms within the channel ecosystem. Potential contaminant impacts associated with exposed high cadmium sediments within a deepened channel would be minimal, primarily because sediment cadmium was found to be unavailable and bioaccumulation tests found cadmium uptake below levels of concern. The essentially anoxic state of the channel sediments should preclude significant movement of cadmium to the environment.

5.2.3 Effects of Proposed Fish Passage at the New Savannah Bluff Lock and Dam

The New Savannah Bluff Lock and Dam at the city of Augusta (rkm 299) is located just a few kilometers below impassible rapids, denying sturgeon access to 7 percent of historically available habitat up to the Augusta Diversion Dam (NMFS and USFWS 1998). The New Savannah Bluff Lock and Dam has five vertical spillway gates that could allow passage for anadromous fish during the normal spawning season flows in the Savannah River. Under normal spring flows when the gates are open, the headpond and tailwater elevations are often at the same level, and fish may pass upstream over the submerged weirs at each gate opening. Limited passage studies at the New Savannah Bluff Lock and Dam have documented significant passage by American shad, river herring, and striped bass for many years, but have not indicated passage by shortnose sturgeon. A study conducted by The Nature Conservancy in 2006 indicated significant numbers of shortnose sturgeon are present at the base of the New Savannah Bluff Lock and Dam during the late winter-spring spawning period. Congressional Acts (Water Resources Development Act of 2000, P.L. 106-541, and the Omnibus Appropriations Act 2001, P.L. 106-554) authorized the Savannah District COE to repair and rehabilitate the New Savannah Bluff Lock and Dam and to transfer the project to the City of North Augusta and Aiken County, South Carolina. The COE commissioned a study to investigate terms for transfer of ownership of the New Savannah Bluff Lock and Dam. The previous study identified and investigated fish passage configurations that would pass many species, including sturgeon.

A recent interagency fish passage workshop held by the COE investigated new alternative fish passage designs and made recommendations for a fish passage design based on performance criteria that would result in safe and effective passage of sturgeon upstream and downstream. NMFS and the workshop participants believed fish passage success criteria should be to provide for safe and effective upstream and downstream passage, where "safe" means negligible chances for harm to fish as a result of interactions with the passage facility or dam, and "effective" refers to the percentage of fish migrating up to and attempting to use the passage facility, that actually succeed in that attempt. Following the workshop, the COE reviewed the designs to determine the engineering specifications that would be needed, along with overall cost for construction, and developed an additional fish passage design alternative that would be less costly; an off-channel rock ramp (described in Section 2.1.5) that they will include in the FEIS.

NMFS has included development of a detailed *Plan for Safe and Effective Fish Passage* as a Term and Condition of this opinion, to ensure the passage facilities will provide the

passage benefits upon which this opinion's conclusions are based. The Plan will be developed by the COE in consultation with NMFS, FWS, SCDNR, and GADNR. The Plan will require input of fish passage engineers and sturgeon experts working with COE on the final design and to ensure the effectiveness of the off-channel rock ramp. The Plan will also include a timetable for completion of construction of the off-channel rock ramp. Methodologies included in a separate monitoring and adaptive management plan will help determine if there are problems with the ramp and how they can be corrected. Development of these plans should commence within six months of the COE receiving all environmental approvals to implement the project. NMFS will review the final design to validate that it is anticipated to meet the performance requirements of this opinion.

Passage Effectiveness

Even though the final design details of the proposed off-channel rock ramp are not known, NMFS believes that the conceptual design can be meaningfully analyzed to assess its likely safety and effectiveness for passing sturgeon. The Plan and other terms and conditions included in this opinion will help ensure that the actual design and construction of the fish passage achieve the estimated success criteria. In their May 11, 2011, Information Paper, the COE estimated that the off-channel rock ramp would "provide 75% performance of upstream shortnose sturgeon passage and 85% performance of downstream passage." Those estimates were based on input from the participants in the April 2011 workshop in Augusta stating that fish passage performance generally matches the percent of river flow through the passage structure. This design would accommodate 100 percent of the river flow for 64 percent of the time during the months of February through June. The primary concern for failed upstream passage would be fish that swim past the rock ramp and up to the dam. Until the river nears flood stage, the predominant flow would still be though the rock ramp. Therefore, fish like shortnose sturgeon that follow the bottom contours and the predominant flow should use the off-channel rock ramp. The inclusion of the guide wall and the thalweg dredging in the design should further strengthen that effect. The COE stated that since vertical sills exist at both the downstream and upstream faces of the dam, no shortnose sturgeon are expected to move through the gates on the dam.

NMFS agrees with the COE's assessment of the likely effectiveness of the proposed off-channel rock ramp. NMFS also agrees that no upstream passage through the spill gates is expected. Traditional fish ladder designs are not effective at passing sturgeon. In recent years, there has been an emphasis on development of nature-like fishways, including rock ramp designs like the COE's proposal, particularly at low-head dams like the New Savannah Bluff Lock and Dam and with sturgeon as particular target species (Aadland 2010). The proposed off-channel rock ramp is sized and sloped appropriately for shortnose and Atlantic sturgeon. Inclusion of large boulders reduces overall water velocity through the fishway and also produces localized areas of low velocity where fish may rest between upstream bursts of movement. The rock ramp itself may have appropriate characteristics for some fish to spawn in it, as has been documented with lake sturgeon (Aadland 2010). NMFS agrees that the frequency of days when all or most of the river flow will pass through the fishway is likely a good proxy for the ability of sturgeon that are attempting to pass upstream or downstream to find and successfully

pass through the rock ramp. NMFS further agrees that the guide wall and thalweg design features are likely to further improve the likelihood of fish reaching the entrance to the fish passage, rather than be attracted to the base of the dam. Thus, NMFS believes that the COE's estimates of 75% upstream passage effectiveness is reasonable based on the current preliminary design for the off-channel rock ramp.

Failure of downstream passage is of much greater concern. If fish upstream of the dam are subsequently unable to return downstream, either because they are trapped above the dam or because they are injured in passing through the facility or the dam, then the loss of those individual spawners and/or their spawning output (i.e., larval fish) negates any benefit of having passed the fish to better spawning habitat. The inclusion of the guide wall and thalweg features are likely to lead many fish, either passively or behaviorally, to the upstream entrance to the rock ramp, even when water is being spilled through the dam. The majority of the flow will go through the rock ramp, especially later in the spring when downstream migration occurs. However, the COE's downstream passage effectiveness estimate (85%) implies that 15% of fish do not successfully navigate downstream through the rock ramp. For adult sturgeon, NMFS believes that, even if fish initially fail to find the upstream entrance to the rock ramp, they will eventually return downstream. Likewise, adult fish searching for passage downstream will eventually find the rock ramp. The navigation lock, although it has high, downward-leading sills, is another route of exit. Finally, when the spill gates on the dam are opened, sturgeon can be spilled through the gates into the tailrace. Larval fish, if they are carried past the entrance to the rock ramp and over the guide wall, are not likely to navigate back to the ramp or through the navigation lock. Thus, passage through the spill gates is the only way downstream for larval fish that initially fail to find the rock ramp. The frequency of spilling is directly associated with the primary presumed reason for failure to navigate the rock ramp, high overall river flows. Therefore, any larval fish that are carried past the guide wall are likely to pass quickly through the spill gates. Also, NMFS believes that the actual percentage of juvenile sturgeon going over the four foot wall and hence possibly passing through the flood gates may be less than the COE's 15% estimate. Studies with Savannah River shortnose sturgeon embryos and larvae indicate that during downstream movement they stay near the bottom hiding in the rocks and swimming at heights no greater than 117 cm which is slightly less than four feet (Parker and Kynard, 2005). The COE's proposed height for the guide wall is three or four feet. Therefore, NMFS believes the COE's estimate of a minimum of 85% downstream passage effectiveness is a reasonable expectation of performance for the proposed off-channel rock ramp.

Passage Safety

NMFS believes that the proposed off-channel rock ramp will be safe for sturgeon. That is, fish attempting to pass upstream or downstream through the rock ramp are unlikely to experience risk of significant injury. Although artificial, the velocities, grades, and structures in the rock ramp as proposed are designed to accommodate sturgeon and to be similar to conditions in natural spawning areas, such as the Augusta Shoals. Spawning fish may experience minor injuries or abrasions in natural circumstances as they navigate

shoals or rapids; NMFS believes fish navigating the off-channel rock ramp would be exposed to no more risk than in navigating a natural, low rapids.

During the April 2011 passage workshop, NMFS and the sturgeon experts in attendance expressed concern about mortality of juvenile and adult sturgeon that do not use the rock ramp on downstream migration and are subsequently passed through the gates of the dam. The COE provided NMFS with additional information in their May 27, 2011, communication on additional details of the off-channel rock ramp design, addressing this issue. The configuration of the dam, spill gates, and tailwater height makes the risk of serious injury or mortality of both juvenile and adult sturgeon to be negligible as a result of passing through the gates during downstream migration. There is a concrete sill extending approximately 70 feet downstream of the gates, 10 feet lower than the gate sill. At the time gates begin to be used (which is the time that would pose the greatest risk of injury or mortality for sturgeon and other fish), water will be approximately 13 feet deep on the apron and 3 feet higher than the bottom of the gate sills. Any fish passing through the gates will therefore not experience any physical drop. Fish would be subjected to brief high velocities and a maximum 12 foot pressure differential (based on the difference in head height upstream and downstream of the dam). Fish would enter a standing pool of water that is roughly 13 feet deep and not be exposed to any significant risk of contact injury, such as a fall onto a hard surface or even the air-water interface. At higher river flow rates and after the gates have been opened, the tailwater will rise, reducing the head and pressure difference between the upstream and downstream sides of the dam, and reducing velocity through the spill gates. Thus, when river flows are highest, and the chances for sturgeon passing through the gates are highest, the potentially injurious hydrodynamic forces are the least.

Mortalities of fish from passing over a spillway have several causes: shearing effects, disorientation, abrasion against spillway surfaces, turbulence in the stilling basin at the base of the dam, sudden variations in velocity and pressure as the fish hits the water, and physical impact against energy dissipaters. Experiments have shown that significant damage occurs (with injuries to gills, eyes, and internal organs) when the impact velocity of the fish on the water surface in the downstream pool exceeds 16 m/s, whatever its size (Bell and Delacy 1972). Passage through a spillway under free-fall conditions is less hazardous for small fish compared to large ones as their terminal velocity is less than the critical velocity (Larinier 2001). A column of water reaches the critical velocity for fish after a drop of 13 m (Larinier 2001); beyond this limit, injuries may become significant and mortality will increase rapidly in proportion to the drop (100% mortality for a drop of 50-60 m). The maximum head differential at the facility would be 12 feet (about 0.36 atmospheres), with the fish being subjected to 17 feet/ sec maximum velocities, both of which are dramatically lower than the injury and mortality thresholds indicated by Bell and Delacy (1972) and Larinier (2001).

Schedule for Construction of Fish Passage

Under the COE's current schedule, any benefits derived from sturgeon passage will not be realized until at least 4 years after the start of project construction, as that is the proposed time frame for construction of the passage facility. The constriction of habitat

in the lower Savannah River adds further urgency to fish passage implementation to restore access to habitat upstream that contains high quality spawning habitat and additional foraging habitat. In order to reduce additional adverse impacts associated with delay of construction of the fish passage, NMFS has included a requirement that the land acquisition process for the fish passage will be initiated prior to or concurrently with project dredging of the entrance channel. This would allow fish passage construction to begin prior to or concurrently with project deepening of the inner harbor. NMFS has also added a Term and Condition that contains a minor change in the construction of the diversion structure that will minimize the impacts of that construction.

After construction of the fish passage, monitoring would need to be conducted to assess the effectiveness of the design in passing sturgeon upstream and downstream. Details of the proposed monitoring should be clearly stated within the Monitoring and Adaptive Management Plan to be developed by the COE in coordination with the resource agencies. NMFS has included a requirement that the COE would coordinate with NMFS and the other federal and state resource agencies in the final development of the Plan within 6 months of the COE receiving all environmental approvals to implement the project. NMFS would have final review of the Plan.

Overall Impacts of Fish Passage
Once fish passage is implemented at the New Savannah Bluff Lock and Dam, both shortnose and Atlantic sturgeon will have free upstream passage to the Augusta Diversion Dam. NMFS believes that vitally important spawning habitat is available in the Savannah River upriver from the New Savannah Bluff Lock and Dam to the Augusta Diversion Dam, and that the species will likely expand their geographic range to reoccupy these formerly available habitats. The passage of fish past the New Savannah Bluff Lock and Dam will add 20 miles of additional spawning habitat and may lead to an increase in spawning activity. This could also reduce the adverse effects of loss of juvenile habitat in the lower river because they will be spawned further up the river, thus giving them more time and distance to mature and forage before reaching the lower river and the salt wedge which will be further up river as a result of the deepening.

As indicated in Section 5.2.1, the proposed deepening will result in a loss of juvenile shortnose and Atlantic sturgeon foraging and refuge habitat and will result in a loss of current adult shortnose sturgeon foraging and refuge habitat as a result of upriver movement of the salt wedge. During past dredging activities (Kings Bay turning basin) sturgeon moved further upriver and established new foraging and refuge areas. Based on this, NMFS expects that sturgeon will again find suitable habitat upriver. However, without fish passage this will cause a constriction of their range in the river and cause young fish to encounter higher salinities with less time to mature. The overall effect of the construction of the off-channel rock ramp is expected to add an additional 20 miles of spawning habitat which may lead to an increase in spawning and a possible increase in spawning success. Although fish passage will not replace the lost foraging and refuge habitat in the lower river, it will increase the sturgeons' range within the river and add an additional 20 miles for juvenile sturgeon to forage and mature prior to reaching the salt

wedge in the lower river. More mature juvenile sturgeon are better able to tolerate higher salinities.

5.2.4 Summary of Effects to Sturgeon

Atlantic sturgeon will be adversely affected by direct interactions with dredges and relocation trawling in the Savannah Harbor Entrance Channel. Atlantic sturgeon may be encountered by hopper dredges, but relocation trawling should limit these encounters. The relocation trawling would result in nonlethal take as sturgeon are released alive. NMFS expects that 4 Atlantic sturgeon will be killed as a result of interactions with the dredge and 20 will be captured during relocation trawling. Shortnose sturgeon are not expected to be found in the offshore areas where hopper dredges will be operating, so no take should occur. No take is anticipated by dredging within the river channel as hopper dredges will not be used within the river channel.

Water quality will be affected by the changes in water flows through the lower Savannah River related to the freshwater flow re-routing modification and by the deepening. Analysis of the best available information indicates that salinities will increase and dissolved oxygen will decrease, adversely affecting important foraging and resting habitat for sturgeon. It is expected that 251 acres of habitat important to juvenile shortnose and Atlantic sturgeon will be lost, which represents 7.6% of their current estuarine habitat in the lower river. It is also expected that 266 acres of habitat important to adult and sub-adult shortnose sturgeon will be lost, which represents 6.9% of their current estuarine habitat in the lower river. Adult and sub-adult Atlantic sturgeon are more salt tolerant and forage mainly in the Atlantic Ocean so the habitat loss will have insignificant effects on them. Surveys conducted by the COE indicate that substrate suitable for the prey species preferred by shortnose and juvenile Atlantic sturgeon is found in the section of the Front River immediately upriver from the lost estuarine foraging habitat. The COE surveys did not establish whether these areas support sturgeon prey species, but NMFS believes that this upriver habitat may eventually be colonized by prey species as the habitat equalizes to the higher salinities resulting from the upriver movement of the salt wedge. To compensate for the lost foraging habitat, sturgeon will be forced to shift foraging efforts into new areas, once suitable prey become available, or to intensify their foraging in the remaining suitable habitats, if sufficient prey remains there. To the extent that sturgeon and the ecosystem are capable of making these responses, the overall impacts of lost foraging habitat may eventually be reduced.

Analysis of the best available information indicates that all juveniles of both species of sturgeon (no estimates of these populations are available) and all adult shortnose sturgeon (estimated at 2000) in the Savannah River will be affected by the deepening. The loss of foraging area mentioned above will reduce the amount of prey available to juveniles, making successful foraging more difficult. This reduction in prey and reduction in foraging success will result in slower growth rates and reduced fitness of juvenile sturgeon. Reduced fitness can also lead to disease and mortality. Adult shortnose sturgeon will also face a reduction in foraging success which will lead to reduced fitness. Reduced fitness in adult shortnose sturgeon can lead to disease and mortality, lower

fecundity in females, and a reduction in the energy required to make spawning runs, thereby, causing a lowering of reproductive success. There is no reliable way to quantify the actual numbers of juvenile shortnose and Atlantic sturgeon or adult shortnose sturgeon that will manifest these effects. Therefore, monitoring of habitat will be used to determine the extent of the effects to these species and to determine the need to reinitiate consultation. The terms and conditions of the incidental take statement issued with this opinion include monitoring of habitat effects.

Monitoring will include ensuring that habitat effects predicted by the COEs modeling are not greater than expected. The monitoring will also be used to determine if prey species do colonize upriver habitats and how long it takes for such colonization to occur. Lastly, monitoring will determine if the sturgeon are using new habitat areas including those that we expect to eventually be newly colonized by prey species. If monitoring indicates that these predictions are not accurate and that the effects of the action are greater than expected, taking action through the adaptive management process will be required.

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. 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, major future changes are not anticipated in ongoing human activities described in the environmental baseline. The present human uses of the action area, such as commercial shipping, boating, and fishing, are expected to continue at the present levels of intensity in the near future as are their associated risks of injury or mortality to sea turtles and shortnose sturgeon posed by incidental capture by fishermen, vessel collisions, marine debris, chemical discharges, and man-made noises.

Sea Turtles
Beachfront development, lighting, and beach erosion control are all ongoing activities along the southeastern coast of the United States. These activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Human activities and development along nesting beaches may also discourage sea turtles from nesting sites. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. However, more and more coastal counties have or are adopting more stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting. Some of these measures were drafted in response to lawsuits brought against the counties by concerned citizens who charged the counties with failing to uphold the ESA by allowing unregulated beach lighting which results in takes of hatchlings.

NMFS presumes that any additional increases in recreational vessel activity in inshore and offshore waters of the Atlantic Ocean will likely increase the risk of turtles taken by injury or mortality in vessel collisions. Recreational hook-and-line fisheries have been

known to lethally take sea turtles. Future cooperation between NMFS and the states on these issues should help decrease take of sea turtles caused by recreational 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.

Sturgeon
Human activities that affect riverine water quality and quantity such as non-point and point-source discharges are also expected to continue at current rates. Future cooperation between NMFS and the GADNR and SCDNR should help decrease take of sturgeon caused by recreational activities. NMFS will continue to work with states to develop ESA Section 6 agreements and with researchers in Section 10 permits to enhance programs to quantify and mitigate these takes.

Climatically, sea level is expected to continue to rise, water temperatures are expected to continue to rise, and levels of precipitation are likely to fluctuate more drastically. Drought and inter-and intra-state water allocation and their associated impacts will continue and may intensify. A rise in sea level will likely drive the salt wedge farther upriver, further constricting shortnose sturgeon habitat.

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 affected ESA-listed sea turtles and sturgeon. In Section 5, we outlined how the proposed action can affect sea turtles and sturgeon and the extent of those effects in terms of estimates of the numbers of each species expected to be 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.

It is the responsibility of the action agency to "insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species…" (ESA Section 7(a)(2)). Action agencies must consult with and seek assistance from the Services to meet this responsibility. The Services must ultimately determine in a biological opinion whether the action jeopardizes listed 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, NMFS must look at whether the action directly or indirectly reduces the reproduction, numbers, or distribution of a listed species. Then, if there is a reduction in one or more of these elements, we evaluate whether it would be expected to cause an appreciable reduction in the likelihood of both the survival and the recovery of the species.

In the following section we evaluate the responses of loggerhead (NWA DPS) and Kemp's ridley sea turtles, and sturgeon, to the effects of the action. We have previously summarized how the Savannah River population of shortnose sturgeon is a part of the larger, Southern metapopulation. The Southern metapopulation consists of all shortnose sturgeon populations inhabiting the rivers from North Carolina through Florida. The Southern metapopulation is markedly separate from the other two metapopulations of the shortnose sturgeon, both physically and genetically. We will also evaluate in the following section the response of the Atlantic sturgeon South Atlantic DPS to the effects of the action, which is currently proposed for ESA listing as endangered.

7.1 Effects of the Action on Loggerhead Sea Turtles' Likelihood of Survival and Recovery in the Wild

The lethal take of 16 sea turtles by hopper dredges would result in an instantaneous, but temporary reduction in total population numbers. Thus, the proposed 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 female 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 is expected to survive to sexual maturity. Thus, the death of an adult female eliminates an individual's contribution to future generations, and the action will result in a reduction in sea turtle reproduction.

Considering the size of the NWA DPS, we believe the loggerhead sea turtle population is sufficiently large enough to persist and recruit new individuals to replace those expected to be lethally taken (i.e., 16 over the course of the 3-year dredging project). We use the following estimates to support our determination.

NMFS SEFSC (2009a) estimated the likely minimum adult female population size for the western North Atlantic subpopulation in the 2004-2008 time frame to be between 20,000 to 40,000 (median 30,050) female individuals, with a low likelihood of there being as many as 70,000 individuals. The estimate of western North Atlantic adult loggerhead females was considered conservative for several reasons. The number of nests used for the western North Atlantic was based primarily on U.S. nesting beaches; as such, the results are a slight underestimate of total nests because of the inability to collect complete nest counts for many non-U.S. nesting beaches. In estimating the current population size for adult nesting female loggerhead sea turtles, NMFS SEFSC (2009a) simplified the number of assumptions and reduced uncertainty by using the minimum total annual nest count over the last five years (i.e., 48,252 nests). This was a particularly conservative assumption considering how the number of nests and nesting females can vary widely from year to year, (cf., 2008's nest count of 69,668 nests, which would have increased proportionately the adult female estimate to between 30,000 and 60,000). Further, minimal assumptions were made about the distribution of remigration intervals and nests per female parameters, which are fairly robust and well-known parameters.

Although not included in the NMFS SEFSC (2009) report, in conducting its loggerhead assessment NMFS SEFSC also produced a much less robust estimate for total benthic females in the western North Atlantic, with a likely range of approximately 60,000 to 700,000, up to less than one million. The estimate of overall benthic females is considered less robust because it is model-derived, assumes a stable age/stage distribution, and is highly dependent upon the life history input parameters. Relative to the more robust estimate of adult females, this estimate of total benthic female population is consistent with our knowledge of loggerhead life history and the relative abundance of adults and benthic juveniles: the benthic juvenile population is an order of magnitude larger than adults. Therefore, we believe female benthic loggerheads number in the hundreds of thousands.

Based on the total numbers of adult females and benthic juvenile females estimated by NMFS SEFSC for the western North Atlantic population of loggerhead sea turtles (now designated as the NWA DPS), the anticipated lethal take resulting from the proposed action (i.e., worst case, up to 16 loggerhead) represent the removal of, at most, approximately 0.043 percent of the estimated adult loggerhead female population. This level of lethal take of sea turtles also represents the removal of, at most, 0.0019 percent of the estimated female benthic loggerheads population. These removals are very small and contribute only minimally to the overall mortality on the population. For adult females, the incremental effect on annual mortality rates is less than four one-hundredths of the range of possible mortality values for the species. For benthic juvenile females, the contribution to overall mortality is less. Further, these percentages are likely an overestimation of the impact of the anticipated lethal take resulting from the proposed project on loggerhead sea turtles because of the following reasons. These percentages represent impacts to adult and benthic juvenile female loggerhead sea turtles only, and not to the population as a whole. Because this estimated contribution to mortality is a tiny part of our range of uncertainty across what total mortality might be for loggerhead sea turtles, we do not believe that the small effect posed by the lethal take resulting from the proposed project will be detectable or appreciable.

The potential lethal take of up to 16 loggerheads over a 3-year period will result in reduction in numbers when takes occur and possibly by lost future reproduction, but, given the magnitude of these trends and likely large absolute population size, it is unlikely to have any detectable influence on the population objectives and trends noted above. In the event that the take is non-lethal, the take would not be expected to impact the reproductive potential, fitness, or growth of the captured sea turtle because it will be immediately released unharmed, or released with only minor injuries from which it is expected to fully recover, or be rehabilitated prior to release. Thus, the proposed action will not interfere with achieving the recovery objectives and will not result in an appreciable reduction in the likelihood of loggerhead sea turtles' recovery in the wild.

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 potential lethal take of up to 16 loggerheads over a 3-year period will result in reduction in numbers when takes occur and possibly by lost future reproduction, but, given the magnitude of these trends and likely large absolute population size, it is unlikely to have any detectable influence on the population objectives and trends noted above. Capture of sea turtles by relocation trawlers will not affect the adult female nesting population or number of nests per nesting season. Thus, the proposed action will not interfere with achieving the recovery objectives and will not result in an appreciable reduction in the likelihood of loggerhead sea turtles' recovery in the wild.

7.2 Effect of the Action on Kemp's Ridley Sea Turtles' Likelihood of Survival and Recovery in the Wild

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. Recent calculations of nesting females determined from nest counts show that the population trend is increasing towards that recovery goal, with an estimate of 4,047 nesters in 2006 and 5,500 in 2007 (NMFS 2007, Gladys Porter Zoo 2007). Recent nesting data indicated a population of an estimated 8,460 females in 2009 and 5,320 females in 2010 (J. Peña, Gladys Porter Zoo, pers. comm. to S. Heberling, NMFS, March 21, 2011). Based on this information, and similar to the conclusion reached for loggerhead sea turtles, the anticipated lethal take of up to 11 Kemp's ridley sea turtles would not be expected to have a detectable effect on the Kemp's ridley sea turtle population.

The lethal take of 11 Kemp's ridleys by hopper dredges over the 3-year duration of the proposed project could potentially result in short-term effects on individuals; however, these effects do not constitute an appreciable reduction in reproduction and numbers. Changes in distribution, even short-term, are not expected from non-lethal takes (interactions/releases from relocation trawling, vessel strikes, etc.) during the Savannah Harbor Expansion Project. 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 up to 11 Kemp's ridleys is anticipated during the proposed project. Because all potential take is 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 sea turtles is expected from the take of these individuals.

Based on the above analysis, we believe that take of Kemp's ridley 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 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 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 potential injury or mortality of 11 Kemp's ridley will result in a reduction in overall population numbers in any given year. We already have determined this take is not likely to reduce population numbers over time due to current population sizes and expected recruitment. Capture of sea turtles by relocation trawlers will not affect the adult female nesting population or number of nests per nesting season. Thus, the proposed action will not result in an appreciable reduction in the likelihood of Kemp's ridley sea turtles recovery in the wild.

7.3 Effects of the Action on Shortnose Sturgeons' Likelihood of Survival and Recovery in the Wild

Adverse effects to important estuarine foraging habitats for juveniles and adults will affect both life stages. These effects are expected to be sub-lethal for individual sturgeon of the existing population, but may reduce the river's overall carrying capacity and ability to provide optimal habitat for shortnose sturgeon to forage. However, based on previous studies indicating that sturgeon moved upriver to suitable habitats after a deepening event (Collins et al., 2001), NMFS believes that both adults and juveniles will move to suitable habitats further upriver after this deepening event. However, NMFS believes there may be a transitional period as the habitat adjusts to the new, higher salinity. Sturgeon are expected to use these areas for foraging once their prey have colonized and stabilized to the new environmental conditions. The adverse effects of habitat loss on young of the year juveniles will be further reduced by being spawned further upriver due to the construction of a sturgeon-friendly fish passage facility, thus giving them more time and distance to mature before reaching the lower river.

NMFS believes that the proposed action is not likely to cause a long-term reduction in reproduction. Although there may be a reduction (1-2 years, maybe longer) in spawning due to lack of fitness of spawning adults resulting from lower foraging success during a transitional period as the habitat adjusts to the new, higher salinity. However, the implementation of the timely sturgeon-friendly fish passage before the project's full impacts occur within the inner harbor will result in the addition of 20 miles of spawning habitat that is expected to result in increased spawning activity over the long term. Adding 20 miles of available habitat will also lengthen the amount of residency time of early juveniles in freshwater, thereby resulting in juveniles being older and larger when

they reach the freshwater/saltwater interface and more adept at adjusting to different salinities.

Based on the fact that NMFS does not believe the proposed action will result in a reduction in reproduction or numbers of shortnose sturgeon in the Savannah River, the proposed action will not result in a decrease in the species' distribution. Based on this information, the proposed action will not appreciably reduce the likelihood of the shortnose sturgeon's survival in the Savannah River.

In the above analysis on the effects of the action, we determined that the loss of foraging habitat for shortnose sturgeon may restrict future population growth but will not appreciably reduce the likelihood of the shortnose sturgeon's survival in the Savannah River. We will analyze the likelihood of shortnose sturgeon recovery in the wild by considering effects resulting from the proposed action relative to accomplishing the conservation goals described in the Recovery Plan (NMFS 1998).

The long-term recovery goal for shortnose sturgeon focuses on recovering each population independently. An increase in the population to a size that maintains a steady recruitment of individuals representing all life stages would provide population stability and enable the population to sustain itself in the event of unavoidable impacts. Goals listed in the 1998 shortnose sturgeon recovery plan that could be affected by the proposed action include:

1. Ensure that all fish passageways permit adequate passage of shortnose sturgeon and do not alter migration or spawning behavior;
2. In each river, identify natural migration patterns of each life stage and any barriers to movement between habitats. Devise methods to pass shortnose sturgeon above/below existing barriers; and
3. Restore flows in regulated rivers during spawning periods to promote spawning success and rehabilitate degraded spawning substrate.

The proposed implementation of fish passage at the New Savannah Bluff Lock and Dam and the associated restoration of 20 miles of upstream habitat, including historic spawning habitat and providing additional habitat for the early life stages of their offspring to use as developmental and foraging habitat. By adding approximately 20 miles of habitat, the early juveniles moving down the river will have a longer length of river in which to feed and grow older and larger before reaching the saltwater/freshwater interface located in the lower Savannah River. As it has been shown by laboratory studies, even a few weeks difference in age enables juvenile sturgeon to develop a higher tolerance of salinity and lower levels of dissolved oxygen. This would help them to be better able to utilize a wider range of foraging habitat once they reach the lower river thereby reducing the negative effects caused by upriver movement of the salt wedge resulting from the deepening. The increased spawning habitat and survival of more juveniles should help to rebuild the population; thereby ensuring a stable population that can maintain continuous recruitment of individuals, will contain all life stages, and will allow the population to sustain itself in the event of unavoidable impacts.

7.4 Effects of the Action on Atlantic Sturgeons' Likelihood of Survival and Recovery in the Wild

While the expected lethal take of 4 Atlantic sturgeon by hopper dredges would result in a reduction in numbers which are considered to be low, the reduction will not decrease the overall population in the South Atlantic DPS as there are significant numbers of fish found in the rivers comprising the South Atlantic DPS range of Atlantic sturgeon.

Adverse effects to important estuarine foraging habitats for juveniles and adults will affect both life stages. These effects are expected to be sub-lethal for individual sturgeon of the existing population, but may reduce the river's carrying capacity and its overall ability to provide suitable foraging habitat for juvenile Atlantic sturgeon. NMFS also believes that both adults and juveniles will move to suitable foraging and resting habitats further upstream. The adverse effects of habitat loss on young of the year juveniles will be further reduced by being spawned further up the river due to the construction of a sturgeon-friendly fish passage structure, thus giving them more time and distance to mature before reaching the lower river.

NMFS believes that the proposed action is not likely to cause a reduction in reproduction. The implementation of the timely sturgeon-friendly fish passage before the project's full impacts occur within the inner harbor will result in the addition of 20 miles of spawning habitat that is expected to result in increased spawning activity over the long term. Adding 20 miles of available habitat may lengthen the amount of residency time of early juveniles in freshwater, thereby resulting in juveniles being older and larger when they reach the freshwater/saltwater interface and more adept at adjusting to different salinities.

Based on the fact the NMFS does not believe the proposed action will result in a reduction in reproduction or numbers of Atlantic sturgeon in the Savannah River, the proposed action will not result in a decrease in the species distribution. Based on this information, the proposed action will not appreciably reduce the likelihood of the Atlantic sturgeon's survival in the Savannah River.

Because the Atlantic sturgeon is not a listed species, there is no recovery plan. However recovery is the process by which listed species and their ecosystems are restored and their future is safeguarded to the point that protections under the ESA are no longer needed (NMFS and USFWS Recovery Planning Guidance 2010). The first step in recovering a species is to reduce identified threats; only by alleviating threats can lasting recovery be achieved (NMFS and USFWS Recovery Planning Guidance 2010). An increase in the population to a size that maintains a steady recruitment of individuals representing all life stages would provide population stability and enable the population to sustain itself even in the event of unforeseen and unavoidable impacts.

Major threats impacting the Atlantic sturgeon South Atlantic DPS were summarized in the proposed listing (75 FR 61904) and include:

1. Dams that curtail the extent of available habitat, as well as modifying sturgeon habitat downstream through a reduction in water quality.
2. Dredging that modifies the quality and availability of Atlantic sturgeon habitat.
3. Degraded water quality that modifies and curtails the extent of available habitat for spawning and nursery areas.
4. Climate change that exacerbates the effects of modification and curtailment of Atlantic sturgeon habitat caused by dams, dredging, and reduced water quality.
5. Overutilization for commercial purposes contributed to the historical drastic decline in Atlantic sturgeon populations throughout the species' range.
6. Inadequacy of regulatory mechanisms to control bycatch and the modification and curtailment of Atlantic sturgeon habitat.

In addition, the proposed implementation of fish passage at the New Savannah Bluff Lock and Dam and the associated restoration of 20 miles of upstream habitat, including historic spawning habitat should provide additional habitat for the early life stages of Atlantic sturgeon to use as developmental and foraging habitat. It has been shown by laboratory study that even a few weeks difference in age enables juvenile sturgeon to develop a higher tolerance of salinity and lower levels of dissolved oxygen. This would help them to be better able to utilize a wider range of foraging habitat once they reach the lower river, thus reducing the negative effects caused by upriver movement of the salt wedge resulting from the deepening; thereby helping to ensure a stable population that can maintain a continuous recruitment of individuals, will contain all life stages, and will allow the population to sustain itself in the event of unavoidable impacts.

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 the Northwest Atlantic DPS of loggerhead sea turtles, Kemp's ridley sea turtles, Atlantic sturgeon, and shortnose sturgeon.

Kemp's Ridley and Loggerhead Sea Turtles (NWA DPS)
Because the proposed action is not reasonably expected to reduce appreciably the likelihood of survival and recovery of Kemp's ridley or loggerhead (NWA DPS) sea turtles, it is our opinion that the Savannah Harbor Expansion Project is not likely to jeopardize their continued existence.

Shortnose Sturgeon
This opinion 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 shortnose sturgeon. Review of the available data indicates that the proposed project will adversely affect shortnose sturgeon through dredging and habitat modification. These effects are expected to be nonlethal for juvenile and adult shortnose sturgeon found in the

Savannah River. NMFS believes the effects of these impacts will be reduced by timely construction of a sturgeon-friendly fish passage prior to or concurrent with project impacts occurring within the inner harbor and will result in the addition of 20 miles of spawning habitat that is expected to result in increased spawning activity. Therefore, it is our opinion that the Savannah Harbor Expansion Project is not likely to jeopardize the continued existence of shortnose sturgeon.

Conference Opinion for South Atlantic DPS of Atlantic Sturgeon
Our Atlantic sturgeon analyses focused on the impacts to and population response of the South Atlantic DPS within the Savannah River. Review of the available data indicates that the proposed project will adversely affect Atlantic sturgeon through dredging and habitat modification. These effects are expected to be nonlethal for the juvenile and adult Atlantic sturgeon found in the Savannah River. NMFS believes the effects of these impacts will be reduced by timely construction of a sturgeon-friendly fish passage prior to or concurrent with project impacts occurring within the inner harbor and will result in the addition of 20 miles of spawning habitat that is expected to result in increased spawning activity. It is therefore our opinion that the Savannah Harbor Expansion Project is not likely to jeopardize the continued existence of the South Atlantic DPS of Atlantic sturgeon.

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, the COE must immediately notify (within 24 hours, if communication is possible) NMFS' Office of Protected Resources should a take of a listed marine mammal occur.

9.1 Anticipated Amount or Extent of Incidental Take

Section 9 of the ESA and Federal regulation pursuant to Section 4(d) of the ESA prohibit take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or

to attempt to engage in any such conduct. Harm is further defined by NMFS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. 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 ESA 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 provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Sea Turtles
Based on historical distribution data, hopper dredge observer reports, and observations of past strandings, loggerhead and Kemp's ridley sea turtles may occur in the action area and may be taken by the hopper dredging operations of this project. NMFS anticipates incidental take, by injury or mortality, will consist of 27 sea turtles (11 Kemp's ridley and 16 loggerhead) during the three years of project dredging and up to 51 non-injurious takes of non-species-specific sea turtles over the three years. 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.

Atlantic sturgeon
During the dredging of the offshore Entrance Channel, we expect 4 Atlantic sturgeon to be killed as a result of interactions with dredges and another 20 will be taken in relocation trawlers but released alive. According to the COE's timeline, dredging of the Entrance Channel will occur over a period of two to three years.

The loss of estuarine habitat currently used by sturgeon will result from the salt wedge moving further upriver causing salinity to increase above levels tolerated by juvenile Atlantic sturgeon. With the higher salinities located further upriver, small juveniles migrating downriver could arrive at the salt wedge too early and be subjected to salinities beyond their tolerable upper limits. This could result in mortality for these individuals. Adult sturgeon may become sick and weak if they are not able to find sufficient prey due to the loss of foraging habitat that would occur with the shift of higher salinity upriver.

An unknown number of Atlantic sturgeon may experience adverse effects due to the loss of estuarine habitat in the inner harbor, but NMFS does not expect this number to rise to a population level. Modeling of habitat loss for Atlantic sturgeon was not conducted due to their proposed listing occurring after the COE had concluded all of its data analyses, however it is generally believed that suitable habitat as determined for juvenile shortnose sturgeon would also be suitable for juvenile Atlantic sturgeon. Modeling for shortnose sturgeon indicates that with the 47-foot deepening alternative, approximately 251.0 acres of foraging and resting habitat used by juvenile shortnose sturgeon during the winter (January conditions were modeled) would be lost. This represents approximately 7.6 percent of the total habitat available to juvenile shortnose sturgeon in the lower river. Because juvenile Atlantic and shortnose sturgeon are thought to share the same foraging and resting habitat, there is a likelihood that juvenile Atlantic sturgeon would also be

affected by the loss of this habitat. The most recent population estimates for Atlantic sturgeon estimated that there are 300 or less adults in the Savannah River, but there are no estimates for juvenile Atlantic sturgeon. Because no population estimates have been conducted, we are unable to determine the actual number of juvenile Atlantic sturgeon currently found in the Savannah River. However, using the loss of 7.6 percent of the total available habitat to extrapolate take of juvenile Atlantic sturgeon, we would estimate that the inner harbor deepening would adversely affect approximately 7.6 percent of the juvenile Atlantic sturgeon found in the Savannah River due to loss of foraging/nursery habitat.

Modeling also indicated that approximately 266.0 acres of foraging and resting habitat used by adult shortnose sturgeon during the winter (January conditions were modeled) would be lost. This represents approximately 6.9 percent of the total habitat available to adult shortnose sturgeon in the lower river. However, since adult Atlantic sturgeon have a wide range of salinity tolerance, we believe the majority of adult Atlantic sturgeon will not be affected and will be able to find suitable foraging habitat. Although we cannot estimate the actual number of sturgeon that would be affected, we would not expect it to rise to a population level adverse affect.

Shortnose sturgeon

NMFS has also determined that juveniles and adults within the Savannah River population of shortnose sturgeon will be affected due to loss of estuarine habitat in the lower river. An unknown number of shortnose sturgeon may experience adverse effects due to the loss of habitat, but NMFS expects this to be a small number and not on a population scale. The modeling indicates that with the 47-foot deepening alternative, approximately 251.0 acres of foraging and resting habitat used by juvenile shortnose sturgeon during the winter (January conditions were modeled) would be lost. This represents approximately 7.6 percent of the total habitat available to juvenile shortnose sturgeon in the lower river. No estimates of juvenile abundance have been conducted. Because no population estimates are available for juvenile shortnose sturgeon, we are unable to determine the actual number of juveniles currently found in the Savannah River.

Modeling also indicated that approximately 266.0 acres of foraging and resting habitat used by adult shortnose sturgeon during the winter (January conditions were modeled) would be lost. This represents approximately 6.9 percent of the total habitat available to adult shortnose sturgeon in the lower river. We believe the majority of adult shortnose sturgeon will not be affected and will be able to find suitable foraging habitat. A draft status review of shortnose sturgeon, being prepared by the Shortnose Status Review Team (2011), provides a (weak) population estimate of 2,000 adults in the Savannah River. If we use this estimate, approximately 2,000 adult shortnose sturgeon in the Savannah River could be adversely affected by the loss of suitable foraging habitat.

9.2 Effect of the Take

Sea Turtles
NMFS has determined the anticipated level of incidental take specified in Section 9.1 is not likely to jeopardize the continued existence of loggerhead (NWA DPS) or Kemp's ridley sea turtles.

Sturgeon
NMFS has determined the anticipated level of incidental take as explained in Section 9.1 is not likely to jeopardize the continued existence of shortnose sturgeon or the Atlantic sturgeon.

9.3 Reasonable and Prudent Measures

Section 7(b)(4) of the ESA requires NMFS to issue a statement specifying the impact of any incidental take on listed species, which results from an agency action otherwise found to comply with Section 7(a)(2) of the ESA. It also states the RPMs necessary to minimize the impacts of take and the terms and conditions to implement those measures, must be provided and must be followed to minimize those impacts. Only incidental taking by the federal agency that complies with the specified terms and conditions is authorized.

The RPMs and terms and conditions are specified as required, by 50 CFR 402.01(i)(1)(ii) and (iv), to document the incidental take by the proposed action and to minimize the impact of that take on ESA-listed species. These measures and terms and conditions are non-discretionary, and must be implemented by the COE in order for the protection of Section 7(o)(2) to apply. The COE has a continuing duty to regulate the activity covered by this incidental take statement. If the COE fails to adhere to the terms and conditions through enforceable terms, and/or fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse.

Sea Turtles
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 intake and overflow screening, use of sea turtle deflector dragheads, observer and reporting requirements, and relocation trawling. The following RPM's 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. 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 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 the action area.

1. Take Reporting: Observer Requirements and Dredged Material Screening

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/or can be identified as from sea turtle species. However, this opinion estimates that with 4-inch inflow screening in place, and 24 hour, 100 percent observer coverage will probably detect and record 66.6 percent of turtle mortality. Additionally, coordination with local sea turtle stranding networks can be a valuable adjunct monitoring method; not to directly monitor takes, but to help ensure that unanticipated impacts to sea turtles are not occurring.

2. 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.

3. 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 to the COE's New Orleans and Galveston Districts on hopper dredging of channels in Texas and Louisiana 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 sea turtle 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 hopper 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 (COE Sea Turtle Data Warehouse; http://el.erdc.usace.army.mil/seaturtles/index.cfm). In Fiscal Year 2007, relocation trawling activities in COE channel projects in the Gulf of Mexico resulted in the capture and relocation of 67 green, 42 Kemp's ridley, and 68 loggerhead sea turtles; in the South Atlantic, 18 loggerhead and 17 Kemp's ridley sea turtles were relocated (Ibid).

This opinion authorizes the use of turtle relocation trawling. NMFS believes the use of relocation trawling should be required during all proposed hopper dredging. NMFS will provide a list of contractors who are approved by NMFS to perform this work. NMFS expects the effect of any turtle relocation trawling would be non-lethal and non-injurious.

Sturgeon

We have determined the following RPMs are necessary and appropriate to minimize the impacts of future takes on sturgeon as the COE conducts the dredging of the harbor and implements fish passage and other modifications in the project area.

1. Implement Safe and Effective Fish Passage in a Timely Manner

The implementation of fish passage at the New Savannah Bluff Lock and Dam is a measure that is expected to provide sturgeon access to upstream habitat. A delay in

implementing fish passage will result in adverse effects on the year-class strength of sturgeon. Reduction in year-class is a major consequence for the late-maturing, long-lived sturgeon that spawn infrequently. The constriction of habitat in the lower Savannah River adds further urgency to prompt fish passage implementation to restore access to habitat upstream that contains high quality spawning habitat and additional foraging habitat. The COE has presented a fish passage design called an Off-Channel Rock Ramp which is expected to pass fish safely and effectively upstream and downstream. NMFS requested a review of the proposed design by Dr. Luther Aadland (Minnesota Department of Natural Resources), who provided assurance that the proposed rock ramp could effectively pass sturgeon and other anadromous species with some modification. Additionally, a comparison analysis of the performance of existing rock ramps located in other parts of the country with similar characteristics to the New Savannah Bluff Lock and Dam fish passage design may provide useful information on the spatial variation of velocities across the width of rock ramp designs. Final design information provided by the COE for the proposed fish passage should include how the velocity fields would vary with different river flows.

The development of the final design of this fish passage will need to be coordinated with NMFS. A timetable for completion of construction of the fish passage facility shall be included. The COE has agreed to immediately initiate final design work and coordinate the results of that effort with the federal and state natural resource agencies within 6 months of receiving all of the environmental approvals to implement the project. In order to consult with the other resource and sturgeon experts, NMFS will require a minimum of 2 months to provide a review of the final fish passage design.

Additional lands must also be acquired to construct the rock ramp and for an access road to the site. The COE shall initiate land acquisition prior to, or concurrent with, the start of dredging of the Savannah Harbor Entrance Channel. The COE has estimated that it will take 6 months to process the land acquisition. Construction of the fish passage shall commence prior to or concurrently with the start of inner harbor dredging and be completed within 2 years. To reduce adverse affects to sturgeon during construction of the fish passage, special provisions for the protection of sturgeon shall be implemented.

The COE will develop a Monitoring and Adaptive Management plan specifically for the fish passage as a part of the comprehensive Monitoring and Adaptive Management Plan for the project (included in RPM 3). The plan will identify detailed success criteria and triggers for passage modification. Sturgeon will be migrating to spawning habitat during the winter and returning downriver during the spring. Larval fish will also be beginning their movement downriver. To protect spawning sturgeon and their offspring, no in-water construction will be performed at the downstream entrance of the fish passage channel during the late winter/spring spawning period through the early summer larval period. In-water work and installation of sheet pile training walls (if necessary) may be performed upstream of the dam throughout the year. The COE shall employ best management practices such as silt curtains to control turbidity throughout the construction of the fish passage facility. No drawdown of water levels can occur during

the late winter/spring spawning period through the early summer larval period to facilitate construction. Normal flows must be maintained.

2. Protective Measures for Sturgeon during Construction in the SHEP Project Area

To reduce adverse effects to sturgeon during construction of the flow re-routing modifications and during the deepening, special provisions for the protection of sturgeon will need to be implemented. The area of the proposed flow re-routing modifications would be located in foraging and resting habitat for sturgeon and is especially important to juvenile shortnose sturgeon during the winter. A moratorium on specific in-water work associated with the flow re-routing modifications will be necessary to protect sturgeon. The timing of the moratorium is linked to the time of year when sturgeon are most likely to occur in the construction area.

3. Development of a Comprehensive Monitoring and Adaptive Management Plan for the Savannah River Project Area

To ensure appropriate monitoring and adaptive management is conducted within the entire Savannah River Project Area a comprehensive monitoring and adaptive management plan shall be developed for assessing project effects associated with the deepening, the effectiveness of the fish passage, and for implementing corrective actions. The Plan shall contain details describing how sturgeon will be monitored. It must also address how adaptive management would be included during the construction phases. The Plan shall identify explicit success criteria and triggers. This would include a mechanism that would allow results from the monitoring to feed into decisions governing operation of the project activities and mitigation actions. If monitoring of sturgeon habitat indicates the loss of suitable habitat exceeds the amount determined by the COE's models, or if the fish passage is not functioning as intended, and these impacts cannot be addressed through adaptive management, this would trigger re-initiation of consultation with NMFS. The COE will coordinate with NMFS on development of the comprehensive plan to include measures to address these concerns.

4. Ensure Appropriate Dissolved Oxygen Levels

The proposed expansion, deepening, and modification of the Savannah Harbor through dredging will have a significant effect on the habitat of sturgeon. The COE is proposing to install oxygen injection systems on the Savannah River above and within the project area to mitigate for expected impacts to dissolved oxygen caused by deepening the harbor. NMFS believes there is a high degree of uncertainty associated with the proposed use of an oxygen injection system. These systems, known as Speece cones, will be used during the summer months to inject oxygen into the river, as needed. These systems have not been previously used in a tidal system such as the Savannah River, so their efficacy cannot be thoroughly assessed before installation. Once operational, extensive monitoring of the river to determine effectiveness of the systems is proposed and modifications may be necessary as a part of a comprehensive monitoring and

adaptive management plan to be developed for the project. Analysis of projected benefits of dissolved oxygen injection indicate that while there would be improvements in portions of the Front River and Middle River, the lower portion of the Back River would still have areas of unsuitable habitat for shortnose sturgeon. If the oxygen injection system does not perform as designed, impacts to sturgeon habitat from the harbor deepening could be greater than what has been estimated by the COE's models. Contingency funding shall be included in the adaptive management plan to accommodate needed modifications to address low levels of dissolved oxygen. This measure is intended to ensure that impacts from SHEP are no worse than the COE's predictions in the DEIS. Sturgeon have been shown to be impacted by low dissolved oxygen levels, and mortality of sturgeon can occur within hours of exposure to low dissolved oxygen (Campbell and Goodman 2004). The three-level dissolved oxygen criteria for shortnose sturgeon recommended by the interagency fisheries group and applied by the COE to identify areas with suitable sturgeon habitat include rare (<1% of the time) excursions of summertime dissolved oxygen to less than 2 mg/Liter, infrequent excursions (<5%) to less than 3mg/Liter, and occasional excursions (<10%) below 4 mg/Liter. Thus, these are already relatively permissive standards that allow exposure of sturgeon to very depressed dissolved oxygen levels even in the areas designated as suitable habitat. Given the physiological threat posed to sturgeon from low dissolved oxygen combined with high thermal stress in the summer (water temperatures in the summer average 25°-28°C), monitoring and adaptive management of dissolved oxygen shall ensure that the oxygen injection systems perform as intended to offset impacts due to deepening the harbor and ensure the amount of suitable habitat identified as summer suitable habitat (Figure 30) meet these established dissolved oxygen criteria.

5. Tissue Sampling, Tags and Reporting Take

Tissue samples taken of any sturgeon handled or stranded will be processed per Appendix C. All sturgeon encountered will need to be scanned for a PIT tag. The PIT tag reader should be able to read both 125 kHz and 134 kHz tags. Sonic tags, or some other type of state-of-the-art tracking device, will be placed on sturgeon captured during relocation trawling, or alive by the hopper dredge, only by NMFS-approved personnel under the authority of this biological opinion. The COE will need to notify NMFS of any and all sturgeon injuries or mortality occurring during the dredging/construction activities within 24 hours of the take.

9.4 Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, the COE must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting and monitoring requirements. These terms and conditions are non-discretionary.

Sea Turtles

1. Observers (RPM 1): The COE 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 throughout the proposed project.

2. Screening (RPM 1): 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 SAD, 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, for example, to 6-inch by 6-inch, then 9-inch by 9-inch, then 12-inch by 12-inch openings. Other variations in screening size are allowed, with prior written approval by NMFS. 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 4-inch screening is mandatory. The COE 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.

3. 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.

4. Sea Turtle Deflecting Draghead (RPM 2): A state-of-the-art rigid deflector draghead must be used on all hopper dredges at all times. Alternate draghead designs shall not be used unless prior, written approval is given by NMFS.

5. 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), and reported by electronic mail to: (**takereport.nmfsser@noaa.gov**) by onboard NMFS-approved protected species observers, the dredging company, or the COE 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, screening type (inflow, overflow) utilized, daily water temperatures, name of dredge, names of endangered species observers, percent observer coverage, and any other information the SAD deems relevant.

6. Sea Turtle Strandings (RPM 1): The SAD 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, the strandings will not be counted against the COE's take limit.

7. Reporting - Strandings: The COE 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 and/or bed-leveler interactions.

8. Relocation Trawling (RPM 3)(if applicable): Prior to turtle relocation trawling, the COE shall develop and submit to NMFS detailed specifications on the final selected turtle relocation trawling gear sufficiently ahead of planned dredging activities for NMFS to review and comment on the plans. NMFS fisheries gear specialists may be able to provide technical assistance in developing specifications. The use of relocation trawling will be required during all proposed hopper dredging during December 1 through March 31.

Non-capture relocation trawling ("sweep trawling") may be used if prior, written approval is given by NMFS, after NMFS ensures that the proper net design and sweep trawling procedures will be used. Sweep-trawling trawl net design and trawling procedures are inherently and fundamentally different from capture-trawling trawl net design and procedures.

9. Relocation Trawling Report (RPM 3)(if applicable): The COE 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.

10. Additional Relocation Trawler Requirements (RPM 3) (if applicable): Any capture-type or sweep-type relocation trawling conducted or contracted by the COE 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 as listed below. In the event that trawling does result in the capture of a sea turtle, the COE or its contractors may employ a separate chase boat to relocate the turtle at a distance of no less than 3 miles from the centerline of the navigation channel at the capture site.

a. Handling: Sea turtles recovered by observers on modified relocation trawlers (e.g., turtles incidentally captured in modified trawl gear, injured turtles recovered on the surface, etc.) 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 B).

b. Captured Sea Turtle Holding Conditions: Sea turtles may be held up to 24 hours 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.

c. Scientific Measurements and Data Collection: 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 observer's 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/tissue sampling operations. External mounting of satellite tags, radio transmitters, data loggers, crittercams, etc. may be done under the authority of this opinion by NMFS-approved, trained personnel, after approval from NMFS SERO PRD (see Terms and Condition #10.g., Other Sampling Procedures).

NMFS-approved protected species observers may conduct more invasive scientific procedures (e.g., bloodletting, laparoscopies, external tumor removals, anal and gastric lavages, 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, or the observer is acting as the duly-designated agent of the permit holder, and has first notified NMFS' Southeast Regional Office, Protected Resources Division.

d. 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 COE shall ensure that logistical arrangements and support to accomplish this are pre-planned and ready, and is responsible for ensuring that dredge vessel personnel comply with this requirement. The COE shall bear the financial cost of sea turtle transport, treatment, rehabilitation, and release.

e. 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.

f. 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 and is comfortable with the procedure, 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);

Unless otherwise approved in advance by NMFS SERO PRD, 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.

g. Other Sampling Procedures: All other tagging and external or internal sampling procedures (e.g., bloodletting, laparoscopies, external tumor removals, anal and gastric lavages, mounting of satellite or sonic transmitters, or similar tracking equipment, 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, or unless the observer (or person performing the procedure, in the case of piggy-back research by the COE or other federal or state government agency or university personnel) receives prior, written approval by NMFS SERO after a thorough review by PRD of their credentials, experience, and training in the proposed procedures.

h. 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.

i. 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.

11. Requirement and Authority to Conduct Tissue Sampling for Genetic and Contaminants Analyses: 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 COE-conducted and COE-permitted activities) shall be tissue-sampled

prior to release. Sampling shall continue uninterrupted until such time as NMFS determines and notifies the COE in writing.

Sea turtle tissue samples shall be taken in accordance with NMFS' SEFSC procedures for sea turtle genetic analyses, and, as specified, for contaminants (e.g., heavy metals) analyses. Protocols for tissue sampling to be utilized in contaminants analyses are currently being developed by Dr. Dena Dickerson, ERDC. The COE 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.

12. Training - Personnel on Hopper Dredges: The COE 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.

13. Dredge Lighting: 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.

14. Best Management Practices: The COE will be required to conduct activities in compliance with NMFS' March 23, 2006, *Sea Turtle and Smalltooth Sawfish Construction Conditions* (Appendix D).

Sturgeon

The following Terms and Conditions implement the RPMS above, which are designed to minimize the adverse impacts of the expected take from the proposed action, and to provide for monitoring and validation of the impacts associated with the proposed action, and must be collectively implemented.

1. Develop a Plan for Safe and Effective Fish Passage (RPM 1): The implementation of a safe and effective fish passage shall be coordinated by the COE in consultation with sturgeon experts with NMFS, FWS, SCDNR, and GADNR. The COE has presented a fish passage design called an Off-Channel Rock Ramp. Using the proposed off-channel rock ramp design as its basis, the COE will work with these agencies to develop the final design details. The COE shall conduct a comparison analysis of the performance of existing rock ramps located in other parts of the country with similar characteristics to the proposed New Savannah Bluff Lock and Dam fish passage conditions to review information on the spatial variation of velocities across the width of rock ramp designs. The COE has agreed to expeditiously initiate final design work and would coordinate the results of that effort with the federal and state natural resource agencies within 6 months of receiving all of the environmental approvals to implement the project. NMFS will need a minimum of 2 months to review the final fish passage design. The proposed final design shall require NMFS' final review to validate that the design meets the requirements specified in the Biological Opinion. The goal of the fish passage alternative is to achieve at least 75 percent upstream passage effectiveness for both shortnose and Atlantic sturgeon, at least 85 percent downstream passage effectiveness, and cause no serious injury to sturgeon that come into contact with the passage or dam structures. The fish passage must maintain velocities comparable to those found in the upstream habitat that the sturgeon are expected to access upon completion of the fish passage facility (at Augusta Shoals).

2. Timeline for Construction of the Fish Passage (RPM 1): Fish passage construction shall commence prior to or concurrently with initiation of inner harbor dredging and be completed within two years.

3. Land for Fish Passage (RPM1): The COE or project sponsor shall purchase any additional land necessary for construction of the fish passage and for an access road to the site. The land acquisition process must be initiated prior to, or concurrent with, commencement of entrance channel dredging actions.

4. Fish Passage Construction Guidelines (RPM 1): To protect spawning sturgeon and their offspring, no in-water fish passage construction downstream of the New Savannah Bluff Lock and Dam shall occur during the late winter/spring spawning period and early summer larval period between February 1 and May 31 of any year. In-water construction of the fish passage may be performed upstream of the dam throughout the year.

5. In-water Work During Construction of the Fish Passage (RPM 1): The COE shall adhere to the following protective measures during construction of the fish passage:

- Appropriate erosion and turbidity controls shall be utilized wherever necessary to limit sediments from entering the water.
- Dredging and construction shall be conducted with minimum environmental impact.
- No construction debris shall be allowed to enter the water.
- To ensure passage throughout the habitat, adequate pathways must be provided at all times so that fish can migrate between foraging habitat and spawning habitat; no blocking of the channel is allowed.
- Normal water flows must be maintained throughout the construction areas.
- The COE shall not reduce flows during spring/early summer to aid in the construction of the fish passage.

6. Fish Passage Effectiveness Monitoring and Adaptive Management (RPM 1): The COE shall develop a Monitoring and Adaptive Management Plan specifically for the fish passage that will, to the maximum extent practicable, ensure the performance criteria described in sturgeon term and condition no.1 above will be achieved. The plan will also identify detailed triggers for passage modification. Post-construction monitoring shall be designed and conducted to assess the effectiveness of the fish passage in safely passing sturgeon upstream and downstream. The COE shall consult with NMFS and the other federal and state resource agencies in the completion of the Plan within 6 months of receiving all environmental approvals to implement the project. NMFS shall have final review of such plan. If it is determined that sturgeon are not safely and effectively passing upstream and downstream through the fish passage, measures shall be taken to identify the source of the problem, and corrective actions approved by NMFS shall be taken to rectify the problem.

7. Timing of Construction of the Flow Re-routing Modifications (RPM 2): The construction of the diversion structure associated with the flow re-routing modifications has the potential to cause injury to sturgeon. The impact to sturgeon shall be minimized by constructing the diversion structure while most sturgeon are congregated upstream of the construction area between May 15 and November 1.

8. Protection of Sturgeon during In-water Construction in the Lower Savannah River (RPM 2): The COE shall adhere to the following measures to protect sturgeon during deepening of the harbor and widening of the channel; and during the modifications associated with the flow re-routing, which include plugging Rifle Cut, filling the Sediment Basin, closing the lower arm of McCoy Cut, construction of a flow diversion structure at McCoy Cut, and the dredging of the upper Middle and Back River.

    - Appropriate erosion and turbidity controls shall be utilized wherever necessary to limit sediments from entering the water.

- Dredging and construction shall be conducted with minimum environmental impact.
- No construction debris shall be allowed to enter the water.
- No blocking of the channel is allowed, except where included as part of the flow re-routing modifications.

9. Ensure Appropriate Monitoring and Adaptive Management within the Lower Savannah River Project Area (RPM 3): A comprehensive monitoring and adaptive management plan shall be developed for assessing project effects associated with the deepening, the flow re-routing modifications, the injection of dissolved oxygen, and for implementing corrective actions. The comprehensive plan would also include monitoring and adaptive management for the fish passage as described in T&C 6. The Plan shall identify explicit success criteria and triggers. The COE shall coordinate with NMFS and other federal and state resource agencies in the completion of the Plan within 6 months of receiving all environmental approvals to implement the project. NMFS shall have final review of such plan. The Plan shall include monitoring to determine whether the predicted amount of habitat loss, as determined by the COE's models, is being exceeded. If the monitoring indicates that habitat loss to any species within NMFS' ESA authority is being exceeded, this will trigger re-initiation of consultation with NMFS. Preconstruction monitoring would begin in time to allow one year of work to be complete before dredging occurs in the inner harbor.

10. Ensure Appropriate Dissolved Oxygen Levels (RPM 4): Monitoring and adaptive management for dissolved oxygen levels shall ensure that the oxygen injection systems perform as intended to offset impacts due to deepening the harbor and ensure the amount of suitable habitat as predicted in the COE's modeling of the three-level summer habitat suitability criteria for sturgeon (Table 7) are not reduced. During the monitoring and adaptive management period if dissolved oxygen excursions below minimal levels in the modeled river cells are longer in duration than specified in the criteria, corrective action will be taken immediately, if practicable, for example by increasing or adjusting the operation of the Speece Cone system or cessation of dredging in the area of concern. If short-term responses are not practicable, potential engineering solutions shall be identified and implemented as soon as possible, and not later than July 1, following discovery of the poor oxygen levels.

11. Tissue Sampling (RPM 5): A tissue sample shall be taken of any sturgeon handled or stranded per Appendix C; samples shall be shipped to the address provided in Appendix C within one month.

12. PIT Tag Scanning (RPM 5): All sturgeon encountered shall be scanned for a PIT tag; codes shall be included in the take report submitted to NMFS. The PIT tag reader shall be able to read both 125 kHz and 134 kHz tags.

13. Lethal Take (RPM 5): If a lethal take occurs, COE shall arrange for contaminant analysis of the carcass. If this requirement is implemented, the carcass should be frozen and NMFS contacted immediately to provide instructions for shipping and preparation.

14. Tagging (RPM 5): Sonic tags, or some other type of state-of-the-art tracking device, shall be placed on sturgeon captured during relocation trawling, or alive by the hopper dredge, by NMFS-approved personnel only, under the authority of this biological opinion.

15. Take Reporting: Observer reports of incidental take by hopper dredges and relocation trawls must be faxed to NMFS' Southeast Regional Office (phone: 727/824-5312, fax: 727/824-5309), and reported by electronic mail to: **(takereport.nmfsser@noaa.gov)** by onboard NMFS-approved protected species observers, the dredging company, or the COE within 24 hours.

10 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authority to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat to help implement recovery plans or to develop information.

Sea Turtles

Pursuant to Section 7(a)(1) of the ESA, the following conservation recommendations are made to assist the COE in contributing to the conservation of sea turtles by further reducing or eliminating adverse impacts that result from dredging.

1. Draghead Modifications and Bed-Leveling Studies: The COE 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 COE in conducting studies to evaluate bed-leveling devices and their potential for interaction with sea turtles, and develop modifications if needed.

2. 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 COE coordinate with ERDC, 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.

3. Continuous Improvements in Monitoring and Detecting Takes: The COE 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.

4. Overflow Screening: The COE 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.

5. Preferential Consideration for Horizontal Overflow Screening: The COE 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.

6. 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 COE ERDC apply to NMFS for an ESA Section 10 research permit to conduct endangered species research on species incidentally captured during traditional relocation trawling. SERO shall assist the COE with the permit application process.

   NMFS also encourages the COE 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 or authorized individuals or their authorized designees.
   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.

7. Draghead Improvements - Water Ports: NMFS recommends that the COE require or at least recommend to dredge operators that all dragheads on hopper dredges contracted by the COE 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 COE 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.

8. Economic Incentives for No Turtle Takes: The COE 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.

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.

Shortnose Sturgeon

COE should support future research on the biology and life history of shortnose sturgeon throughout the Savannah River.

Recommended research includes:

1. Estimating population size and structure.

2. Identification of spawning sites and substrate.

3. Assessment of areas upstream NSBLD as spawning habitat.

4. Effects of regulated flow on spawning habitat.

5. Effects of water quality changes on shortnose sturgeon and their resting and foraging habitats.

Specific research should include:

1. A study to examine prey composition and availability in the Savannah River would improve knowledge of the distribution of preferred foraging habitat of sturgeon.

2. As the implementation of fish passage at the New Savannah Bluff Lock and Dam would trigger implementation of fish passage at the dams located upstream, it would be useful to acquire data identifying the best design for fish passage at these facilities. Accommodating passage of sturgeon at these dams would restore access to additional former spawning habitat and assist in the recovery of the species.

3. COE should support future research that evaluates the relationship between flow, water temperature, and sturgeon migration. Additional information on this relationship would provide a better indicator of conditions that cue and successfully initiate sturgeon spawning movement. COE could apply this information to determine future adequate flow rates within Savannah River and the geographic range of the species. The Nature Conservancy (TNC) has taken an active role in shortnose sturgeon research and restoration in the South. In the Savannah River, TNC is working with the COE to identify effects of water release on sturgeon spawning habitat; shortnose sturgeon implanted with ultrasonic transmitters are being tracked to assess impacts of flow and identify spawning areas. The COE should continue to support and encourage more of this type of research.

4. COE should develop and coordinate a basin-wide research plan to obtain better results in understanding sturgeon population dynamics and movement. A basin-

wide flow regimen should be developed to ensure adequate water quality for the sturgeon during drought, and a conservative approach to storing excess water for later use.

11 REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed deepening of the Savannah Harbor federal navigational channel. 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. In instances where the amount or extent of take is exceeded, COE must immediately request reinitiation of formal consultation.

12 LITERATURE CITED

Aadland, L. 2010. Reconnecting Rivers: Natural Channel Design in Dam Removal and Fish Passage. Minnesota Department of Natural Resources. First Edition.

Ackerman, R.A. 1997. The nest environment and embryonic development of sea turtles. Pp 83-106. In: Lutz, P.L. and J.A. Musick (eds.), The Biology of Sea Turtles. CRC Press, New York. 432 pp.

Aguilar, R., J. Mas and X. Pastor. 1995. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle, *Caretta caretta*, population in the western Mediterranean, pp. 1. *In*: 12th Annual Workshop on Sea Turtle Biology and Conservation, February 25-29, 1992, Jekyll Island, Georgia.

Anders, P.J., C.R. Gelok, and M.S. Powell. 2002. Population structure and mitochondrial DNA (mtDNA) diversity in North American white sturgeon (*Acipenser transmontanus*). Proceedings of the Fourth International Sturgeon Symposium, 8-13 July 2001. Oshkosh, Wisconsin.

Antonelis, G.A., J.D. Baker, T.C. Johanos, R.C. Braun, and A.L. Harting. 2006. Hawaiian monk seal (*Monachus schauinslandi*): status and conservation issues. Atoll Research Bulletin 543:75-101.

Arendt, M., J. Byrd, A. Segars, P. Maier, J. Schwenter, D. Burgess, J. Boynton, J.D. Whitaker, L. Ligouri, L. Parker, D. Owens, and G. Blanvillain. 2009. Examination of local movement and migratory behavior of sea turtles during spring and summer along the Atlantic Coast off the Southeastern United States. Final Project Report to the National Marine Fisheries Service. Prepared by: South Carolina Department of Natural Resources. 164pp.

ASSRT. 2007. Status review of the Atlantic sturgeon (*Acipenser oxyrinchus oxyrhincus*) Report to the National Marine Fisheries Service, Northeast Regional Office. 174pp.

Auer, N.A. 1996. Importance of habitat and migration to sturgeons with emphasis on lake sturgeon. Canadian Journal of Fisheries and Aquatic Sciences 53 (Suppl.1): 152-160.

Bain, M.B. 1997. Atlantic and shortnose sturgeons of the Hudson River: common and divergent life history attributes. Environmental Biology of Fishes 48:347-358.

Bain, M.B., N. Haley, J.R. Waldman, and K. Arend. 2000. Harvest and habitats of Atlantic sturgeon *Acipenser oxyrinchus* Mitchill, 1815 in the Hudson River estuary: lessons for sturgeon conservation. Bol. Inst. Esp. Oceanogr. 16:43-53.

Baker, J.D., C.L. Littnan, and D.W. Johnston. 2006. Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna on the Northwestern Hawaiian Islands. Endangered Species Research 2:21-30.

Baldwin, R., G.R. Hughes, and R.I.T. Prince. 2003. Loggerhead turtles in the Indian Ocean. Pages 218-232 *in* Bolten, A.B. and B.E. Witherington (editors). Loggerhead Sea Turtles. Smithsonian Books, Washington D.C.

Bath, D.W., J.M. O'Conner, J.B. Alber, and L.G. Arvidson. 1981. Development and identification of larval Atlantic sturgeon (*Acipenser oxyrinchus*) and shortnose sturgeon (*A. brevirostrum*) from the Hudson River estuary, New York. Copeia 1981: 711-717.

Bemis WE, Grande L. 1992. Early development of the actinopterygian head. I. External development and staging of the paddlefish *Polyodon spathula*. J Morphol. 213:47–83.

Berlin, W.H., R.J. Hesselberg, and M.J. Mac. 1981. Chlorinated hydrocarbons as a factor in the reproduction and survival of lake trout (*Salvelinus namaycush*) in Lake Michigan. Technical Paper 105, U.S. Fish and Wildlife Service. 42 pp.

Birstein, V.J. and W.E. Bemis. 1997. How many species are there within the genus *Acipenser?* Environmental Biology of Fishes, 48: 157–163.

Bjorndal, K.A. 1997. Foraging ecology and nutrition of sea turtles. *In*: Lutz, P.L. and J.A. Musick (eds.), The Biology of Sea Turtles. CRC Press, Boca Raton, Florida.

Blumenthal, J.M., J.L. Solomon, C.D. Bell, T.J. Austin, G. Ebanks-Petrie, M.S. Coyne, A.C. Broderick, B.J. Godley. 2006. Satellite tracking highlights the need for international cooperation in marine turtle management. Endangered Species Research 7:1-11.

Bolten, A.B., K.A. Bjorndal, and H.R. Martins. 1994. Life history model for the loggerhead sea turtle (*Caretta caretta*) populations in the Atlantic: Potential impacts of a longline fishery. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-SWFSC-201:48-55.

Bolten, A.B., J.A. Wetheral, G.H. Balazs, and S.G. Pooley (compilers). 1996. Status of marine turtles in the Pacific Ocean relevant to incidental take in the Hawaii-based pelagic longline fisheries. NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-230.

Bonsdorff, E. 1980. Macrozoobenthic recolonization of a dredged brackish water bay in SW Finland. Ophelia Suppl. 1: 145-155.

Boreman, J. 1997. Sensitivity of North American sturgeons and paddlefish to fishing mortality. Environmental Biology of Fishes 48(1-4): 399-405

Brongersma, L. 1972. European Atlantic Turtles. Zool. Verhand. Leiden, 121: 318 pp.

Brown, J.J. and G.W. Murphy. 2010. Atlantic Sturgeon Vessel Strike Mortalities in the Delaware Estuary. Fisheries 35: 2, 72-83.

Buckley, J. and B. Kynard. 1981. Spawning and rearing of shortnose sturgeon from the Connecticut River. Progressive Fish Culturist 43: 74-76.

Buckley, J. and B. Kynard. 1985a. Habitat use and behavior of pre-spawning and spawning shortnose sturgeon, *Acipenser brevirostrum*, in the Connecticut River. North American Sturgeons 111-117.

Buckley, J. and B. Kynard. 1985b. Yearly movements of shortnose sturgeons in the Connecticut River. Transactions of the American Fisheries Society 114: 813-820.

Caldwell, D.K. and A. Carr. 1957. Status of the sea turtle fishery in Florida. Transactions of the 22nd North American Wildlife Conference, March 4-7, 1957, pp. 457-463.

Cameron, P., J. Berg, V. Dethlefsen, and H.V. Westernhagen. 1992. Developmental defects in pelagic embryos of several flatfish species in the southern North Sea. Netherlands Journal of Sea Research 29: 239-256.

Campbell, J.G. and L.R. Goodman. 2004. Acute sensitivity of juvenile shortnose sturgeon to low dissolved oxygen concentrations. Transactions of the American Fisheries Society 133: 772-776.

Carlson, D.M. and K.W. Simpson. 1987. Gut contents of juvenile sturgeon in the upper Hudson Estuary. Copeia 1987: 796-802.

Caron, F., D.Hatin, and R. Fortin. 2002. Biological characteristics of adult Atlantic sturgeon (*Acipenser oxyrinchus*) in the Saint Lawrence River estuary and the effectiveness of management rules. Journal of Applied Ichthyology 18:580-585.

Carr, A. 1963. Pan specific reproductive convergence in *Lepidochelys kempii*. Ergebn. Biol. 26: 298-303.

Carr, A. 1984. So Excellent a Fishe. Charles Scribner's Sons, New York.

Catesby M. 1734. The natural history of Carolina, Florida and the Bahama Islands, 1731-1734.

Chaloupka, M., K.A. Bjorndal, G.H. Balazs, A.B. Bolten, L.M. Ehrhart, C.J. Limpus, H. Suganuma, S. Troëng, and M. Yamaguchi. 2007. Encouraging outlook for recovery of a once severely exploited marine megaherbivore. Global Ecol. Biogeogr. (Published online Dec. 11, 2007; to be published in the journal in 2008).

Chapman, D. 2008. Carolina River War Has Big Ripples. Atlanta Journal Constitution. Atlanta, Georgia, August 24, 2008.

Chytalo, K. 1996. Summary of Long Island Sound dredging windows strategy workshop. In: Management of Atlantic Coastal Marine Fish Habitat: Proceedings of a workshop for habitat managers. ASMFC Habitat Management Series #2.

Clarke, D. and C.A. Miller-Way. 1992. An environmental assessment of the effects of open-water disposal of maintenance dredged material on benthic resources in Mobile Bay, Alabama. USAE Waterways Exp. Stn. MP-D-92-1.

Cobb, J.N. 1900. The sturgeon fishery of Delaware River and Bay. Report to the Commissioner, U.S. Commission of Fish and Fisheries. 25: 369-381.

Cochnauer, T.G. 1983. Abundance, distribution, growth and management of white sturgeon (*Acipenser transmontanus*) in the middle Snake River, Idaho. Ph.D. Dissertation, University of Idaho, Moscow, ID. 52 pp.

Collins, M.R. and T.I.J. Smith. 1993. Characteristics of the adult segment of the Savannah River population of shortnose sturgeon. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 47: 485-491.

Collins, M.R. and T.I.J. Smith. 1997. Management Briefs: Distributions of Shortnose and Atlantic Sturgeons in South Carolina. North American Journal of Fisheries Management 17: 995-1000.

Collins, M.R., S.G. Rogers, and T.I.J. Smith. 1996. Bycatch of sturgeons along the southern Atlantic coast of the USA. North American Journal of Fisheries Management 16: 24-29.

Collins, M.R., S.G. Rogers, T.I.J. Smith, and M.L. Moser. 2000a. Primary factors affecting sturgeon populations in the southeastern US: fishing mortality and degradation of essential habitats. Bulletin of Marine Science 66(3): 917-928.

Collins, M.R., T.I.J. Smith, W.C. Post, and O. Pashuk. 2000b. Habitat utilization and biological characteristics of adult Atlantic sturgeon in two South Carolina rivers. Transactions of the American Fisheries Society 129:982-988.

Collins, M. R., W.C. Post, and D.C. Russ. 2001. Distribution of shortnose sturgeon in the lower Savannah River. Final Report to the Georgia Ports Authority. 21 p.

Collins, M. R., W.C. Post, D.C. Russ, and T.I.J. Smith. 2002. Habitat use and movements of juvenile shortnose sturgeon in the Savannah River, Georgia-South Carolina. Transactions of the American Fisheries Society 131:975-979.

Collins, M.R., D. Cooke, B. Post, J. Crane, J. Bulak, T.I.J. Smith, T.W. Greig, and J.M. Quattro. 2003. Shortnose sturgeon in the Santee-Cooper Reservoir System, South Carolina. Transactions of the American Fisheries Society 132: 1244-1250.

Collins, M.R., C. Norwood, B. Post and A. Hazel. 2006. Shortnose and Atlantic Sturgeons: Final Report to NFWF. South Carolina Department of Natural Resources. 38 pp.

Collins, M.R., C. Norwood, and A. Rourk. 2008. Shortnose and Atlantic sturgeon age growth, status, diet, and genetics. Final Report to National Fish and Wildlife Foundation. South Carolina Department of Natural Resources, Charleston, South Carolina, 2006-0087-009. 41p.

Conant, T.A., P.H. Dutton, T. Eguchi, S.P. Epperly, C.C. Fahy, M.H. Godfrey, S.L. MacPherson, E.E. Possardt, B.A. Schroeder, J.A. Seminoff, M.L. Snover, C.M. Upite, and B.E. Witherington. 2009. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service, August 2009. 222 pages.

Cooper, K. 1989. Effects of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans on aquatic organisms. Reviews in Aquatic Sciences 1(2): 227-242.

COSEWIC 2005. COSEWIC assessment and update status report on the shortnose sturgeon *Acipenser brevirostrum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 27 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Counihan, T.D., J.D. DeVore, and M.J. Parsley. In press. The effect of river discharge and water temperature on the year-class strength of Columbia River white sturgeon. Transactions of the American Fisheries Society.

Craft, C., J. Clough, J. Ehmna, S. Joye, R. Park, S. Pennings, H. Guo, and M. Machmuller. 2008. Forecasting the effects of accelerated sea-level rise on tidal march ecosystem services. Frontiers in Ecology and the Environment.

Crocker, C.E. and J.J. Cech. 1997. Effects of environmental hypoxia on oxygen consumption rate and swimming activity in juvenile white sturgeon, *Acipenser transmontanus*, in relation to temperature and life intervals. Environmental Biology of Fishes 50: 382-389.

Dadswell, M.J. 1979. Biology and population characteristics of the shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818 (Osteichthyes: Acipenseridae), in the Saint John River estuary, New Brunswick, Canada. Canadian Journal of Zoology 57: 2186-2210.

Dadswell, M.J., B.D. Taubert, T.S. Squiers, D. Marchette, and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum* LeSueur. 1818. NOAA Technical Report-14. 53 pp.

Daniels, R.C., T.W. White, and K.K. Chapman. 1993. Sea-level rise: destruction of threatened and endangered species habitat in South Carolina. Environmental Management, 17(3):373-385.

DeVries, R.J. 2006. Population dynamics, movements, and spawning habitat of the shortnose sturgeon, *Acipenser brevirostrum*, in the Altamaha River. Master's Thesis, University of Georgia. 103 pp.

Dial-Cordy and Associates. 2010. Sediment survey of the lower Savannah River.

Diamond, J.M. 1984. "Normal" extinctions of isolated populations. Pp. 191-246 *In:* M.H. Nitecki (ed). Extinctions. University of Chicago Press, Chicago.

Dickerson, D., K. Reine, D. Nelson, and C. Dickerson, Jr. 1995. Assessment of sea turtle abundance in six south Atlantic U.S. channels. Miscellaneous Paper EL-95-5, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Dickerson, D.D. and J.E. Clausner. 2003. Draft: Summary of Sea Turtle/Dredging Issues and Recommended Action Tasks Generated by the Improved Draghead Design Meeting, September 4, 2003, Atlanta, Georgia. U.S. Army Corps of Engineers, Engineering Research and Development Center, Vicksburg, Mississippi. 13pp.

Dickerson, D., M. Wolters, C. Theriot, D. Slay. 2004. Dredging impacts on sea turtles in the southeastern USA: A historical review of protection. Submitted for proceedings of the World Dredging Congress, Hamburg, Germany, 27 September-1 October 2004.

Dickerson, D.D, C. Theriot, M. Wolters, C. Slay, T. Bargo, W. Parks. 2007. Effectiveness of relocation trawling during hopper dredging for reducing incidental take of sea turtles. 2007 World Dredging Conference. Available at: http://el.erdc.usace.army.mil/seaturtles/docs/07-DickersonWODCON.pdf

Diffendorfer, J. 1998. Testing models of source-sink dynamics and balanced dispersal. – Oikos 81: 417–433.

Dodd, C.K. 1988. Synopsis of the biological data on the loggerhead sea turtle *Caretta caretta* (Linnaeus 1758). U.S. Fish and Wildlife Service Biological Report, 88-14, 1988. 110 pp.

Doughty, R.W. 1984. Sea turtles in Texas: A forgotten commerce. Southwestern Historical Quarterly 88: 43-70.

Dovel, W.L., and T.J. Berggren. 1983. Atlantic sturgeon of the Hudson River estuary, New York. New York. Fish and Game Journal 30:140-172.

Dovel, W.L., A.W. Pekovitch, and T.J. Berggren. 1992. Biology of the shortnose sturgeon (*Acipenser brevirostrum* Lesueur, 1818) in the Hudson River estuary, New York. Pages 187-216 In: C.L. Smith (Ed) Estuarine Research in the 1980s. State University of New York Press, Albany, New York.

Ehrhart, L.M. 1983. Marine turtles of the Indian River lagoon system. Florida Sci. 46(3/4): 337-346.

Ehrhart, L.M. 1989. Status Report of the Loggerhead Turtle. Ogren, L., F. Berry, K. Bjorndal, H. Kumpf, R. Mast, G. Medina, H. Reichart, and R. Witham (Eds.). Proceedings of the Second Western Atlantic Turtle Symposium. NOAA Technical Memorandum NMFS-SEFSC-226, pp. 122-139.

Ehrhart, L.M., W.E. Redfoot, D.A. Bagley. 2007. Marine turtles of the central region of the Indian River Lagoon system. Florida Scientist 70(4): 415-434.

Epperly, S.P. and W.G. Teas. 2002. Turtle excluder devices: Are the escape openings large enough? Fish Bull. 100: 466-474.

Epperly, S.P., J. Braun, and A.J. Chester. 1995a. Aerial surveys for sea turtles in North Carolina inshore waters. Fishery Bulletin 93: 254-261.

Epperly, S.P., J. Braun, and A. Veishlow. 1995b. Sea turtles in North Carolina waters. Conserv. Biol. 9: 384-394.

Epperly, S.P., J. Braun, A. J. Chester, F.A. Cross, J. Merriner, and P.A. Tester. 1995c. Winter distribution of sea turtles in the vicinity of Cape Hatteras and their interactions with the summer flounder trawl fishery. Bull. Mar. Sci. 56(2): 519-540.

Epperly, S., L. Avens, L. Garrison, T. Henwood, W. Hoggard, J. Mitchell, J. Nance, J. Poffenberger, C. Sasso, E. Scott-Denton, and C. Yeung. 2002. Analysis of sea turtle bycatch in the commercial shrimp industry of southeast U.S. waters and the Gulf of Mexico. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-490. 88 pp.

Epperly, S.P., J. Braun-McNeill, P.M. Richards. 2007. Trends in the catch rates of sea turtles in North Carolina, U.S.A. Endangered Species Research. 3: 283-293.

Erickson, D.L., J.A. North, J.E. Hightower, J. Weber, and L. Lauck. 2002. Movement and habitat use of green sturgeon *Acipenser medirostris* in the Rogue River, Oregon, U.S.A. Journal of Applied Ichthyology 18:565.569.

Evermann, B.W. and B.A. Bean. 1898. Indian River and its fishes. Report of the United States Fisheries Commission 1896: 227-248.

Fish, M.R., I.M. Cote, J.A. Gill, A.P. Jones, S. Renshoff, and A.R. Watkinson. 2005. Predicting the impact of sea-level rise on Caribbean sea turtle nesting habitat. Conservation Biology, 19(2):482-491.

Flournoy, P.H., S.G. Rogers, and P.S. Crawford. 1992. Restoration of shortnose sturgeon in the Altamaha River, Georgia. Final Report to the United States Fish and Wildlife Service. 29 pp.

Frazer, N.B. and L.M. Ehrhart. 1985. Preliminary growth models for green, *Chelonia mydas*, and loggerhead, *Caretta caretta*, turtles in the wild. Copeia 1985: 73-79.

Frazer, N.B., C.J. Limpus, and J.L. Greene. 1994. Growth and age at maturity of Queensland loggerheads. U.S. Department of Commerce. NOAA Technical Memorandum, NMFS-SEFSC-351: 42-45.

Garduño-Andrade, M., V. Guzman, E. Miranda, R. Briseno-Duenas, and F.A. Abreu-Grobois. 1999. Increases in hawksbill turtle (*Eretmochelys imbricata*) nestings in the Yucatan Peninsula, Mexico, 1977-1996: data in support of successful conservation? Chelonian Conservation and Biology 3(2): 286-295.

Giesy, J.P., J. Newsted, and D.L. Garling. 1986. Relationships between chlorinated hydrocarbon concentrations and rearing mortality of chinook salmon (*Oncorhynchus tshawytscha*) eggs from Lake Michigan. Journal of Great Lakes Research 12(1): 82-98.

Gilbert, C.R. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic Bight): Atlantic and shortnose sturgeons. United States Fish and Wildlife Service Biological Report-Report Number-82 (11.91).

Gladys Porter Zoo. 2007. Report on the Mexico/United States of America Population Restoration Project for the Kemp's Ridley Sea Turtle, Lepidocheyls kempii, on the coasts of Tamaulipas and Veracruz, Mexico – 2007. Report submitted to the U.S. Fish and Wildlife Service, Department of Interior.

Gladys Porter Zoo. 2008. Final Report on the Mexico/United States of America Population Restoration Project for the Kemp's Ridley Sea Turtle, *Lepidochelys kempii*, on the Coasts of Tamaulipas, Mexico. Report presented by Dr. Patrick M. Burchfield and prepared by Luis Jaime Pena- Gladys Porter Zoo, Brownsville, Texas.

Gladys Porter Zoo. 2010. Summary Final Report on the Mexico/United States of America Population Restoration Project for the Kemp's Ridley Sea Turtle,

Lepidochelys kempii, on the Coasts of Tamaulipas, Mexico. Report presented by Dr. Patrick M. Burchfield and prepared by Luis Jaime Pena- Gladys Porter Zoo, Brownsville, Texas.

Greene, K.E., J.L. Zimmerman, R.W. Laney, and J.C. Thomas-Blate. 2009. Atlantic coast diadromous fish habitat: A review of utilization, threats, recommendations for conservation, and research needs. Atlantic States Marine Fisheries Commission Habitat Management Series No. 9. Washington, D.C.

Groombridge, B. 1982. The IUCN Amphibia - Reptilia Red Data Book. Part 1. Testudines, Crocodylia, Rhynchocephalia. Int. Union Conserv. Nature and Nat. Res., 426pp.

Gross, M.R., J. Repka, C.T. Robertson, D.H. Secor, and W.V. Winkle. 2002. Sturgeon conservation: insights from elasticity analysis. Pages 13-30 In: V.W. Webster et al. (eds.). Biology, management, and protection of North American sturgeon, Symposium 28. American Fisheries Society, Bethesda, Maryland.

Grunwald, C., J. Stabile, J. R. Waldman, R.Gross, and I. Wirgin. 2002. Population genetics of shortnose sturgeon *Acipenser brevirostrum* based on mitochondrial DNA control region sequences. Molec. Ecol. 11:1885-1898.

Grunwald, C., L. Maceda, J. Waldman, J. Stabile, I. Wirgin. 2007. Conservation of Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus*: delineation of stock structure and distinct population segments. Conserv. Genet 9:1111–1124.

Guseman, J.L. and L.M. Ehrhart. 1992. Ecological geography of Western Atlantic loggerheads and green turtles: evidence from remote tag recoveries. *In* Salmon M. and J. Wyneken (compilers), Proceedings of the Eleventh Annual Workshop on Sea Turtle Biology and Conservation, NOAA Technical Memorandum NMFS-SEFC-302. 50 pp.

Hall, J.W., T.I.J. Smith, and S.D. Lamprecht. 1991. Movements and habitats of shortnose sturgeon, *Acipenser brevirostrum*, in the Savannah River. Copeia 1991(3): 695-702.

Hansen, P.D. 1985. Chlorinated hydrocarbons and hatching success in Baltic herring spring spawners. Marine Environmental Research 15: 59-76.

Hanski, I. 1999. Old and new challenges. Pp. 264-265 in: Metapopulation Ecology (I. Hanski, ed.). Oxford University Press, Oxford.

Hanski, I., and D. Simberloff. 1997. The metapopulation approach, its history, conceptual domain, and application to conservation. Pp. 5-26 in: Metapopulation Biology: Ecology, Genetics and Evolution (I. Hanski and M.E. Gilpin, eds.). Academic Press, New York.

Hardy, R.S. and M.K. Litvak. 2004. Effects of temperature on the early development, growth, and survival of shortnose sturgeon, *Acipenser brevirostrum*, and Atlantic sturgeon, *Acipenser oxyrinchus*, yolk-sac larvae. Environmental Biology of Fishes 70: 145-154.

Harrison, S. 1991. Local extinction in a metapopulation context: an empirical evaluation. Biological Journal of the Linnean Society 42:73-88.

Hatase, H., M. Kinoshita, T. Bando, N. Kamezaki, K. Sato, Y. Matsuzawa, K. Goto, K. Omuta, Y. Nakashima, H. Takeshita, and W. Sakamoto. 2002. Population structure of loggerhead turtles, *Caretta caretta*, nesting in Japan: Bottlenecks on the Pacific population. Marine Biology 141:299-305.

Hawkes, L.A., A.C. Broderick, M.S. Coyne, M.H. Godfrey, L.-F. Lopez-Jurado, P. Lopez-Suarez, S.E. Merino, N. Varo-Cruz, and B.J. Godley. 2006. Phenotypically linked dichotomy in sea turtle foraging requires multiple conservation approaches. Current Biology 16: 990-995.

Hawkes, L.A., A.C. Broderick, M.H.Godfrey, and B.J. Godley. 2007. Investigating the potential impacts of climate change on a marine turtle population. Global Change Biology, 13:923-932.

Hays, G.C., A.C. Broderick, F. Glen, B.J. Godley, J.D.R. Houghton, and J.D. Metcalfe. 2002. Water temperature and internesting intervals for loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles. Journal of Thermal Biology, 27:429-432.

Heidt, A.R. and R.J. Gilbert. 1978. The shortnose sturgeon in the Altamaha River drainage. Pp 54-60 In: R.R. Odum and L. Landers (eds.) Proceedings of the rare and endangered wildlife symposium. Georgia Department of Natural Resources, Game and Fish Division.

Henwood, T.A. and L.H. Ogren. 1987. Distribution and migrations of immature Kemp's ridley (*Lepidochelys kempii*) and green turtles (*Chelonia mydas*) off Florida, Georgia, and South Carolina. Northeast Gulf Sci. 9: 153-159.

Heppell, S.S., L.B. Crowder, D.T. Crouse, S.P. Epperly, and N.B. Frazer. 2003. Population models for Atlantic loggerheads: past, present, and future. *In*: Loggerhead Sea Turtles. Bolten, A.B. and B.E. Witherington (eds.). Smithsonian Books, Washington. pp 255-273.

Hildebrand, H.H. 1963. Hallazgo del area de anidacion de la tortuga marina "lora" *Lepidochelys kempii* (Garman), en la costa occidental del Golfo de Mexico. Ciencia Mexicana 22(4): 105-112.

Hildebrand, H.H. 1982. A historical review of the status of sea turtle populations in the Western Gulf of Mexico. In Bjorndal, K.A. (ed.), Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington D.C. pp 447-453.

Hill, J. 1996. Environmental considerations in licensing hydropower projects; policies and practices of the Federal Energy Regulatory Commission. American Fisheries Society Symposium 16: 190-199.

Hirth, H.F. 1997. Synopsis of the biological data on the green turtle *Chelonia mydas* (Linnaeus 1758). Biological Report 97(1), U.S. Fish and Wildlife Service, U.S. Dept. of the Interior. 120 pp.

Hoff, T.B., R.J. Klauda and J.R. Young. 1988. Contribution to the biology of shortnose sturgeon in the Hudson River Estuary. Pp 171-189 In: C.L. Smith (ed.) Fisheries Research in the Hudson River. Hudson River Environmental Society. State University of New York press, Albany, New York.

Huff, J.A. 1975. Life history of Gulf of Mexico sturgeon, *Acipenser oxyrinchus desotoi*, in Suwannee River, Florida. Florida Department of Natural Resources, Marine Research Publication 16, St. Petersburg, FL.

Hulme, P.E. 2005. Adapting to climate change: is there scope for ecological management in the face of global threat? Journal of Applied Ecology 43: 617-627.

IPCC (Intergovernmental Panel on Climate Change). 2007. Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Quin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds)] Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Jager, H.I., W. VanWinkle, J.A. Chandler, K.B. Lepla, P. Bates, and T.D. Counihan. 2002. A simulation study of factors controlling white sturgeon recruitment in the Snake River. American Fisheries Society Symposium 28: 127-150.

Jarvis, P. L., J. S. Ballantyne, and W. E. Hogans. 2001. The influence of salinity on the growth of juvenile shortnose sturgeon. North American Journal of Aquaculture 63:272-276.

Jenkins, W.E., T.I.J.Smith, L.D. Heyward, and D.M. Knott. 1993. Tolerance of shortnose sturgeon, *Acipenser brevirostrum*, juveniles to different salinity and dissolved oxygen concentrations. Proceedings of the Annual Conference of Southeastern Association of Fish and Wildlife Agencies 47: 476-484.

Jensen, A. and G. Silber. 2003. Large Whale Ship Strike Database. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-F/OPR-25, 37 pp.

Johnson, S.A. and L.M. Ehrhart. 1994. Nest-site fidelity of the Florida green turtle. *In* Schroeder, B.A. and B.E. Witherington (compilers), Proceedings of the Thirteenth

Annual Symposium on Sea Turtle Biology and Conservation, NOAA Technical Memorandum NMFS-SEFSC-341. 83 pp.

Kahn, J. and M. Mohead. 2010. A Protocol for Use of Shortnose, Atlantic, Gulf, and Green Sturgeons. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-OPR-45, 62 p.

Kahnle, A.W., K.A. Hattala, K.A. McKown, C.A. Shirey, M.R. Collins, T.S. Squiers, Jr., and T. Savoy. 1998. Stock Status of Atlantic sturgeon of Atlantic Coast Estuaries. Report for the Atlantic States Marine Fisheries Commission. Draft III.

Kaplan, E.H., J.R. Welker, M.G. Kraus, and S. McCourt. 1975. Some factors affecting the colonization of a dredged channel. Marine Biology 32,193e204.

Keinath, J.A., J.A. Musick and R.A. Byles. 1987. Aspects of the biology of Virginia's sea turtles: 1979-1986. Virginia J. Sci. 38(4):329-336.

Keiser, R.K. 1976. Species composition, magnitude and utilization of the incidental catch of the South Carolina shrimp fishery. S.C. Mar. Resour. Cent. Tech. Rep. 16, 94 p.

Kieffer, M.C. and B. Kynard. 1993. Annual movements of shortnose and Atlantic sturgeons in the Merrimack River, Massachusetts. Transactions of the American Fisheries Society 122: 1088-1103.

Kieffer, M. and B. Kynard. 1996. Spawning of shortnose sturgeon in the Merrimack River, Massachusetts. Transactions of the American Fisheries Society 125: 179-186.

Kindvall, O. and I. Ahlen. 1992. Geometrical factors and metapopulation dynamics of the brush cricket, *Metrioptera bicolor* Phillippi (Orthoptera: Tettigoniidae). Conservation Biology 6: 520-529.

King, T. L., B. A. Lubinski, and A. P. Spidle. 2001. Microsatellite DNA variation in Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and cross-species amplification in the Acipenseridae. Conservation Genetics 2: 103-119.

King, T.L., A.P Henderson, B.E. Kynard, M.C. Kiefer, D.L. Peterson and D.S. Pavek. In prep. A nuclear DNA perspective on delineating fundamental units of management and distinct population segments in the endangered shortnose sturgeon. Final Report to the National Capital Region, U.S. National Park Service and Eastern Region, USGS.

Kite-Powell, H.K., A. Knowlton, and M. Brown. 2007. Modeling the effect of vessel speed on right whale ship strike risk. Project report for NOAA/NMFS Project NA04NMF47202394. April 2007.

Knowlton, A.R. and S.D. Kraus. 2001. Mortality and serious injury of northern right whales (Eubalaena glacialis) in the western North Atlantic Ocean. Journal of Cetacean Research and Management (Special Issue) 2:193-208.

Kynard, B. 1997. Life history, latitudinal patterns and status of shortnose sturgeon, *Acipenser brevirostrum*. Environmental Biology of Fishes 48: 319-334.

Kynard, B. 1998. Twenty-two years of passing shortnose sturgeon in fish lifts on the Connecticut River: What has been learned? In: Fish migration and fish bypasses, M. Jungwirth, S. Schmutz, and S. Weiss, Editors. pp. 255-264.

Kynard, B. and M. Horgan. 2002. Ontogenetic behavior and migration of Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus*, and shortnose sturgeon, *A. brevirostrum*, with notes on social behavior. Environmental Behavior of Fishes 63: 137-150.

Kynard, B., M. Kieffer, M. Burlingame and M. Horgan. 1999. Studies on shortnose sturgeon. Final Report to Northeast Utilities Service Company, Berlin, Connecticut and the City of Holyoke, Massachusetts.

Kynard, B., M. Horgan, M. Kieffer, and D. Seibel. 2000. Habitats used by shortnose sturgeon in two Massachusetts rivers, with notes on estuarine Atlantic sturgeon: a hierarchical approach. Transactions of the American Fisheries Society 129: 487-503.

Laist, D.W. and C. Shaw. 2006. Preliminary evidence that boat speed restrictions reduce deaths of Florida manatees. Marine Mammal Science 22(2):472-479.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17(1):35-75.

Lande, R. 1988. Genetics and demography in biological conservation. Science 241: 1455-1460.

Laurent, L., P. Casale, M.N. Bradai, B.J. Godley, G. Gerosa, A.C. Broderick, W. Schroth, B. Schierwater, A.M. Levy, D. Freggi, E.M. Abd El-Mawla, D.A. Hadoud, H.E. Gomati, M. Domingo, M. Hadjichristophorou, L. Kornaraki, F. Demirayak, and C. Gautier. 1998. Molecular resolution of the marine turtle stock composition in fishery bycatch: A case study in the Mediterranean. Molecular Ecology 7:1529-1542.

León, Y.M. and C.E. Diez, 2000. Ecology and population biology of hawksbill turtles at a Caribbean feeding ground (Proceedings of the Eighteenth International Sea Turtle Symposium. U.S. Dept. of Commerce. NOAA Technical Memorandum NMFS-SEFSC-436, 293 pp.; 2000, p. 32-33)

Levins, R. 1969. Some demographic and genetic consequence of environmental heterogeneity for biological control. Bulletin of the Entomological Society of America. 15: 237-240.

Limpus, C.J. and D.J. Limpus. 2003. Loggerhead turtles in the equatorial Pacific and southern Pacific Ocean: A species in decline. *In*: Bolten, A.B., and B.E. Witherington (eds.), Loggerhead Sea Turtles. Smithsonian Institution.

Longwell, A.C., S. Chang, A. Hebert, J. Hughes, and D. Perry. 1992. Pollution and developmental abnormalities of Atlantic fishes. Environmental Biology of Fishes 35: 1-21.

Lutcavage, M. and J.A. Musick. 1985. Aspects of the biology of sea turtles in Virginia. Copeia (1985): 449-456.

Mac, M.J. and C.C. Edsall. 1991. Environmental contaminants and the reproductive success of lake trout in the Great Lakes: An epidemiological approach. Journal of Toxicology and Environmental Health 33: 375-394.

Mangin, E. 1964. Croissance en Longueur de Trois Esturgeons d'Amerique du Nord: *Acipenser oxyrhynchus*, Mitchill, *Acipenser fulvescens*, Rafinesque, et *Acipenser brevirostris* LeSueur. Verh. Int. Ver. Limnology 15: 968-974.

Marchette, D.E. and R. Smiley. 1982. Biology and life history of incidentally captured shortnose sturgeon, *Acipenser brevirostrum*, in South Carolina. South Carolina Wildlife and Marine Resources. Unpublished MS.

Margaritoulis, D., R. Argano, I. Baran, F. Bentivegna, M.N. Bradai, J.A. Camiñas, P. Casale, G.De Metrio, A. Demetropoulos, G. Gerosa, B.J. Godley, D.A. Haddoud, J. Houghton, L.Laurent, and B. Lazar. 2003. Loggerhead turtles in the Mediterranean Sea: present knowledge and conservation perspectives. Pages 175-198 *in* Bolten, A.B. and B.E.Witherington (editors). Loggerhead Sea Turtles. Smithsonian Books, Washington D.C.

Márquez, R. 1990. FAO Species Catalogue, Vol. 11. Sea turtles of the world, an annotated and illustrated catalogue of sea turtle species known to date. FAO Fisheries Synopsis, 125. 81 pp.

McCleave, J.D., S.M. Fried, and A.K. Towt. 1977. Daily movements of shortnose sturgeon, *Acipenser brevirostrum*, in a Maine estuary. Copeia 1977: 149-157.

McCord, J.W. 1998. Investigation of fisheries parameters for anadromous fisheries in South Carolina. South Carolina Department of Natural Resources. Completion report to National Marine Fisheries Service (AFC -53).

McClellan, C.M. and A.J. Read. 2007. Complexity and variation in loggerhead sea turtle life history. Biology Letters 3:592-594.

McDonald, M. 1887. The rivers and sound of North Carolina. Pp 625-637 *In:* G.B. Goode (ed.) The fisheries and fishery industries of the United States, Section V, Volume 1. U.S. Commission on Fish and Fisheries, Washington D.C.

McElhaney, P., M.H. Rucklelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionary significant units. U.S. Dept. Commer. NOAA Tech Memo. NMFS-NWFSC-42. 156 p.

McMaster, H. 2007. South Carolina Attorney General's Office, Current Cases, State of South Carolina vs. State of North Carolina Water War. November 13, 2008. http://www.scattorneygeneral.org/currentcases/waterwar.html

Mendonca, M.T., and L.M. Ehrhart. 1982. Activity, Population Size and Structure of Immature *Chelonia mydas* and *Caretta caretta* in Mosquito Lagoon, Florida. Copeia 1:161-167.

Meylan, A. 1999. Status of the Hawksbill Turtle (*Eretmochelys imbricata*) in the Caribbean Region. Chelonian Conservation and Biology 3(2): 177B184. Available at (http://www.iucn-mtsg.org/publications/cc&b_april1999/4.14-Meylan-Status.pdf).

Meylan, A., B. Schroeder, and A. Mosier. 1995. Sea turtle nesting activity in the state of Florida. Florida Marine Research Publications, No. 52

Milton, S.L., S. Leone-Kabler, A.A. Schulman, and P.L. Lutz. 1994. Effects of Hurricane Andrew on the sea turtle nesting beaches of South Florida. Bulletin of Marine Science, 54(3): 974-981.

Milton, S.L., Lutz , P.L. 2003 Physiological and genetic responses to environmental stress. *In:* Lutz PL, Musick JA, Wyneken J (eds) The biology of sea turtles, Vol II. CRC Press, Boca Raton, FL, p 163–197

Moorehead, K.K. and M.M. Brinson. 1995. Response of wetlands to rising sea level in the lower coast plain of North Carolina. Ecological Applications 5: 261-271.

Moser, M. L. and S. W. Ross. 1993. Distribution and movements of shortnose sturgeon (*Acipenser brevirostrum*) and other anadromous fishes of the lower Cape Fear River, North Carolina. Final Report to the U.S. Army Corps of Engineers, Wilmington, North Carolina.

Moser, M.L. and S.W. Ross. 1995. Habitat use and movements of shortnose and Atlantic sturgeons in the Lower Cape Fear River, North Carolina. Transactions of the American Fisheries Society 124: 225-234.

Moser M. L., J. B. Bichy, and S. B. Roberts. 1998. Sturgeon distribution in North Carolina. Center for Marine Science Research. Final Report to U.S. ACOE, Wilmington District, NC.

Moser, M.L., M. Bain, M.R. Collins, N. Haley, B. Kynard, J.C. O'Herron II, G. Rogers, and T.S. Squiers. 2000. A Protocol for Use of Shortnose and Atlantic Sturgeons. U.S. Department of Commerce, NOAA Technical Memorandum-NMFS-OPR-18. 18 pp.

Munro, J., R.E. Edwards, and A.W. Kahnle. 2007. Anadromous sturgeons: habitats, threats, and management. American Fisheries Society Symposium 56: 1-15.

Murawski, S.A. and A.L. Pacheco. 1977. Biological and fisheries data on Atlantic sturgeon, *Acipenser oxyrhynchus* (Mitchill). National Marine Fisheries Service, Sandy Hook Lab., Sandy Hook. Tech. Report No. 10. 78 pp.

Murdoch, P.S., J.S. Baron and T.L. Miller. 2000. Potential effects of climate change on surface-water quality in North America. Journal of the American Water Resources Association 36: 347-366.

Murphy, T.M. and S.R. Hopkins. 1984. Aerial and ground surveys of marine turtle nesting beaches in the Southeast region, U.S. Final Report to the National Marine Fisheries Service; NMFS Contract No. NA83-GA-C-00021. 73 pp.

Musick, J.A. 1999. Ecology and conservation of long-lived marine animals. Pp 1-10 In: J.A. Musick (ed.) Life in the slow land: ecology and conservation of long-lived marine animals. American Fisheries Society Symposium 23, Bethesda, Maryland.

Musick, J.A. and C.J. Limpus. 1997. Habitat utilization in juvenile sea turtles. *In* Lutz, P.L. and J.A. Musick (eds.), The Biology of Sea Turtles. CRC Press, Boca Raton, Florida. pp. 137-163.

NAST (National Assessment Synthesis Team). 2000. Climate change impacts on the United States: the potential consequences of climate variability and change. US Global Change Research Program, Washington D.C.

Niklitschek, E.J. 2001. Bioenergetics modeling and assessment of suitable habitat for juvenile Atlantic and shortnose sturgeons (*Acipenser oxyrinchus* and *A. brevirostrum*) in the Chesapeake Bay [dissertation]. [College Park(MD)]: University of Maryland.

Niklitschek, E.J. and D.H. Secor. 2005. Modeling spatial and temporal variation of suitable nursery habitats for Atlantic sturgeon in the Chesapeake Bay. Estuarine, Coastal and Shelf Science 64:135–148.

NIDIS (National Integrated Drought Information System). 2008. Current Drought Conditions for the State of Georgia, November 4, 2008. http://www.drought.gov/portal/server.pt?uuID=%7B950C0A74-978E-47AF-2FF0-9159361A2000%7D&mode=2&in_hi_userid=2&state=GA

NMFS. 1991. Biological Opinion for the Dredging of channels in the Southeastern United States from North Carolina through Cape Canaveral, Florida.

NMFS. 1995. Endangered Species Act section 7 consultation on United States Coast Guard vessel and aircraft activities along the Atlantic coast. Biological Opinion. September 15.

NMFS. 1996. Endangered Species Act section 7 consultation on reinitiation of consultation on United States Coast Guard Vessel and Aircraft Activities along the Atlantic Coast. Biological Opinion. July 22.

NMFS. 1997a. Endangered Species Act section 7 consultation on Navy activities off the southeastern United States along the Atlantic Coast. Biological Opinion. May 15.

NMFS. 1997b. Endangered Species Act Section 7 consultation on the continued hopper dredging of channels and borrow areas in the southeastern United States. Biological Opinion. September 25.

NMFS. 1998. Endangered Species Act section 7 consultation on COE permits to Kerr-McGee Oil and Gas Corporation for explosive rig removals off of Plaquemines Parish, Louisiana. Draft Biological Opinion. September 22.

NMFS. 1998. Recovery plan for the shortnose surgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team. 119 pp.

NMFS. 2001a. Stock assessments of loggerhead and leatherback sea turtles and an assessment of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. U.S. Department of Commerce NOAA Technical Memorandum NMFS-SEFSC-455.

NMFS. 2001b. Endangered Species Act section 7 consultation on the reinitiation of consultation on the Atlantic highly migratory species fishery management plan and its associated fisheries. Biological Opinion. June 14.

NMFS. 2002. Endangered Species Act section 7 consultation on shrimp trawling in the southeastern United States under the sea turtle conservation regulations and as managed by the fishery management plans for shrimp in the South Atlantic and the Gulf of Mexico. Biological Opinion, December 2.

NMFS. 2003. Endangered Species Act section 7 consultation on the continued operation of Atlantic shark fisheries (commercial shark bottom longline and drift gillnet

fisheries and recreational shark fisheries) under the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks (HMS FMP) and the Proposed Rule for Draft Amendment 1 to the HMS FMP. Biological Opinion. July 2003.

NMFS. 2004a. Endangered Species Act section 7 consultation on proposed regulatory amendments to the FMP for the pelagic fisheries of the western Pacific region. Biological opinion. February 23.

NMFS. 2004b. Endangered Species Act section 7 reinitiation consultation on the Atlantic pelagic longline fishery for highly migratory species. Biological Opinion. June 1.

NMFS. 2007. Endangered Species Act section 7 consultation on the dredging of Gulf of Mexico navigation channels and sand mining ("borrow") areas using hopper dredges by COE Galveston, New Orleans, Mobile, and Jacksonville Districts. Revised Biological Opinion (November 2003). January 2007.

NMFS SEFSC (Southeast Fisheries Science Center). 2001. Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. U.S. Department of Commerce, National Marine Fisheries Service, Miami, Florida, SEFSC Contribution PRD-00/01-08; Parts I-III and Appendices I-V1.

NMFS-SEFSC. 2009. Estimated impacts of mortality reductions on loggerhead sea turtle population dynamics, preliminary results. Presented at the meeting of the Reef Fish
Management Committee of the Gulf of Mexico Fishery Management Council, June 16, 2009, Tampa, Florida, 20p. (Posted 6/2009 at http://www.sefsc.noaa.gov/seaturtleabstracts.jsp)

NMFS and USFWS. 1991a. Recovery Plan for U.S. Population of Atlantic Green Turtle. National Marine Fisheries Service, Washington, D.C.

NMFS and USFWS. 1991b. Recovery Plan for U.S. Population of Loggerhead Turtle. National Marine Fisheries Service, Washington, D.C.

NMFS and USFWS. 1993. Recovery Plan for Hawksbill Turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico. National Marine Fisheries Service, St. Petersburg, Florida.

NMFS and USFWS. 1995. Status reviews for sea turtles listed under the Endangered Species Act of 1973. National Marine Fisheries Service, Silver Spring, Maryland.

NMFS and USFWS. 1998a. Recovery Plan for U.S. Pacific Populations of the Green Turtle. Prepared by the Pacific Sea Turtle Recovery Team.

NMFS and USFWS. 1998b. Recovery Plan for U.S. Pacific Populations of the Hawksbill Turtle (*Eretmochelys imbricata*). National Marine Fisheries Service, Silver Spring, Maryland.

NMFS and USFWS. 1998c. Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle. Prepared by the Pacific Sea Turtle Recovery Team.

NMFS and USFWS. 1998d. Recovery Plan for U.S. Pacific Populations of the Loggerhead Turtle. Prepared by the Pacific Sea Turtle Recovery Team.

NMFS and USFWS. 2007a. Loggerhead Sea Turtle (*Caretta caretta*) 5-Year Review: Summary and Evaluation.

NMFS and USFWS. 2007b. Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) 5-Year Review: Summary and Evaluation.

NMFS and USFWS. 2007c. Green Sea Turtle (*Chelonia mydas*) 5-Year Review: Summary and Evaluation.

NMFS and USFWS. 2007d. Leatherback sea turtle (Dermochelys coriacea) 5 year review: summary and evaluation. National Marine Fisheries Service, Silver Spring, Maryland. 79 pp.

NMFS and USFWS. 2007e. Loggerhead sea turtle (Caretta caretta) 5 year review: summary and evaluation. National Marine Fisheries Service, Silver Spring, Maryland. 65 pp.

NMFS and USFWS. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*), Second Revision. National Marine Fisheries Service, Silver Spring, MD.

NRC (National Research Council, Committee on Sea Turtle Conservation). 1990. Decline of the Sea Turtles: Causes and Prevention. National Academy Press, Washington D.C.

Ogren, L.H. 1989. Distribution of juvenile and subadult Kemp's Ridley Sea Turtles: Preliminary Results from the 1984-1987 Surveys. *In* Caillouet, C.W., Jr. and A.M Landry, Jr. (eds.), Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management. Texas A&M University Sea Grant College Program, Galveston. TAMU-SG-89-105

O'Herron, J.C., K.W. Able, and R.W. Hastings. 1993. Movements of shortnose sturgeon (*Acipenser brevirostrum*) in the Delaware River. Estuaries 16:235-240.

Ong, T.L., J. Stabile, I. Wirgin, and J.R.Waldman. 1996. Genetic divergence between *Acipenser oxyrhinchus oxyrhinchus* and *A. o. desotoi:* An assessment by mitochondrial DNA analysis Copeia 2: 464–469.

Pace, R.M. and G.K. Silber. 2005. Abstract. Simple analyses of ship and large whale collisions: Does speed kill? Sixteenth Biennial Conference on the Biology of Marine Mammals, San Diego, December 2005.

Palmer, M.A., C.A. Reidy Liermann, C. Nilsson, M. Florke, J. Alcama, P.S. Lake and N. bond. 2008. Climate change and the world's river basins: anticipating management options. Frontiers in Ecology and the Environment 6: 81-89.

Panigada, S., G. Pesante, M. Zanardelli, F. Capoulade, A. Gannier, and M.T. Weinrich. 2006. Mediterranean whales at risk from fatal ship strikes. Marine Pollution Bulletin 52, 1287–1298.

Paragamian, V.L. and J.P. Duehr. 2005. Variation in vertical location of Kootenai River white sturgeon during the prespawn and spawning periods. Trans. Am. Fish. Soc. 134 (1):261-266.

Paragamian, V.L., and G. Kruse. 2001. Kootenai River white sturgeon spawning migration behavior and a predictive model. North American Journal of Fisheries Management 21:22-33.

Park, R.A., J.K. Lee, P.W. Mausel, and R.C. Howe. 1991. The effects if sea level rise on US coastal wetlands. In: J.B. Smith and D.A. Tirpak (eds), The potential effects of global climate change on the United States. Appendix B – sea-level rise. Washington DC: US Environmental Protection Agency.

Peterson, D.L., P. Vecsei, C.A. Jennings. 2006. Ecology and biology of the lake sturgeon: a synthesis of current knowledge of a threatened North American *Acipenseridae*. Rev. Fish Biol. Fisheries 17:59–76.

Pike, D.A., R.L. Antworth, and J.C. Stiner. 2006. Earlier nesting contributes to shorter nesting seasons for the Loggerhead sea turtle, *Caretta caretta*. Journal of Herpetology, 40(1):91-94.

Poddubny, S.P. and D.L. Galat. 1995. Habitat associations of Upper Volga River fishes: effects of reservoirs. Regulated Rivers: Research and Management 11: 67-84.

Pottle, R., and M.J. Dadswell. 1979. Studies on larval and juvenile shortnose sturgeon (*Acipenser brevirostrum*). Report to the Northeast Utilities Service Company, Hartford, Connecticut.

Pritchard, P.C.H. 1969. Sea turtles of the Guianas. Bull. Fla. State Mus. 13(2): 1-139.

Pritchard, P.C.H. 1997. Evolution, phylogeny, and current status. *In*: Lutz, P.L. and J.A. Musick (ed). The Biology of Sea Turtles. pp 1-28. CRC Press. Boca Raton, Florida.

Quattro, J.M., T.W. Greig, D.K. Coykendall, B.W. Bowen, and J.D. Baldwin. 2002. Genetic issues in aquatic species management: the shortnose sturgeon (*Acipenser brevirostrum*) in the southeastern United States. Conservation Genetics 3: 155-166

Ray, G. 1997. Benthic Assemblages of the Padilla Bay National Estuarine Research. Reserve, Mount Vemon, Washington. Washington State Department of Ecology Publication No., Padilla Bay National Estuarine Research Reserve Technical Report No. 21, Mount Vernon, Washington. 91pp.

Renaud, M.L. 1995. Movements and submergence patterns of Kemp's ridley turtles (*Lepidochelys kempii*). Journal of Herpetology 29: 370-374.

Richmond, A. and B. Kynard. 1995. Ontogenetic behavior of shortnose sturgeon. Copeia 1995: 172-182.

Rogers, S.G. and W. Weber. 1994. Occurrence of shortnose sturgeon (*Acipenser brevirostrum*) in the Ogeechee-Canoochee river system, Georgia, during the summer of 1993. Final Report of the United States Army to the Nature Conservancy of Georgia.

Rogers, S.G. and W. Weber. 1995. Status and restoration of Atlantic and shortnose sturgeons in Georgia. Final Report to the National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, Florida.

Rogers, S.G., P.H. Flourney, and W. Weber. 1994. Status and restoration of Atlantic sturgeon in Georgia. Final report to the National Marine Fisheries Service Project NA46F0098-01, -02, -03.

Rosenthal, H. and D.F. Alderdice. 1976. Sub-lethal effects of environmental stressors, natural and pollutional, on marine fish eggs and larvae. Journal of the Fisheries Research Board of Canada 33: 2047-2065.

Ross, J.P. 1979. Historical decline of loggerhead, ridley, and leatherback sea turtles. *In*: Bjorndal, K.A. (editor), Biology and Conservation of Sea Turtles. pp. 189-195. Smithsonian Institution Press, Washington, D.C. 1995.

Ruelle, R. and K.D. Keenlyne. 1993. Contaminants in Missouri River Pallid Sturgeon. Bulletin of Environmental Contamination and Toxicology 50: 898-906.

Rusert, W., and R. Cummings. 2004. Characteristics of Water-use Control Policies: A Survey of 28 Eastern States. Water Policy Working Paper #2004-001. North Georgia Water Planning and Policy Center, Andrew Young School of Policy Studies, Georgia State University, Atlanta, Georgia, February 2004.

Sæther, B.E., S. Engen, A. Islam, R. McCleery, and C. Perrins. (1998) Environmental stochasticity and extinction risk in a population of a small song bird, the great tit. American Naturalist, 151, 441–450.

Savoy, T. 1991. Sturgeon status in Connecticut Waters. Connecticut Department of Environmental Protection. 43 pp.

SCDNR. 2008. Loggerheadlines. July-December 2008.

Schlosser, I.J. and P.L. Angermeier. 1995. Spatial variations in demographic processes of lotic fishes: conceptual models, empirical evidence, and implications for conservation. Pp 392-401 In: J.L. Nielsen (ed.) Evolution and the Aquatic Ecosystem: Defining Unique Unites in Population Conservation. American Fisheries Society. Bethesda, MD.

Schmid, J.R. and W.N. Witzell. 1997. Age and growth of wild Kemp's ridley turtles (*Lepidochelys kempii*): Cumulative results of tagging studies in Florida. Chelonian Conservation and Biology 2: 532-537.

Schroeder, B.A., and A.M. Foley. 1995. Population studies of marine turtles in Florida Bay. *In* Richardson, J.I. and T. H. Richardson (compilers), Proceedings of the Twelfth Annual Workshop on Sea Turtle Biology and Conservation, NOAA Technical Memorandum NMFS-SEFSC-361. 117 pp.

Schueller, P., and D.L. Peterson. 2010. Abundance and recruitment of juvenile Atlantic sturgeon in the Altamaha River, Georgia. Transactions of the American Fisheries Society 139: 1526-1535.

Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada Bulletin 184: 966 pp.

Secor, D.H. 1995. Chesapeake Bay Atlantic sturgeon: current status and future recovery. Summary of findings and recommendations from a workshop convened 8 November 1994 at Chesapeake Biological Laboratory. Chesapeake Bay Biological Laboratory, Center for Estuarine and Environmental Studies, University of Maryland System, Solomons, MD.

Secor, D.H. 2002. Atlantic sturgeon fisheries and stock abundances during the late nineteenth century. American Fisheries Society Symposium 28: 89-98.

Secor, D.H. and T.E. Gunderson. 1998. Effects of hypoxia and temperature on survival, growth, and respiration of juvenile Atlantic sturgeon (*Acipenser oxyrinchus*). Fishery Bulletin U.S. 96: 603-613.

Secor, D.H. and E.J. Niklitschek. 2001. Hypoxia and sturgeons. Chesapeake Biological Laboratory Technical Report Series-Number TS-314-01-CBL. 26 pp.

Secor, D.H. and E.J. Niklitschek. 2003. Sensitivity of sturgeons to environmental hypoxia: physiological and ecological evidence. Pp 61-78 In: Fish Physiology, Toxicology, and Water Quality – Proceedings of the Sixth International Symposium, La Paz, Mexico, January 22-26, 2001. U.S. EPA Office of Research and Development, Ecosystems Research Division, Athens, Georgia.

Secor, D. H. and J. R. Waldman. 1999. Historical abundance of Delaware Bay Atlantic sturgeon and potential rate of recovery. American Fisheries Society Symposium 23: 203- 216.

Secor, D., P. Anders, V.W. Webster, and D. Dixon. 2002. Can we study sturgeon to extinction? What we do and don't know about the conservation of North American sturgeon. Pages 3-9. In: V.W. Webster et al. (eds.) Biology, management, and protection of North American sturgeon, Symposium 28. American Fisheries Society, Bethesda, Maryland

Shaver, D.J. 1991. Feeding ecology of wild and head-started Kemp's ridley sea turtles in south Texas waters. Journal of Herpetology. Vol 23, 1991.

Shaver, D.J. 1994. Relative abundance, temporal patterns, and growth of sea turtles at the Mansfield Channel, Texas. Journal of Herpetology 28: 491-497.

Shoop, C., T. Doty and N. Bray. 1982. A characterization of marine mammals and turtles in the mid- and north-Atlantic areas of the U.S. outer continental shelf: Final Report, December 1982. Univ. Rhode Island, Kingston.

Shortnose Sturgeon Status Review Team. 2011. Status Review of shortnose sturgeon (*Acipenser brevirostrum*). Report to National Marine Fisheries Service, Northeast Regional Office.

Simberloff, D. 1988. The contribution of population and community biology to conservation science. Annual Review of Ecology and Systematics 19: 473-511.

Sindermann, C.J. 1994. Quantitative effects of pollution on marine and anadromous fish populations. NOAA Technical Memorandum NMFS-F/NEC-104, National Marine Fisheries Service, Woods Hole, Massachusetts.

Smith, T.I.J. 1985. The fishery, biology, and management of Atlantic sturgeon, *Acipenser oxyrinchus*, in North America. Environmental Biology of Fishes 14:61-72.

Smith, T.I.J. and J.P. Clugston. 1997. Status and management of Atlantic sturgeon, *Acipenser oxyrinchus*, in North America. Environmental Biology of Fishes 48: 335-346.

Smith, T.I.J., E.K. Dingley, and E.E. Marchette. 1980. Induced spawning and culture of Atlantic sturgeon. Progressive Fish Culturist 42:147-151.

Smith, T.I.J., D.E. Marchette, and R.A. Smiley. 1982. Life history, ecology, culture and management of Atlantic sturgeon, *Acipenser oxyrhynchus*, Mitchill, in South Carolina. South Carolina Wildlife and Marine Resources. Resources Department, Final Report to U.S. Fish and Wildlife Service Project AFS-9. 75 p.

Smith, T.I.J., D.E. Marchette, and G.F. Ulrich. 1984. The Atlantic sturgeon fishery in South Carolina. North American Journal of Fisheries Management 4: 164-176.

Smith, T.I.J., E. Kennedy and M.R. Collins. 1992. Identification of critical habitat requirements of shortnose sturgeon in South Carolina. Final Report to USFWS. Atlanta, Georgia.

Smith, T.I.J., M.R. Collins, and E.Kennedy. 1993. Identification of critical habitat requirements of shortnose sturgeon in South Carolina. Final Report Project AFS-17, USFWS. Atlanta, GA. 97 pp.

Smith, T. I. J., M.C. Collins, W.C. Post, and J.W. McCord. 2002. Stock enhancement of shortnose sturgeon: a case study. Pages 31–44 in W. Van Winkle, P. J. Anders, D.H. Secor, and D. A. Dixon, editors. Biology, management, and protection of North American sturgeon. American Fisheries Society, Symposium 28, Bethesda, Maryland.

Soule, M.E. 1986. Conservation biology: the science of scarcity and diversity. Sinauer Associates, Sunderland, Massachusetts.

Spencer, D., and L.B. Muzekari. 2002. Source Water Assessment Plans Across State Lines Beaufort Jasper Water & Sewer Authority and the City of Savannah. Presented at the 2002 South Carolina Environmental Conference.

Spotila, J.R., A.E. Dunham, A.J. Leslie, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino. 1996. Worldwide population decline of *Dermochelys coriacea*: are leatherback turtles going extinct? Chel. Conserv. Biol. 2(2): 209-222.

Stabenau, E.K. and K.R. Vietti. 1999. Physiological effects of short-term submergence of loggerhead sea turtles, *Caretta caretta*, in TED-equipped commercial fishing nets. Final Report to National Marine Fisheries Service, Pascagoula Laboratory, Pascagoula, Mississippi.

Standora, E.A., S.J. Morreale, A. Bolten, M.D. Eberle, J.M. Edbauer, T.S. Ryder, and K.L. Williams. 1993. Diving behavior, daily movements, and homing of loggerhead turtles (*Caretta caretta*) at Cape Canaveral, Florida. March and April 1993. Contr. Report to COE.

Stevenson, J.C. and M.S. Kearney. In press. Impacts of global climate change and sea level rise on tidal wetlands. In: B.R. Silliman, M.D. Bertness and D. Strong (eds.), Anthropogenic modification of North American salt marshes. Berkeley, CA: University of California Press.

Stevenson, J.C. and D.H. Secor. 1999. Age determination and growth of Hudson River Atlantic sturgeon, *Acipenser oxyrinchus*. Fishery Bulletin 97:153-166.

Swingle, M., S. Barco, T. Pitchford, W. McLellan and D.A. Pabst. 1993. The occurrence of foraging juvenile humpback whales (*Megaptera novaeangliae*) in Virginia Coastal Waters. Marine Mammal Science. 9(3):309-315.

Taubert, B.D. 1980. Reproduction of the shortnose sturgeon (*Acipenser brevirostrum*) in Holyoke Pool, Connecticut River, Massachusetts. Copeia 1: 114-117.

Taubert. B.D. and M.J. Dadswell. 1980. Description of some larval shortnose sturgeon (*Acipenser brevirostrum*) from the Holyoke Pool, Connecticut River, Massachusetts, U.S.A. and the Saint John River, New Brunswick, Canada. Canadian Journal of Zoology 58: 1125-1128.

TEWG (Turtle Expert Working Group). 1998. An Assessment of the Kemp's ridley sea turtle (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the western North Atlantic. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-409. 96 pp.

TEWG (Turtle Expert Working Group). 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the Western North Atlantic. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-444. 115 pp.

TEWG (Turtle Expert Working Group). 2007. An Assessment of the Leatherback Turtle Population in the Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-555, 116p.

TEWG (Turtle Expert Working Group). 2009. An Assessment of the Loggerhead Turtle Population in the Western North Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-575, 131p.

Thomas, C.D. 1990. Environmental fluctuations and extinction – single species. Theoretical Population Biology 27: 1-26.

Thomas, C.D. 1994. Extinction, colonization, and metapopulations: environmental tracking by rare species. Conservation Biology 8: 373-378.

Tillman, M. 2000. Internal memorandum, dated July 18, 2000, from M. Tillman (NMFS-Southwest Fisheries Science Center) to R. McInnis (NMFS-Southwest Regional Office).

USACE. 2011. Sea Turtle Data Warehouse. http://el.erdc.usace.army.mil/seaturtles/.

USDOI (U.S. Department of Interior). 1973. Threatened wildlife of the United States. Resource Publication 114, March 1973.

USFWS (U.S. Fish and Wildlife Service). 1993. Pallid Sturgeon Recovery Plan. U.S. Fish and Wildlife Service, Bismarck, North Dakota. 55 pp.

USFWS. 2000. Report on the Mexico/United States of America Population Restoration Project for the Kemp's ridley sea turtle, *Lepidochelys kempii*, on the coasts of Tamaulipas and Veracruz, Mexico.

USFWS and NMFS. 1992. Recovery Plan for the Kemp's ridley sea turtle (*Lepidochelys kempii*). U.S. Fish and Wildlife Service, Washington, DC.

USFWS and NMFS. 1998. Consultation Handbook: Procedures for conducting consultation and conference activities under section 7 of the Endangered Species Act.

USFWS, NMFS, and SCDNR. 2001. Santee-Cooper Basin Diadromous Fish Passage Restoration Plan. 72 pp.

Van Dam, R.P., and C.E. Diez. 1998. Home range of immature hawksbill turtles (*Eretmochelys imbricata*) at two Caribbean islands. J. Exp. Mar. Biol. Ecol. 220:15-24.

Van Den Avyle, M. J. 1984. Species profile: Life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic): Atlantic sturgeon. U.S. Fish and Wildlife Service Report No. FWS/OBS-82/11.25, and U. S. Army Corps of Engineers Report No. TR EL-82-4, Washington, D.C.

Vanderlaan, A.S.M and C.T. Taggart. 2007. Vessel collisions with whales: The probability of lethal injury based on vessel speed. Marine Mammal Science 23(1):144-156.

Van Dolah, R.F., D.R. Calder, F.W. Stapor, Jr., R.H. Dunlap, and C.R. Richter. 1979 Atlantic Intracoastal Waterway environmental studies at Sewee Bay and North Edisto River. South Carolina Marine Resources Center Technical Report No. 39. South Carolina Wildlife and Marine Resources Department, Charleston, SC.

Van Dolah, R.F., D.R. Calder, and D.M. Knott. 1984. Effects of dredging and open water disposal on benthic macroinvertebrates in a South Carolina estuary. Estuaries 7:28-37.

Van Eenennaam, J.P., S.I. Doroshov, G.P. Moberg, J.G. Watson, D.S. Moore, and J. Linares. 1996. Reproductive conditions of the Atlantic sturgeon (*Acipenser oxyrhinchus*) in the Hudson River. Estuaries 19: 769-777.

Varanasi, U. 1992. Chemical contaminants and their effects on living marine resources. Pp 59-71 In: R.H. Stroud (ed.) Stemming the Tide of Coastal Fish Habitat Loss. Proceedings of the Symposium on Conservation of Fish Habitat, Baltimore, Maryland. Marine Recreational Fisheries Number 14. National Coalition for Marine Conservation, Inc., Savannah, Georgia.

Vargo, S., P. Lutz, D. Odell, E. van Vleet, and G. Bossart. 1986. The effects of oil on marine turtles. Final Report, Vol. 2. Prepared for Mineral Management Services, U.S. Department of Interior. OCS Study MMS 86-0070

Vecsei, P. and D. Peterson. 2004. Sturgeon ecomorphology: A descriptive approach. Pp 103-133 In: G.T.O. LeBreton et al. (eds.) Sturgeons and Paddlefishes of North America. Kluwer Academic, Netherlands.

Vladykov, V. D. and J. R. Greely. 1963. Order Acipenseroidei. In: Fishes of Western North Atlantic. Sears Foundation. Marine Research, Yale Univ. 1630 pp.

Von Westernhagen, H., H. Rosenthal, V. Dethlefsen, W. Ernst, U. Harms, and P.D. Hansen. 1981. Bioaccumulating substances and reproductive success in Baltic flounder *Platichthys flesus*. Aquatic Toxicology 1:85-99.

Waldman, J.R., J.T. Hart, and I. Wirgin. 1996. Stock composition of the New York Bight Atlantic sturgeon fishery based on analysis of mitochondrial DNA. Trans. Am. Fish. Soc. 125:364–371.

Waldman, J.R., C. Grunwald, J. Stabile, and I. Wirgin. 2002. Impacts of life history and biogeography on the genetic stock structure of Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus*, Gulf sturgeon *A. oxyrinchus desotoi*, and shortnose sturgeon *A. brevirostrum*. Journal of Applied Ichthyology 18: 509-518.

Wallace, B.P., S.S. Heppell, R.L. Lewison, S. Kelez, and L.B. Crowder. 2008. Impacts of fisheries bycatch on loggerhead turtles worldwide inferred from reproductive value analyses. Journal of Applied Ecology 45:1076–1085.

Walsh, M.G., M.B. Bain, T. Squires Jr., J.R. Waldman, and I. Wirgin. 2001. Morphological and genetic variation among shortnose sturgeon *Acipenser brevirostrum* from adjacent and distant rivers. Estuaries 24: 41-48.

Wang, Y.L. F.P. Binkowski and S.I. Doroshov. 1985. Effect of temperature on early development of white and lake sturgeon, *Acipenser transmontanus* and *A. fulvescens*. Environmental Biology of Fishes 14: 43-50.

Weber, W. 1996. Population size and habitat use of shortnose sturgeon, *Acipenser brevirostrum*, in the Ogeechee River system, Georgia. MSc. Thesis. University of Georgia, Athens, Georgia.

Weber, W., C.A. Jennings, and S.G. Rogers. 1999. Population size and movement patterns of shortnose sturgeon in the Ogeechee River system, Georgia. Proceedings of the annual conference of the Southeastern Association of Fish and Wildlife Agencies. 52: 18-28.

Weishampel, J.F., D.A. Bagley, and L.M. Ehrhart. 2004. Earlier nesting by loggerhead sea turtles following sea surface warming. Global Change Biology, 10:1424-1427

Welcomme, R.L. 1995. Relationships between fisheries and the integrity of river systems. Regulated Rivers: Research and Management 11: 121-136.

Wershoven, J.L. and R.W. Wershoven. 1992. Juvenile green turtles in their nearshore habitat of Broward County, Florida: a five year review. *In* Salmon M. and J. Wyneken (compilers), Proceedings of the Eleventh Annual Workshop on Sea Turtle Biology and Conservation, NOAA Technical Memorandum NMFS-SEFC-302: 121-123.

Wiley, D.N., R. A. Asmutis, T.D. Pitchford, and D.P. Gannon. 1995. Stranding and mortalities of humpback whales, *Megaptera novaeangliae*, in the mid-Atlantic and southeast United States, 1985-1992. Fishery Bull. 93:196-205.

Williamson, M. 1981. Island populations. Oxford University Press, Oxford.

Winger, P. V., P. J. Lasier, D. H. White, J. T. Seginak. 2000. Effects of contaminants in dredge material from the lower Savannah River. Archives of Environmental Contamination and Toxicology 38: 128-136.

Wirgin, I., J.R. Waldman, J. Rosko, R. Gross, M. Collins, S.G. Rogers, and J. Stabile. 2000. Genetic structure of Atlantic sturgeon populations based on mitochondrial DNA control region sequences. Transactions of the American Fisheries Society 129: 476-486.

Wirgin, I., J. Waldman, J. Stabile, B. Lubinski and T. King. 2002. Comparison of mitochondrial DNA control region sequence and microsatellite DNA analyses in estimating population structure and gene flow rates in Atlantic sturgeon (*Acipenser oxyrinchus*). Journal of Applied Ichthyology 18: 313-219.

Wirgin, I., C. Grunwald, E. Carlson, J. Stabile, D.L. Peterson, and J. Waldman. 2005. Range-wide population structure of shortnose sturgeon *Acipenser brevirostrum* based on sequence analysis of the mitochondrial DNA control region. Estuaries 28(3): 406-421.

Wirgin, I., C. Grunwald, J. Stabile and J.R. Waldman. 2009. Delineation of discrete population segments of shortnose sturgeon *Acipenser brevirostrum* based on mitochondrial DNA control region sequence analysis. Conserv. Genet. doi: 10.1007/s10592-009-9840-1.

Witherington, B., P. Kubilis, B. Brost, and A. Meylan. 2009. Decreasing annual nest counts in a globally important loggerhead sea turtle population. Ecological Applications 19:30–54.

Witzell, W.N. 2002. Immature Atlantic loggerhead turtles (*Caretta caretta*): suggested changes to the life history model. Herpetological Review 33(4): 266-269.

Witzell, W.N. and J.R. Schmid. 2005. Diet of immature Kemp's ridley turtles (*Lepidochelys kempi*) from Gullivan Bay, Ten Thousand Islands, southwest Florida. Bull. Mar. Sci. 77: 191-199.

Wooley, C.M. and E.J. Crateau. 1985. Movement, microhabitat exploitation and management of Gulf of Mexico sturgeon, Apalachicola River, Florida. North Am. J. Fish Manage. 5, 590–605.

Wyneken, J., K. Blair, S. Epperly, J. Vaughan, and L. Crowder. 2004. Surprising sex ratios in west Atlantic loggerhead hatchlings – an unexpected pattern. Poster presentation at the 2004 International Sea Turtle Symposium in San Jose, Costa Rica.

Young, J.R., T.B. Hoff, W.P. Dey, and J.G. Hoff. 1988. Management recommendations for a Hudson River Atlantic sturgeon fishery based on an age-structured population model. Fisheries Research in the Hudson River. State of University of New York Press, Albany, New York. 353 p.

Ziegeweid, J.R., C.A. Jennings, and D.L. Peterson. 2008a. Thermal maxima for juvenile shortnose sturgeon acclimated to different temperatures. Environmental Biology of Fishes 82: 299-307.

Ziegeweid, J.R., C.A. Jennings, D.L. Peterson, and M.C. Black. 2008b. Effects of salinity, temperature, and weight on the survival of young-of-year shortnose sturgeon. Environmental Biology of Fishes 137:1490-1499.

Zurita, J.C., R. Herrera, A. Arenas, M.E. Torres, C. Calderon, L. Gomez, J.C. Alvarado, and R. Villavicencio. 2003. Nesting loggerhead and green sea turtles in Quintana Roo, Mexico. Pp. 125-127 *In*: Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum. NMFS SEFSC.

Zwinenberg, A.J. 1977. Kemp's ridley, *Lepidochelys kempii* (Garman, 1880), undoubtedly the most endangered marine turtle today (with notes on the current status of *Lepidochelys olivacea*). Bulletin of the Maryland Herpetological Society, 13(3): 170-192.

APPENDIX A

Summary of annual incidental take levels anticipated under the incidental take statements associated with NMFS' existing biological opinions in the action area. Note that while these activities overlap the action area, the takes include the entire range of the activity which often far exceeds the geographical scope of the action area.

Federal Action	Sea Turtle Species (numbers represents lethal takes unless otherwise noted)				
	Loggerhead	Leatherback	Green	Kemp's Ridley	Hawksbill
Coast Guard Vessel Operation	1 (combined)				
Navy – SE Ops Area[1]	91	17	16	16	4
COE Dredging – S. Atlantic	35	0	7	7	2
Dolphin/Wahoo Fishery	16 (No more than 2 lethal)	16 (No more than 1 lethal)	2 (No more than 1 lethal)	2 (No more than 1 lethal)	2 (No more than 1 lethal)
Monkfish Fishery	6 (No more than 3 lethal)	1	1	1	0
Summer Flounder, Scup, and Black Sea Bass Fishery	15 (No more than 5 lethal)	3	3	3	3
Shrimp Fishery[2]	163,160 (No more than 3,948 lethal)	3,090 (No more than 80 lethal)	155,503 (No more than 4,208 lethal)	18,757 (No more than 514 Lethal)	640[3] (All lethal)
Weakfish Fishery	20	0	0	2	0
Atlantic HMS-Shark Fisheries **(Note: this is 3-year take, not annual)**	679 (No more than 346 lethal)	74 (No more than 47 lethal)	2 (No more than 1 lethal)	2 (No more than 1 lethal)	2 (No more than 1 lethal)
Coastal Migratory Pelagic	33 (No more than 33 lethal)	2 (No more than 2 lethal)	4 (No more than 4 lethal)	14 (No more than 14 lethal)	2 (No more than 2 lethal)

[1]Total estimated take includes acoustic harassment
[2]Represents estimated take (interactions between sea turtles and trawls). Lethal take in parentheses.
[3]Actual mortalities of hawksbills, as a result of sea turtle/trawl interactions, is expected to be much lower than this number. This number represents the estimated total number of mortalities of hawksbill sea turtles from all sources in areas where shrimp fishing takes place.

APPENDIX B

Sea Turtle Resuscitation Guidelines

If a turtle appears to be unconscious or comatose, attempt to revive it before release. Turtles can withstand lengthy periods without breathing; a living comatose sea turtle may not move, breathe voluntarily, or show reflex responses or other signs of life. In other cases, a lightly comatose turtle may show shallow breathing or reflexes such as eyelid or tail movement when touched. Use the following method of resuscitation in the field if veterinary attention is not immediately available:

- Place the turtle on its plastron (lower shell) and elevate the hindquarters approximately 15 - 30 degrees to permit the lungs to drain off water for a period of 4 up to 24 hours. A board, tire or boat cushion, etc. can be used for elevation.

- Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the carapace and lifting one side about 3 inches, then alternate to the other side.

- Keep the turtle in the shade, at a temperature similar to water temperature at capture. Keep the skin (especially the eyes) moist while the turtle is on deck by covering the animal's body with a wet towel, periodically spraying it with water, or by applying petroleum jelly to its skin and carapace. Do not put the turtle into a container with water.

- Do not put the turtle on its carapace (top shell) and pump the plastron (breastplate) or try to compress the turtle to force water out, as this is dangerous to the turtle and may do more harm than good.

- Periodically, gently touch the corner of the eye or eyelid and pinch the tail near the vent (reflex tests) to monitor consciousness.

- Sea turtles may take some time to revive; do not give up too quickly. Turtles that are successfully resuscitated benefit from being held on deck as long as possible (up to 24 hours) to fully recover from the stress of accidental forced submergence.

- Release successfully resuscitated turtles over the stern of the boat, when fishing or scientific collection gear is not in use, the engine is in neutral, and in areas where they are unlikely to be recaptured or injured by vessels. A turtle that has shown no sign of life after 24 hours on deck may be considered dead and returned to the water in the same manner.

NMFS/SEFSC Photos

References:

Federal Register, December 31, 2001. Government Printing Office, Washington DC 66 (250), pp. 67495- 67496.

July 2009

APPENDIX C

Protocol for tissue sampling for genetic analysis.

Tissue samples should be a small (1.0cm2) fin-clip collected from soft pelvic fin tissue using a pair of sharp scissors. Tissue samples should be preserved in individually labeled vials containing either alcohol (70 to 100%) or SDS-UREA.

Data to accompany tissue sample should include species, important morphological Information (TL, SL, weight, sex if known), date, and capture location. Record condition of fish upon release. Keep tissue sample out of direct sun, refrigeration not necessary.

Send samples and supporting data within one month to:

Julie Carter
NOAA/NOS
219 Ft. Johnson Road
Charleston, SC 29412
PH: (843)762-8547

APPENDIX D

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.

b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.

c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.

e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006

APPENDIX E

South Atlantic Division Corps of Engineers
Hopper Dredging Protocol for Atlantic Coast
FY 98 - FY 03

1. Sea turtle deflecting dragheads will be used at all times.

2. Districts will inspect sea turtle deflecting dragheads systems to ensure that they are fully operational, prior to initiation of work.

3. Districts will ensure that draghead operators know how to properly use the sea turtle deflecting system.

4. Maintenance dredging at Savannah, Brunswick and Kings Bay Harbors must be restricted to 15 December through the end of March. Maintenance dredging at Charleston and Wilmington Harbors must be restricted to 1 December through the end of March where the sea turtle deflecting draghead system can not be used effectively. Dredging may begin as soon as mid-November in those portions of the Wilmington and Charleston Harbor channels where the sea turtle deflecting draghead can be used effectively. All Districts will cooperate to ensure that their scheduling of hopper dredging contracts, does not interfere with this Division priority work area.

5. Sea turtle observers, inflow screens and overflow screens will be used during all dredging operations, except for the months of January and February, which are optional. Variations from this provision may be granted by Division, but must be justified from a technical perspective.

6. All sea turtle takes will be reported promptly to SAD-ET-CO/PM and posted at usace.sad.turtle newsgroup on the Internet.

7. If two sea turtle takes occur within 24 hours, you should immediately notify the Division POC so that he can initiate reconsultation with National Marine Fisheries Service.

8. If a third take occurs on the project the district will cease operations and notify the South Atlantic Division. Continuation of dredging will occur only after cleared by Division. Upon taking three turtles, District will develop a risk assessment along with an appropriate risk management plan, and submit that to Division for assessment. Generally relative abundance and relocation trawling would be an integral part of a risk assessment and management plan. Should a total take of 5 sea turtles occur, for whatever reason, all work will be terminated unless other prior agreements had been reached with Division.

Georgia Department of Natural Resources
2 Martin Luther King, Jr. Drive, S.E., Suite 1152 East Tower, Atlanta, Georgia 30334-9000
Mark Williams, Commissioner
F. Allen Barnes, Director
Environmental Protection Division
404/656-4713

February 16, 2011

Colonel Jeffrey M. Hall
U.S. Army Corps of Engineers
Savannah District
PO Box 889
Savannah, Georgia 31402-0889

Re: Water Quality Certification
November 15, 2010 Joint Public Notice
Navigation Channel Improvements
Savannah River Harbor
Deepening and Maintenance Activities
Savannah River Basin
Chatham County

Dear Colonel Hall:

Pursuant to Section 401 of the Federal Clean Water Act, the State of Georgia issues this certification to the U.S. Army Corps of Engineers (USACE), Savannah District, an applicant for a federal permit or license to conduct an activity in, on or adjacent to the waters of the State of Georgia.

The State of Georgia certifies that there is no applicable provision of Section 301; no limitation under Section 302; no standard under Section 306; and no standard under Section 307, for the applicant's activity. The State of Georgia certifies that the applicant's activity will comply with all applicable provisions of Section 303, contingent upon the following conditions:

1. All work performed during construction will be done in a manner so as not to violate applicable water quality standards.

2. No oils, grease, materials or other pollutants will be discharged from the construction activities that reach public waters.

3. Savannah's Industrial and Domestic Drinking Water Treatment Facility

With respect to the City of Savannah's Industrial and Domestic (I&D) drinking water facility, elevated chlorides are a treatment cost and public health concern. The public health concern is related to the uncertainty of how increased chloride levels will impact the lead and copper concentrations in the water provided to the customers of the Savannah I&D system and the purchase water systems. The industrial concerns relate to potential negative impacts on industrial processes.

The City withdraws water from Abercorn Creek, a tributary of the Savannah River located upstream of the Savannah Harbor Expansion Project (SHEP). The Chloride Modeling for the SHEP (document dated December 15, 2010) predicts elevated chloride levels at the Savannah I&D drinking water intake. The USACE is continuing to evaluate the science, modeling and impacts regarding this issue and as part of that evaluation, the USACE is working with the City of Savannah and key industries supplied by the City of Savannah's I&D drinking water system to determine the effects of potential elevated chlorides. Those additional analyses will be completed and included in the Final Environmental Impact Statement (EIS).

The Georgia Environmental Protection Division (Georgia EPD) will evaluate the results of the aforementioned studies. Once the pending studies have been completed as discussed above, the USACE will include, within the Final EIS, the chloride information, impacts, and its determination based on the studies regarding any mitigation remedy selected. The schedule for completion of the selected mitigation will be in conjunction with the start of the SHEP and will be dependent on the aforementioned study results. Mitigation will be based on the Savannah I&D treatment plant design capacity of 62.5 MGD. Any proposed adjustments in the water treatment process to mitigate the increased chloride concentrations must address simultaneous compliance with all drinking water regulations. In addition, after consultation and agreement with the Georgia EPD, the schedule, sampling locations and parameters for the selected mitigation's monitoring program (to include the case where mitigation may not be required) will be specified in the Final EIS. Pursuant to Special Condition 14, the issues associated with increased chlorides at the Abercorn Creek drinking water intake will be carefully reviewed on an ongoing basis throughout the life of the project.

4. Chloride Migration into the Floridan Aquifer

The Floridan Aquifer Analysis is based on the initial Study Report of September 2003 and the Supplemental Study of September 2005. The aquifer is the main water supply throughout most of South Georgia.

Monitoring and Reporting. To insure early detection of chloride migration, the USACE shall establish monitoring stations at appropriate locations throughout the project to monitor salinity seepage through the Miocene sediments. Annual chloride monitoring reports shall be provided to the Georgia EPD by January 31st of each year following initiation of dredging.

Monitoring Along Groundwater Flow Paths (Sentry Wells). Monitoring of chloride in the Upper Floridan aquifer must be conducted along critical groundwater flow paths where chloride migrating downward through the confining unit beneath the Savannah River could move toward Savannah area production wells. Sentry wells along critical groundwater flow paths must be installed at two depths:

- Near the top of the aquifer to monitor downward migration of chloride through the confining unit; and
- Deeper in the aquifer to monitor how horizontal flow of fresh water within the aquifer mixes with and dilutes the chloride.

Sentry wells must be located west of the locations of exploratory borings SHE-11 and SHE-13, and on Cockspur Island near Fort Pulaski. Existing wells can be used as sentry wells if the existing wells were constructed to allow monitoring near the top of the aquifer and deeper in the aquifer. The Georgia EPD must approve locations and depths of sentry wells.

Upgradient Background Wells. Monitoring wells must be installed upgradient of critical groundwater flow paths to provide information on background chloride concentrations associated with groundwater withdrawals in the Savannah area independent of SHEP dredging activities. Background wells must be installed near the top of the aquifer and deeper in the aquifer. The Georgia EPD must approve locations and depths of background wells.

Establish Background Concentrations. Background chloride concentrations at sentry and background wells must be established. At least four background samples must be collected from each sentry and background well and statistical methods must be used to establish background chloride concentrations at each

sentry and background well. The Georgia EPD must approve the collection of background samples and the statistical methods used to establish background chloride concentrations. Background sampling must be conducted before any SHEP dredging activities are started.

Annual Monitoring. Monitoring of sentry and background wells must occur annually for the life of the project, which may be 50 years. Groundwater samples collected for monitoring must be analyzed for chloride. Samples may be analyzed for specific conductance if chloride is also analyzed. At no time during the monitoring will analyses for specific conductance be substituted for analyses of chloride.

In the annual monitoring reports, differences in the long-term trends of chloride concentrations in the sentry and background wells must be used to evaluate impacts of SHEP dredging activities from impacts of groundwater withdrawals on chloride concentrations in the Upper Floridan aquifer. SHEP dredging activities include the initial dredging and maintenance dredging over the 50-year project period. The Georgia EPD must approve the methods used to evaluate impacts of SHEP dredging activities.

Benchmark Concentrations and Analysis. A benchmark chloride concentration must be established for each sentry well. The USACE must also determine what chloride concentrations caused by SHEP dredging activities would result in a measurable increase in chloride concentrations at Savannah area production wells. The benchmark chloride concentrations must be protective of the Savannah area production wells. Savannah area production wells include industrial, commercial, municipal, agricultural, and other un-permitted wells. Benchmark concentrations must be established for each pair of sentry wells and for sentry wells near the top of the Upper Floridan aquifer and deeper in the aquifer. The Georgia EPD must approve each benchmark concentration.

If benchmark concentrations are exceeded at any sentry well, and it has been determined that the exceedence is due to SHEP dredging activities, all sentry wells must immediately be resampled for chloride. If exceedence of a benchmark concentration is confirmed at any sentry well, additional evaluation of wells must be conducted to determine if any new monitoring wells are warranted. The Georgia EPD must approve locations and depths of additional monitoring wells.

Remediation Plan and Implementation. If it is determined that the chloride entering the Upper Floridan aquifer through the confining unit beneath the Savannah River could affect Savannah area production wells the USACE shall develop a remediation and implementation plan. The plan must account for adaptive management measures specific to accelerated chloride intrusion into the aquifer.

Mitigation must be implemented if sampling of additional monitoring wells indicates that Savannah area production wells may be affected by downward migration of chloride through the confining unit as a result of SHEP dredging activities. The Georgia EPD must approve mitigation activities. Pursuant to Special Condition 14, these migration issues will be carefully reviewed on an ongoing basis throughout the life of the project.

5. Cadmium Monitoring

Cadmium is present throughout the sediments in the Savannah River Harbor. Therefore, the USACE shall conduct the following monitoring:

(a) During the Savannah River Harbor deepening activities (project depth + advance dredging + overdepth) cadmium concentrations shall be monitored weekly at the point of discharge from those Confined Disposal Facilities (CDF) receiving sediments from the four known reaches within the harbor having elevated cadmium concentration in the sediments. US EPA laboratory testing methodology must have a detection limit of at least 0.7 micrograms per liter (ug/l). Monitoring shall continue at these CDF discharge points as long as discharge is present and until all dredged sediments have been dewatered, stabilized and capped as per the Final EIS. Data shall be reported to the Georgia EPD quarterly in micrograms per liter (ug/l) within 30 days of the end of each calendar quarter.

(b) Following the installation of a stable clean cap within the CDFs that receive cadmium bearing sediments, cadmium shall be monitored weekly at the point of discharge for a period of one year. Data shall be reported to the Georgia EPD quarterly in ug/l within 30 days of the end of each calendar quarter.

(c) For maintenance dredging in known reaches of high cadmium concentration identified in the Final EIS, accumulated sediments to be dredged within 45 days shall be sampled for cadmium from two locations

within that reach that are representative of average sediment accumulation for that reach. This protocol shall remain in effect through two complete maintenance dredging cycles for each reach identified in the Final EIS at which time the Georgia EPD will review all data and determine if additional monitoring shall be required for future maintenance dredging.

Reporting: (1) Analysis of cadmium in the sediments shall be reported as mg cadmium / kilogram sediment (mg/kg). (2) Sampling results shall be provided to Georgia EPD prior to initiation of dredging within the reach to be dredged over the next 45 days.

6. Water Quality Monitoring of Dewatering Discharge from the Confined Disposal Facility

Dewatering discharge from all CDFs shall be monitored by USACE and reported to the Georgia EPD monthly and due within 30 days following the end of each reporting period. Monitoring reports shall include the location of the discharge point, dates of discharge, total suspended solids, dissolved oxygen, pH, temperature, salinity, turbidity and conductivity. The USACE will monitor weekly when there is a discharge and provide monthly reports to the Georgia EPD within 30 days of the end of each reporting period.

7. Striped Bass Recovery

(a) No dredging should be conducted upstream of Sta. 63 during the striped bass spawning period from April 1 to May 15 of each year. A variance to this condition may be granted by the Georgia EPD 1) where navigational safety is compromised and it can be demonstrated that the channel or other navigational water had been at project depth within 90 days prior to the commencement of dredging closure on April 1, or 2) if salinity conditions at a proposed dredging location are lethal to striped bass larvae.

(b) Water quality and hydrodynamic models of the proposed deepening of the inner Savannah River Harbor to –48 feet Mean Low Water (MLW) demonstrate striped bass life stages habitat may be adversely impacted. The USACE shall mitigate for this impact through compensatory mitigation to the Georgia Department of Natural Resources (Georgia DNR) Fisheries Section for continuation of the existing striped bass management/stocking program in the Savannah River.

8. Sea Turtles

(a) All hopper dredging activities (deepening and maintenance) should be restricted to December 15 through March 31 when sea turtles are least abundant. Hopper dredges must have fully functional inflow and outflow screening and protected species observers. Sea turtle takes must be reported to the Georgia Wildlife Resources Division and the Georgia EPD within 24 hours. Hopper dredging activities should be halted if sea turtle takes exceed the limits specified by NOAA. Bed leveling equipment may not be used unless approved by the Georgia EPD.

(b) Other types of dredging (non-hopper) activities should be restricted to the following windows based on the location of the placement of fill material: Deepening activities involving the placement of dredge material at any near shore site within 1,000 feet of MLW is restricted to September 1 through March 31. Deepening activities involving the placement of dredge material at any near shore site beyond 1,000 feet of MLW may occur year-round. Operation and maintenance activity involving the placement of dredge material at any near shore site within 1,000 feet of MLW is restricted to November 1 through March 31. Operation and maintenance activity involving the placement of dredge material at any near shore site beyond 1,000 feet of MLW is restricted to September 1 through March 31.

9. Dissolved Oxygen Water Quality Criteria

The Georgia Rules and Regulations for Water Quality Control establishes the Dissolved Oxygen criteria for the section of the Savannah River with a designated use of "Coastal Fishing", which includes the Savannah River Harbor.

The USACE must install continuous water quality monitoring equipment on the Front River, Middle River, and Back River at Houlihan Bridge, and the Savannah River at I-95. This equipment will collect water temperature, conductivity, pH, dissolved oxygen, and water depth data every fifteen minutes and the data will be made available on the web. The monitoring equipment is to be installed before the flow altering mitigation and Savannah River Harbor deepening begins and continue until the post-construction monitoring is complete and the dissolved oxygen mitigation is working and effective.

The oxygen injection systems on Hutchinson Island shall be installed and operational prior to commencement of channel deepening in the inner harbor

(inside the harbor entrance, Sta. 0+000). The oxygen injection system near Georgia Pacific shall be operational within one year of commencement of channel deepening in the inner harbor. The monitoring data will be used to evaluate the effectiveness of the oxygen mitigation. Pursuant to Special Condition 14, these oxygen mitigation issues will be carefully reviewed on an ongoing basis throughout the life of the project.

In addition, the USACE must secure approval from the Georgia EPD for a plan for monitoring dissolved oxygen in the proximity of all maintenance dredging operations in the Savannah River Harbor.

Dredging operations must maintain a daily average of 5.0 mg/L and an instantaneous average of 4.0 mg/L throughout the water column during those times of year when the natural condition in the waterbody has a dissolved oxygen level above these values. If it is determined that the natural condition in the waterbody is less than these values, the criteria will revert to the "natural condition" and the water quality standard will allow for a 0.1 mg/L deficit from the "natural" dissolved oxygen value. Up to a 10% deficit will be allowed if it is demonstrated that resident aquatic species shall not be adversely affected. Since the available dissolved oxygen deficit has already been allocated, the USACE will only be able to conduct maintenance dredging when the dissolved oxygen, one meter from the bottom, is 3.0 mg/L or greater and the maintenance dredging does not affect the dissolved oxygen levels in the Savannah River Harbor. Variances for maintenance dredging when dissolved oxygen levels are less than 3.0 mg/L may be granted if the additional oxygen is effectively injected into the Savannah River Harbor as appropriate.

The USACE shall provide monitoring reports monthly due within 30 days of the end of each reporting period. Reports shall include locations of dredging by river mile station, tidal flow direction, and dissolved oxygen in the downstream tidal flow of the dredge activity.

10. Maintenance Dredging Schedules

The USACE shall provide the Georgia EPD with an annual schedule by January 1 of each year for expected maintenance dredging that provides dredge locations, times, sediment amounts and placement locations with the consideration of 401 conditions, federal funding and other applicable planning issues.

11. Restoration of Confined Disposal Facility 1S

Restoration of CDF 1S is proposed to offset unavoidable direct impacts to approximately 15.68 acres of salt/brackish marsh habitat. Up to approximately 42 acres of salt marsh will be restored at this site. Restoration of this mitigation element must comply with the USEPA and USACE Final Rule for Compensatory Mitigation for Loses of Aquatic Resources of April 10, 2008 and the Savannah District USACE, Regulatory Division Mitigation SOP.

12. Buffer Variances

Various elements of the project are going to require the USACE to be granted buffer variances from the State of Georgia. Because the USACE's Draft EIS and Draft General Re-evaluation Report (GRR) do not provide the level of design necessary for variance application submittal, as various elements move toward design and construction the USACE shall submit a buffer application to the Georgia EPD. Such elements may include, but are not limited to, shore bank stationing of oxygen injection systems, a recreational boat launch, various elements of the marsh mitigation proposal, cut closures, bank stabilization, etc. Completed applications shall be submitted 90 days prior to such land disturbing activities. In accordance with the Georgia DNR's Rules for Erosion and Sedimentation Control, once the Georgia EPD has proposed issuance of a stream buffer variance, the USACE must publish a public notice to provide a 30-day public comment period.

13. Fish Passage at the New Savannah Bluff Lock and Dam

Adequate fish passage shall be established at the New Savannah Bluff Lock and Dam to provide unencumbered movement upstream of shortnose sturgeon. Georgia EPD shall review and concur with final design prior to construction.

14. Reopener for Section 401 Certification

The project shall be periodically reviewed by the Georgia EPD and the USACE to consider new dredging technologies, shoaling rates, environmental conditions, laws, regulations, any modifications to the Draft EIS and Draft GRR, additional harbors located on the Savannah River, and any other changes to the construction, maintenance and operation of the Savannah River Harbor for the life of the project as it may effect this Section 401 Certification. It is expected that

these reviews would generally be performed every 5 years. The 401 certification will be modified as appropriate.

15. Annual meeting

This is a complex project using an adaptive management approach with potential long-term impacts. EPD and USACE will meet annually to review the status of these Water Quality Certification conditions.

This certification does not relieve the applicant of any obligation or responsibility for complying with the provisions of any other laws or regulations of other federal, state or local authorities.

It is your responsibility to submit this certification to the appropriate federal agency.

Sincerely,

F. Allen Barnes
Director

FAB:kp

cc: William Bailey, USACE
Hope Moorer, GPA
David Baize, SCDHEC
Ken Rentiers, SCDNR
Spud Woodward, CRD
John Biagi, WRD

BOARD:
Allen Amler
Chairman
Mark S. Lutz
Vice Chairman
Steven G. Kistler
Secretary

D H E C

PROMOTE PROTECT PROSPER

C. Earl Hunter, Commissioner

Promoting and protecting the health of the public and the environment

BOARD:
R. Kenyon Wells
L. Clarence Batts, Jr
Ann B. Kind, DDS
John O. Hunter, Sr., MD

Board of Health and Environmental Control; Telephone (803) 898-3309 Fax: (803) 898-3393

November 15, 2011

U.S. Mail – Certified and Electronic Mail

91 7108 2133 3938 7370 5664

Keith Klein, Acting District Counsel
US Army Corp of Engineers, Savannah District
100 East Oglethorpe Avenue
Savannah, GA 31402
Keith.J.Klein@usace.army.mil

91 7108 2133 3938 7370 5671

Susan H. Richardson, Esq.
Kilpatrick Townsend
Suite 2800 1100 Peachtree Street
Atlanta, GA 30309-4528
srichardson@kilpatricktownsend.com

Via Electronic Mail
John Harleston, Esq.
SCDHEC – Office of General Counsel
2600 Bull Street
Columbia, SC 29201
harlesj@dhec.sc.gov

RE: ***Final Review Conference - Docket No. 11-RFR-52*** *– Decision dated September 30, 2011, to deny a 401 Water Quality Certification and objection to the Federal Consistency Determination under the Coastal Zone Management Act.*

Dear Counsel:

Please find enclosed the Final Agency Decision in the above referenced matter.

Sincerely,

Lisa Lucas Longshore

Lisa Lucas Longshore
Clerk

IN THE STATE OF SOUTH CAROLINA
BEFORE THE BOARD OF HEALTH AND ENVIRONMENTAL CONTROL

FINAL AGENCY DECISION

IN RE: Savannah Harbor Expansion Project (SHEP)

Board Docket Number 11-RFR-52

Appearances:

Col. Jeffrey M. Hall, for Requestor US Army Corps of Engineers

Curtis Foltz, for Requestor Georgia Ports Authority

John Harleston, Esq. for South Carolina Department of Health & Environmental Control

---

This Final Agency Decision is issued with the consent of the Department of Health and Environmental Control staff (DHEC), the US Army Corps of Engineers (COE), and the Georgia Ports Authority (GPA) to resolve the Requests for Review presented herein regarding the Savannah Harbor Expansion Project.

DHEC staff denied COE's request for certification from DHEC under Section 401 of the Clean Water Act and for concurrence from DHEC with COE's consistency determination under the federal Coastal Zone Management Act for the Savannah Harbor Expansion Project ("the Project"). COE and GPA requested review by the Board of the staff decisions and a final review conference was scheduled before the Board at its November 10, 2011 meeting. At the conference, it was stated that DHEC staff and the Requestors, COE and GPA, reached an agreement that resolves the disputed issues among them concerning the Project, and presented the agreement to the Board for approval.

The Board finds that the agreement is consistent with the laws of the State of South Carolina and that the applicant COE is entitled to the requested approvals. The Board adopts the agreement of DHEC staff, COE, and GPA as the Final Agency Decision.

FINDINGS OF FACT

The Savannah District of the United States Army Corps of Engineers (COE) proposes to deepen the Savannah Harbor navigational channel. The Project will involve dredging the Savannah Harbor navigational channel in the Savannah River which forms the boundary between the State of Georgia and the State of South Carolina. The COE requests Section 401 Water Quality Certifications from the Georgia Department of Natural Resources (Georgia DNR) and from the South Carolina Department of Health and Environmental Control and seeks concurrence from Georgia DNR and DHEC that the Project is consistent with the States' Coastal Zone Management Programs.

On November 15, 2010, COE issued a Joint Public Notice for the Project which served as an application to DHEC for a Section 401 Water Quality Certification and Coastal Zone Management consistency determination. On January 25 and 31, 2011, DHEC's Office of Ocean and Coastal Resource Management issued letters objecting to COE's determination that the project is fully consistent with the South Carolina Coastal Tidelands and Wetlands Act and the Coastal Zone Management Program. On September 30, 2011, DHEC issued a letter reiterating that position. On September 30, 2011, DHEC also issued a Notice of Department Decision proposing to deny the application for a Section 401 Water Quality Certification.

On October 7, 2011, COE filed a timely Request for Final Review of both the proposed denial of the Section 401 Water Quality Certification and the finding that the project was not consistent with the South Carolina Coastal Tidelands and Wetlands Act and the Coastal Zone

Management Program. GPA also filed a timely Request for Review of both staff decisions. On November 3, 2011, the South Carolina Coastal Conservation League, South Carolina Wildlife Federation, and Savannah Riverkeeper filed a motion to intervene, which the Board denied.

CONCLUSIONS OF LAW

DHEC has authority under Section 401 of the Clean Water Act, 33 USC §1341, the S.C. Pollution Control Act, S.C. Code Ann. §§48-1-10, et seq., and S.C. Code R.61-101 to grant and deny certifications of projects affecting waters of the State. DHEC also has authority to certify projects affecting the Coastal Zone for consistency with the Coastal Management Program under the federal Coastal Zone Management Act, 16 U.S.C. §§1451, et seq., and South Carolina Coastal Tidelands and Wetlands Act, S.C. Code Ann. §§48-39-10, et seq. Subject to the conditions of this agreement, the Board concludes that DHEC has reasonable assurance that the Project will comply with South Carolina water quality standards, and that the Project is consistent with enforceable provisions of the Coastal Management Program.

IT IS THE FINAL AGENCY DECISION OF THE BOARD, WITH THE CONSENT OF THE PARTIES, that:

1. COE will commit to operation of the Dissolved Oxygen system as stated in the letter from Col. Jeffrey M. Hall of November 4, 2011, specifically:

> First, the project Record of Decision will expressly recognize a binding commitment to install, operate, and maintain the DO system in accordance with the project mitigation plan, subject to Congressional appropriation of funds for the project. Second, the Savannah District will make the DO system a top priority for annual operation and maintenance (O&M) funds appropriated and received for the project, above normal maintenance requirements.

2. The GPA will provide financial assurance, in a manner acceptable to DHEC, that it will fund operation and maintenance of the Dissolved Oxygen system in any year that sufficient

federal funds for the operation and maintenance of the system are not made available. This obligation extends for the life of the project (50 years). Such financial assurance may be achieved through a Standby Trust Fund, Surety Bond, Letter of Credit, Insurance, or other means deemed acceptable to DHEC. The GPA will provide the financial assurance before any dredging begins. For purposes of the COE, this offer and commitment by GPA to provide financial assurance does not constitute an item of local cooperation or cost-shared feature.

3. To address DHEC concerns about the sufficiency of mitigation for potential impacts on salt marsh, the State of Georgia agrees to transfer salt marsh to the State of South Carolina to maintain as a marsh or for the State of Georgia to preserve as marsh in perpetuity and from development an amount of acreage of salt marsh in South Carolina equivalent to 2,200 mitigation credits (generally 1,690 acres) as part of its Environmental Sustainability Program. For purposes of the COE, this offer and commitment by GPA to transfer salt marsh does not constitute an item of local cooperation or cost-shared feature.

4. COE shall comply with all terms and conditions in the National Marine Fisheries Service Final Biological Opinion.

5. To ensure protection of cultural resources, DHEC must receive an executed Programmatic Agreement for Cultural Resources signed by COE and the South Carolina Historic Preservation Office.

6. To ensure that the levels of environmental effects predicted in the Environmental Impact Statement (EIS) are not exceeded, COE will comply with the Monitoring and Adaptive Management Plan provided as Appendix D of the EIS. The Monitoring and Adaptive Management Plan will ensure the accuracy of the predicted environmental impacts, assess the effectiveness of the mitigation features, and provide for modification of the Project as needed.

7. The attached 401 certification and concurrence with COE's Coastal Management Plan consistency determination are hereby issued.

8. COE agrees that no Project dredging will begin until compliance with these conditions, and specifically that no dredging will begin until the provision by the Georgia Ports Authority of the financial assurance required above.

9. The GPA represents and agrees that it has authority to execute this agreement on behalf of itself and the State of Georgia, with regard to their respective obligations, and that its consent to this agreement fully binds the GPA and the State of Georgia to the terms of this agreement.

10. COE and the GPA acknowledge that this agreement is legally binding and DHEC may enforce their respective obligations assumed herein as necessary and appropriate in a court of law with jurisdiction.

11. Neither COE nor the GPA admits that the project as described in the Environmental Impact Statement was or is not in compliance with the requirements of the 2008 Mitigation Rule or any other applicable requirements for mitigation. The GPA and the State of Georgia agree to the additional measures required above in order to facilitate settlement of the disputes among the parties and to alleviate DHEC concerns regarding the environmental effects of the Project. DHEC understands that the COE may not include these additional measures in the Final EIS or ROD for the Project.

Allen Amsler
Chairman
Board of Health and Environmental Control
For the Board

11/15, 2011

CONSENTED TO AND AGREED BY:

John Harleston **Attorney for DHEC, Respondent**	11/15/11 **Date**
Jeffrey M. Hall. Col, US Army **For COE, Requestor**	15/NOV/2011 **Date**
Curtis Foltz **For GPA, Requestor**	11/15/11 **Date**

BOARD:
Paul C. Aughtry, III
Chairman
Edwin H. Cooper, III
Vice Chairman
Steven G. Kisner
Secretary

D H E C

PROMOTE PROTECT PROSPER

C. Earl Hunter, Commissioner

Promoting and protecting the health of the public and the environment

BOARD:
Henry C. Scott
M. David Mitchell, MD
Glenn A. McCall
Coleman F. Buckhouse, MD

November 15, 2011

US Army Corps of Engineers
PO Box 889
Savannah GA 31402-0889

Re: Certification in Accordance with Section 401 of the Clean Water Act, as amended.

US Army Corps of Engineers
Savannah Harbor Expansion Project
Savannah River
Jasper County
P/N 2010 SHEP

Dear Sir,

The Bureau of Water of the South Carolina Department of Health and Environmental Control (Department) has reviewed plans for this project and determined that there is a reasonable assurance that the proposed project will be conducted in a manner consistent with the Certification requirements of Section 401of the Federal Clean Water Act, as amended, and the permitting requirements of R. 19-450 et. seq., 1976 SC Code of Laws.

The Department issued a Notice of Department Decision proposing to deny the Certification for this project on September 30, 2011. Timely requests for review were filed with the Board of Health and Environmental Control by the US Army Corps of Engineers – Savannah District and the Georgia Ports Authority in accordance with S.C. Code Section 44-1-60. Subsequent to the filing of the requests for review, the Department and the parties entered into negotiations towards a settlement. The parties reached an agreement and the DHEC Board adopted the agreement on November 10, 2011, authorizing issuance of this certification on terms consistent with the agreement.

In accordance with the provisions of Section 401, we certify that this project, subject to the indicated conditions, is consistent with applicable provisions of Section 303 of the Federal Clean Water Act, as amended. We also hereby certify that there are no applicable effluent limitations under Sections 301(b) and 302, and that there are no applicable standards under Sections 306 and 307.

This certification is subject to the following conditions:

1. The project must comply with the terms and conditions of the Final Agency Decision of the Board of Health and Environmental Control signed on November 15, 2011.

2. The project must comply with the terms and conditions of the Water Quality Certification issued on February 16, 2011, by the Georgia Department of Natural Resources.

The Department reserves the right to impose additional conditions on this Certification to respond to unforeseen, specific problems that may arise and to take any enforcement action necessary to ensure compliance with State water quality standards.

Sincerely,

Heather Preston, Director
Division of Water Quality
Bureau of Water

cc: U.S. Army Corps of Engineers,
Charleston District Office
SC DHEC, Beaufort EQC Office District Office
SC DHEC, OCRM

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
COASTAL RESOURCES DIVISION

MARK WILLIAMS
COMMISSIONER

A.G. "SPUD" WOODWARD
DIRECTOR

January 25, 2011

Mr. William Bailey
Attn: PD, USACE, Savannah District
100 West Oglethorpe Avenue
Savannah, Georgia 31401-3640

RE: SHEP Tier II DEIS & GRR, Savannah Harbor Deepening Project, Federal Consistency Determination

Dear Mr. Bailey:

Staff of the Georgia Coastal Management Program (GCMP) has reviewed your November 15, 2010 letter and attached Savannah Harbor Expansion Project (SHEP) Tier II Draft Environmental Impact Statement (DEIS) and General Re-Evaluation Report (GRR) to determine the Savannah Harbor Expansion Project's consistency with the Georgia Coastal Management Program. The Federal Coastal Zone Management Act, 16 USC 1451 et seq., as amended, requires each Federal agency activity performed within or outside of a state's coastal zone boundary that affects land or water uses, or natural resources of the coastal zone, to be carried out in a manner that is consistent to the maximum extent practicable with the enforceable policies of the approved coastal management program.

Georgia Coastal Management Program staff has worked for years with staff of the Corps, Georgia Department of Transportation, stakeholder groups, the City of Tybee and those with a vested interest in the project and especially the disposition of dredged material from the project, and the public. Program staff appreciates the access to Corps staff that has been afforded throughout the project development process.

The documents describe six harbor deepening plans. Alternative A is a No Action Alternative that maintains the current harbor depth at –42 feet mean low water. Alternative B dredges to –44 feet mean low water. Alternative C dredges to –45 feet mean low water. Alternative D dredges to –46 feet mean low water. Alternative E dredges to –47 feet mean low water and is the National Economic Development (NED) plan. Alternative F dredges to –48 feet mean low water and is the recommended plan of the non-federal sponsor of the project, the Georgia Department of Transportation (GaDOT). In addition to the dredging plan alternatives, the documents also describe, in varying levels of detail, dredged material disposal alternatives, positive and adverse impacts of the project, and the mitigation of adverse impacts.

In general, the proposal to deepen the Savannah Harbor by dredging to any of its alternative depths, as described above, is consistent with the enforceable policies of the Georgia Coastal Management Program. The Georgia Coastal Management Program especially supports dredging

ONE CONSERVATION WAY | BRUNSWICK, GEORGIA 31520-8686
912.264.7218 | FAX 912.262.3143 | WWW.COASTALGADNR.ORG

the project to –48 feet mean low water, the recommended plan of the non-federal sponsor of the project, GaDOT. However, the disposition of dredge materials is not described with sufficient detail, clarity, or finality for a determination to be made at this time that the dredged material placement portion of the project is consistent with the enforceable policies of the Georgia Coastal Management Program. Also, Georgia DNR's Environmental Protection Division and Wildlife Resource Division are submitting comments that will likely affect the GCMP's final federal consistency determination letter.

A particular concern at this time is that the described project would place **new work dredge material** in nearshore areas that could have adverse affects to the City of Tybee Island's economic and environmental interests. The City has determined that new work dredge material proposed for placement is unsuitable for placement in state waters. The State supports Tybee's position and finds that placement of dredge material at locations in state waters that would be adverse to the quality of the Tybee nearshore environment and/or its beach nourishment borrow site is not acceptable.

Further, placement of **new work dredge material** in federal waters outside of the Environmental Protection Agency (EPA) Approved Ocean Dredge Material Disposal Site (ODMDS) is likely to cause long-term adverse impacts to marine habitat, commercial and recreational offshore fishing, and cultural resources. Enhanced fish habitat benefits will be short lived from placement at sites outside of the ODMDS. Prevailing currents will quickly dissipate the materials. The State's experience with placing concrete rubble on offshore artificial reefs, as proposed, has been that the rubble quickly settles into the sea floor without retaining the mounded sand beneath. Also, two unmarked structures exist in close proximity to proposed dredge disposal Site #11 and Site #12 (a plane and a vessel) that are currently targeted by anglers and could be negatively impacted by shifting dredge materials. Therefore, disposal at Sites #11 and #12 should not occur. It is unknown if other hard bottom habitats exist nearby which could also be negatively impacted by placement of dredge materials.

New work material from the Outer Channel Extension (Station -57+000B to Station -98+600B, estimated volume = 4,652,033 cubic yards), located in Federal water but not proposed for beach replenishment, is expected to meet City of Tybee suitability criteria for nearshore placement (≤ 10% fines and minimal marine clays). Nearshore placement and beneficial use of these materials would allow the Corps to accomplish several objectives stated in the DEIS:

a. Offset deflation of the Tybee shelf and beach caused by historic construction and maintenance of the Harbor;
b. Meet environmental management and restoration measures set out in the Long Term Maintenance Strategy (LTMP) and Dredge Material Management Plan (DMMP);
c. Mitigate environmental consequences; and
d. Improve sustainability of the navigation project and the shore protection project.

The project GRR indicates that all future **maintenance dredging** will be performed by hopper dredge and in all probability taken to the ODMDS. Maintenance material excavated by hopper dredge having overflow capability that separates fine grained fractions could be highly suitable for both nearshore and potentially onshore placement on Tybee Island. The proposal notes that some 325,000 cubic yards of sediment excavated annually between Stations -30+000B and -

40+000B could be recovered and placed in a beneficial manner by a hopper dredge with pump-out capability. The City of Tybee Island has determined that this is acceptable and the State supports that determination and disposal alternative. Further, the possibility of beneficially using material from the Jones/Oysterbed area should be explored.

Based on the above, the project's compliance with the River and Harbor Development Act needs to be redressed. We believe that Outer Channel Extension new work dredged material, and Operation and Maintenance materials from Station –30+000B to –40+000B and Jones/Oysterbed (Station +28+000 to 0+000) are suitable for beach replenishment. To determine the feasibility of using these materials for beach replenishment, the costs or savings to the project, irregardless of how those costs might be met, must be identified and provided to the State.

The Program looks forward to working with the Corps to resolve these matters discussed above and is committed to doing so as quickly as possible. Please feel free to contact Kelie Moore at 912-262-2334 or me at 912-262-3130 if you have questions, need of additional information, or if we can be of additional assistance.

Sincerely,

B. Gane

Brad Gane, Chief
Ecological Services Section

cc: Mayor Jason Beulterman, City of Tybee Island
Allen Barnes, Ga DNR EPD
Dan Forster, Ga DNR WRD

D H E C

PROMOTE PROTECT PROSPER

C. Earl Hunter, Commissioner

Promoting and protecting the health of the public and the environment.

November 15, 2011

Colonel Jeffrey M. Hall, District Commander
U.S. Army Corps of Engineers, Savannah District
P.O. Box 889
Savannah, Georgia 31402-0889

Re: Savannah Harbor Expansion Project (SHEP) – Federal Consistency Determination

Dear Colonel Hall:

Based on the executed consent agreement entered into by SCDHEC, US Army Corps of Engineers and the State of Georgia, SCDHEC-OCRM removes its objection to the Corps finding of Consistency for the SHEP.

Sincerely,

Carolyn Boltin-Kelly

Carolyn Boltin-Kelly, Deputy Commissioner
SCDHEC- Office of Ocean and Coastal Resource Management

cc: Earl Hunter, Commissioner, SCDHEC

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
Ocean and Coastal Resource Management
Charleston Office • 1362 McMillan Avenue • Suite 400 • Charleston, SC 29405
Phone: (843) 744-5838 • Fax: (843) 744-5847 • www.scdhec.gov

GEORGIA
DEPARTMENT OF NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION

MARK WILLIAMS
COMMISSIONER

DR. DAVID CRASS
DIVISION DIRECTOR

November 21, 2011

Mr. William Bailey
ATNN: PD
US Army Corps of Engineers
Savannah District
100 West Oglethorpe Avenue
Savannah, Georgia 31401-3640
CESAS-PD@usace.army.mil

RE: Programmatic Agreement - Final
Savannah Harbor Navigation Channel Project
Chatham County, Georgia
HP-911120-001

Dear Mr. Bailey:

The Historic Preservation Division (HPD) has received the Programmatic Agreement (PA) for the above referenced undertaking in Chatham County, Georgia. Our comments are offered to assist the US Army Corps of Engineers (USACE) in complying with Section 106 of the National Historic Preservation Act of 1966, as amended.

As previously stated, HPD agrees that the stipulations of the PA are adequate to address adverse effects associated with this undertaking. Therefore, I have signed the agreement and am forwarding it to your office for review and further processing.

If you have any questions, please contact Elizabeth (Betsy) Shirk, Environmental Review Coordinator, at 404-651-6624 or via email at elizabeth.shirk@dnr.state.ga.us.

Sincerely,

Dr. David Crass
Division Director
Deputy State Historic Preservation Officer

DC/ECS

Enclosure

cc: Lupita McClenning, Coastal Georgia RC
PA File

The South Carolina Archives & History Center
History & Heritage For All Generations

November 30, 2011

Mr. William Bailey
Chief, Planning Division
Corps of Engineers, Savannah District
100 W. Oglethorpe Ave.
Savannah, GA 31401-3640

Re: Savannah Harbor Expansion Project
Jasper County, South Carolina
SHPO Project No. 03-VM0063

Dear Mr. Bailey:

Enclosed please find our signature on the programmatic agreement for the above-referenced project. This programmatic agreement will govern the future consultation, historic property identification, and mitigation for historic properties in South Carolina and Georgia. Please provide our office with a copy of the executed agreement.

We look forward to continuing to work with the Corps of Engineers on this project. If you have any questions, please contact me at (803) 896-6183 or dobrasko@scdah.state.sc.us.

Sincerely,

Rebekah Dobrasko

Rebekah Dobrasko
Supervisor of Compliance, Tax Incentives, and Survey
State Historic Preservation Office

cc: Barbara Neale, DHEC-OCRM (via e-mail)

S. C. Department of Archives & History • 8301 Parklane Road • Columbia • South Carolina • 29223-4905 • (803) 896-6100 • http://scdah.sc.gov

STATE AND AGENCY COMMENTS REGARDING
THE PROPOSED REPORT OF THE CHIEF OF ENGINEERS AND THE REPORT OF THE DISTRICT ENGINEER ON THE

SAVANNAH HARBOR EXPANSION PROJECT
Chatham County, Georgia and Jasper County, South Carolina

US Army Corps of Engineers
Savannah District
South Atlantic Division

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

June 5, 2012

Colonel Jeffrey M. Hall
District Engineer
U.S. Army Corps of Engineers
Savannah District
100 West Oglethorpe Avenue
Savannah District, Georgia 31401-3640

ATTN: Mr. Bill Bailey, Chief of the Planning Division

SUBJ: **EPA Review of COE's "Savannah Harbor Expansion Project" (January 2012); Final Environmental Impact Statement (FEIS); Chatham County, Georgia and Jasper County, South Carolina; CEQ No. 20120103; ERP No. COE-E32083-00**

Dear Colonel Hall:

Pursuant to Section 102(2)(C) of the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act (CAA), the U.S. Environmental Protection Agency (EPA) Region 4 has reviewed the subject U.S. Army Corps of Engineers (COE), Savannah District, Final Environmental Impact Statement (FEIS) for the Savannah Harbor Expansion Project (SHEP), dated January 2012, which we received on April 12, 2012. The project is proposed by the Georgia Ports Authority (GPA) of the Georgia Department of Transportation, the non-federal project sponsor (sponsor). EPA notes that this FEIS was developed to disclose the economic and environmental impacts associated with deepening the inner harbor and entrance (ocean bar) navigation channel to alternative incremental depths of up to -48 feet (ft) Mean Low Water (MLW), with an additional 2 ft allowable over depth dredging and 6 ft advance maintenance dredging (depending upon the location). EPA also notes that the COE has identified the 47-foot depth alternative as the National Economic Development (NED) Plan – "the plan that maximizes net economic benefits to the Nation and fully complies with Army policy." The responsible lead agency is the US Army Engineer District, Savannah, and the Cooperating Agencies are the Environmental Protection Agency (Region 4), the Department of Commerce (acting through the National Marine Fisheries Service), the Department of the Interior (acting through the US Fish and Wildlife Service).

The Savannah Harbor was last deepened in 1994 to -42 ft, and in 1999 the Water Resources Development Act (WRDA 1999) authorized the COE to dredge Savannah Harbor to a maximum depth of -48 ft ("Maximum Authorized Plan"), which is a -6 ft deepening of the existing conditions. WRDA 1999 requires that the authorized project may be carried out only after the Secretary of the Army, in consultation with affected Federal, State of Georgia,

State of South Carolina, regional, and local entities, reviews and approves an environmental impact statement (EIS) for the project that includes the following:

- an analysis of the impacts of project depth alternatives
- ranging from 42 feet through 48 feet; and
- a selected plan for navigation and an associated mitigation plan as required under section 906(a) of the Water Resources Development Act of 1986 (33 U.S.C. 2283(a));

WRDA 1999 also requires that the Secretary of the Interior, the Secretary of Commerce, the Administrator of the EPA, and the Secretary of the Army approve the selected plan and determine that the associated mitigation plan adequately addresses the potential environmental impacts of the project.

The NEPA process for SHEP has been extensive, and includes a number of earlier studies and technical reports. Initial NEPA efforts included the development by the Savannah District of a "Tier I" EIS (1998), which drew heavily upon a previous GPA feasibility study. While the Tier I EIS provided information analyzing the impacts of a proposed harbor deepening, it did not address all of the concerns and issues raised by the resource agencies. This led to the Savannah District initiating the development of the more detailed "Tier II" EIS and GRR (in early 2002), including the holding of public scoping meetings. Approximately ten years of technical field studies, economic and environmental modeling, and scientific and engineering analyses have been conducted since 2002 as part of the Tier II EIS process, involving the study of water quality (including dissolved oxygen and salinity), wetlands and aquatic ecosystems, sediments, fisheries, drinking water supplies, cultural and archeological resources, hydrology, hydraulics, air quality and other important factors affected by the proposed harbor deepening. As part of the EIS process, numerous detailed studies (over 40 different reports including many computer models) have been developed. EPA has also participated in many of the different types of stakeholder and collaborative EIS development team meetings that have occurred during this 10 year period. Some of these groups have held numerous meetings, such as the Stakeholders Evaluation Group (the "SEG").

The FEIS has been developed from response to comments received on the DEIS, including comments from EPA and the other Cooperating Agencies, as well as the public review, the COE Headquarters Policy Review, the COE Agency Technical Review, and an Independent External Peer Review by the Battelle Memorial Institute. EPA notes the following changes between the DEIS and the FEIS, many of which relate to issues raised in response to previous comments from EPA and the other Cooperating Agencies.

- Incorporating a larger fish passage design at the New Savannah Bluff Lock and Dam near Augusta, Georgia, as mitigation for impacts to habitat of the endangered Shortnose sturgeon.
- Removal from the project of the construction of an underwater sill in the Lower Middle River.
- Increasing Post-Construction Monitoring from 5 to 10 years for several elements.
- Adding two Speece cones to the Dissolved Oxygen Injection System.

- Completing an additional evaluation of chloride impacts on the City of Savannah's Abercorn Creek intake and adding mitigation for those impacts.
- Removing nearshore placement of new work dredged sediments near Tybee Island, Georgia from the project.
- Adding real estate to address additional fish passage and chloride mitigation needs.
- Increasing construction management costs to address additional fish passage and chloride mitigation needs.
- Increasing the amount of Planning, Engineering and Design costs across all project features and to address additional fish passage and chloride mitigation needs.
- Updating costs from October 2010 to October 2011 price levels.
- The economic analysis in the draft report depended on data and information from vessel operations and forecasts up through 2007 and 2008. The FEIS incorporates vessel operations information and forecasts available through 2010. Key elements incorporated include establishing a new baseline for forecasting commodity flow and traffic, updating the world fleet and Savannah vessel call information, including vessel operating costs, and inclusion of Post-Panamax Generation 2 vessels in the "without-project" condition.
- Changes made to the Final GRR and DEIS that did not affect project costs or benefits include updating the air quality evaluation, incorporating the conditions from the National Marine Fisheries Service Final Biological Opinion, conducting additional dissolved oxygen modeling in shallow areas, and documenting interagency coordination from November 2010 to the present.

The following summarizes EPA's major technical areas of concern and summarizes EPA's remaining comments on the FEIS. Additional suggestions and recommendations are provided for implementation of the project in an environmentally protective and sustainable manner.

EPA's FEIS Comments and Recommendations

1. Water Quality, Dissolved Oxygen (DO), and Modeling Issues

The Harbor is impaired for dissolved oxygen due to historical deepening projects and a large number of dischargers of biological oxygen demanding substances into the Harbor, which cause the dissolved oxygen levels in the Harbor to drop to very low levels in the summer months. As part of the NEPA process, the COE has intensively investigated measures to address additional impacts to dissolved oxygen levels in the harbor that will result from the proposed additional harbor deepening. Based on the existing dissolved oxygen impairment, EPA developed and finalized a Total Maximum Daily Load (TMDL) based on Georgia's then-applicable water quality standard (WQS) for dissolved oxygen in 2006. The TMDL requires a "zero discharge" of biological oxygen demanding substances into and upstream of the Harbor. In April 2010, Georgia revised their WQS for dissolved oxygen to be consistent with South Carolina's approved WQS. Since that time, EPA has been working closely with Georgia and South Carolina to develop a new TMDL consistent with the revised WQS. As reflected in a revised draft TMDL issued by EPA for public comment in May 2010, Georgia's new WQS will allow for some loadings of oxygen demanding

substances into the harbor, but the existing harbor dischargers will still be required to considerably reduce their existing permitted loads. EPA is continuing to work with South Carolina and Georgia to determine the best approach to revise the 2006 TMDL and address the continued impairment of the new WQS. The findings of studies conducted for the Savannah Harbor Ecosystem Restoration Study were incorporated into analysis of the harbor deepening project, which included examining 25 different methods of improving DO levels in Savannah Harbor.

After significant engineering analysis, computer modeling, and a full scale demonstration project, the COE, in collaboration with EPA, the states, and other federal agencies, has concluded that oxygen injection, using "Speece Cones" with supporting equipment, is the most cost-effective method for raising DO levels in the harbor during the summer months. The COE has proposed placing these oxygen injection systems on the land at up to four locations. Given that the additional deepening of the Harbor will create a permanent additional impact to dissolved oxygen levels in the Harbor, EPA has requested strong financial assurances to ensure the operation of these systems throughout the life of the project (identified in the FEIS as 50 years).

In response to EPA's comments on the issue of funding of operation and maintenance of speece cones for the life of the project, COE stated that it agreed to operate and maintain the mitigation features as described in the FEIS throughout the project's life. For example, as part of the conditions placed upon the project by SCDHEC through the State's Section 401 Certification, dated November 15, 2011, the GPA has agreed to provide financial assurance in the event that federal funding for the oxygenation system is insufficient in any year. Specifically, South Carolina's 401 Certification provides that "[t]he GPA will provide financial assurance, in a manner acceptable to DHEC, that it will fund operation and maintenance of the Dissolved Oxygen system in any year that sufficient federal funds for the operation and maintenance of the system are not made available. This obligation extends for the life of the project (50 years). Such financial assurance may be achieved through a Standby Trust Fund, Surety Bond, Letter of Credit, Insurance, or other means deemed acceptable to DHEC. The GPA will provide the financial assurance before any dredging begins. For purposes of the COE, this offer and commitment by GPA to provide financial assurance does not constitute an item of local cooperation or cost-shared feature." This level of financial assurance provides greater certainty that operations and maintenance costs will be covered through the life of the project.

2. Aquatic Issues

For the 47-ft deepening alternative supported by the sponsor, direct impacts to wetlands include 15.68 acres of brackish marsh wetlands by excavation and 223 acres of indirect impacts to freshwater wetlands due to salinity changes (as noted in the FEIS Appendix C). To mitigate for the direct impacts, the Savannah District's Standard Operating Procedure for Compensatory Mitigation (SOP) indicated that approximately 28.8 acres of restored saltmarsh would be required. The Corps intends to restore approximately 40.3 acres of brackish marsh at Disposal Area 1S, which is located within the boundaries of the Savannah National Wildlife Refuge (SNWR). The Savannah District proposes to mitigate the

indirect impacts through the preservation of 2,245 acres of wetlands (consisting of bottom land hardwoods and upland buffer in SNWR).

EPA's primary concerns expressed in our DEIS comments were related to the District's proposed mitigation approach (use of the Savannah District Mitigation SOP), the adequacy of the mitigation, and the proposed mitigation monitoring and adaptive management plans. In response to concerns expressed by EPA over the use of the SOP for large scale projects, the Savannah District conducted consultations with the COE's Center of Expertise for Ecosystem Restoration (Center) to analyze the use of the SOP as an appropriate method of determining the amount of acres that would need to acquire and preserve in order to compensate for adverse impacts to wetlands from SHEP. In response to concerns expressed regarding the adequacy of the mitigation proposed, the Savannah District provided an analysis (Consideration of USEPA/USACE Final Mitigation Rule) and determined that the mitigation-to-impacts ratio to be approximately 10:1 which would be consistent with the 2008 Mitigation Rule. The District also points out that these wetlands would still provide some of the ecological functions associated with emergent wetland systems. The Savannah District acknowledged that there was uncertainty about the degree to which conversion will ultimately occur, pointing to the need for monitoring and adaptive management for this project. Therefore the District provided a monitoring and adaptive management plan in the FEIS (Appendix D). EPA also believes that the development of a monitoring and adaptive management plan is an important step in satisfying our concerns outlined in our DEIS comments regarding wetland and water quality mitigation. To ensure that the adaptive management and monitoring plan is fully implemented, EPA supports the establishment of an Interagency Adaptive Management Team. EPA also recommends specific time frames for receiving and reviewing monitoring data, and developing an implementation strategy to be carried out by the COE in the event adaptive management actions are required.

In summary, while EPA expressed concerns in our comment letter on the DEIS concerning the COE's wetlands analysis and overall proposed mitigation plan, our concerns with the planned mitigation are addressed when considered in association with monitoring and adaptive management to address the uncertainty over conversion. Due to the unique nature of SHEP's impacts (potential vegetative conversion), and the uncertainty associated with the mitigation, the COE has developed an extensive monitoring program to quantify the magnitude of the marsh conversion that does occur. If impacts to tidal freshwater marsh exceed those expected, funds would be made available to purchase additional lands for preservation as noted in the Monitoring and Adaptive Management Plan.

3. Section 103 (Sediment) Issues

The FEIS includes information related to the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA, also known as the Ocean Dumping Act or ODA). MPRSA governs disposal of dredged material in ocean waters along with EPA's regulations and criteria established at 40 CFR Parts 220-229. If determined to meet EPA's Ocean Dumping Criteria, the FEIS proposes disposal of sediments dredged from Stations +4+000 to -97+680B into the Savannah Ocean Dredged Material Disposal Site (ODMDS). The COE proposes that the ODMDS receive both new work and maintenance sediments from the entrance channel,

and the COE is currently working with EPA on remaining Section 103 issues, including a determination as to whether the sediments meet EPA's Ocean Dumping Criteria for placement into the Savannah ODMDS. It is EPA's position that the proposed dredged material does not meet any of the exclusionary criteria and therefore must undergo testing and evaluation in accordance with the 40 CFR Parts 220-229. Samples of bottom sediments from the excavation area in the existing entrance channel have recently been tested to evaluate contaminants which may be present in new work sediment materials. Additional sampling and testing (bioaccumulation studies) for the existing channel and extension of the harbor entrance channel have been completed to evaluate whether the new work material complies with the Ocean Dumping Criteria and is suitable for placement in the Savannah ODMDS. The results of these analyses were used to prepare a Section 103 Evaluation for SHEP, which the COE provided to EPA Region 4 on May 25, 2012, accompanied by a request that EPA concurs with the COE's determination regarding the suitable disposal of the dredging sediments from Stations +4+000 to -97+680B.

4. Air Emissions Inventory and Air Toxics Issues

As part of the NEPA process for evaluating the potential environmental impacts resulting from SHEP, the Savannah District completed an air quality analysis in 2006 and a more detailed assessment in 2010. The 2006 report described the air emissions associated with container vessels that were utilizing GPA's Garden City and Ocean Terminals in Savannah Harbor. Emission estimates for those operations were presented in the report for the period 2004 through 2050, both with and without implementation of the proposed harbor deepening project. The 2010 assessment expanded the Corps 2006 air quality analysis to the entire harbor to more completely assess air quality impacts from the proposed harbor deepening. This more detailed assessment evaluated the air emissions from all cargo-carrying vessels and landside cargo handling equipment at both the GPA and privately-operated terminals at the port. In accordance with the requirements of NEPA, it also compared emissions for both the "with" and "without project" (No Action) alternatives.

In addition to EPA's recommended criteria pollutants, estimates of "air toxics" emitted at the port were also calculated. In the 2006 and 2010 studies, port related annualized emissions were estimated for current and future years, and in with respect to future years, compared with asynchronous estimated annualized emissions in Chatham County as a whole. And while the 2010 report was expanded in scope and more detailed in nature than the 2006 report, EPA noted that it was prepared using a "mid tier" approach to an emissions inventory in which average vessel, vehicle, and other equipment characteristics and usage were used to compile the inventory. To address EPA's remaining concerns regarding an effective emissions inventory for SHEP and to supplement the 2006 and 2010 studies, GPA commissioned (2011) and is currently funding the Georgia Institute of Technology (Georgia Tech) to conduct a $250,000 follow-up study to the FEIS known as "Detailed Criteria and Hazardous Air Pollutant Emission Inventories for the Ports of Savannah and the Savannah Metropolitan Area." EPA still prefers that this emission inventory be used to conduct a screening level air toxic assessment consistent with our previous comments.

EPA also notes that there may be specific air quality improvement strategies that although they may not be cost effective at present, merit consideration by GPA in the future. EPA recommends that the following Special Conditions be included in the SHEP ROD to facilitate a more environmentally sustainable project:

- When electrifying Ship-to-Shore (STS) gantry cranes, GPA should ensure that the power supply and related hardware is adequate to install shore power at a future date if warranted by the dwell time of the vessels.
- GPA should work to provide non-monetary incentives to the drayage truck fleet that is part of the "SmartWay" Drayage program.
- GPA should work with companies when designing the distribution center to ensure that idling is minimized through installation of shore power, signage, and/or providing a designated room for drivers, so the drivers can wait in this room while waiting to pick up containers, rather than idling in their trucks.

Finally, as an outgrowth of the studies completed by the COE and the work underway by GPA, EPA Region 4, in collaboration with the EPA Office of Research and Development (including both the National Risk Management Laboratory and the National Exposure Research Laboratory), is currently developing several collaborative research projects that are very relevant to SHEP, with a goal of ultimately developing strategies for improving air quality for sensitive populations near the port. The projects being considered include an evaluation of local-scale air quality impacts from port-related emissions, as well as implementing a low cost, continuous measurement of air pollution in local environmental justice (EJ) communities around the port.

5. Community Outreach Issues

As required under NEPA, over the last 15 years the COE has made substantial efforts both to inform the public as well as receive public comments, while working closely with the SEG, local communities, and State and Federal resource agencies regarding many complex issues associated with the proposed harbor deepening. EPA notes that these efforts have incorporated the use of the latest technology and social media, including use of large E-mail distribution lists, Twitter messaging, Youtube videos, a website dedicated to the project, and PowerPoint presentations and reports available on the web for download. As previously mentioned in this letter, since 1999 the Corps has met with the SEG approximately 70 times to discuss SHEP. In addition to the NEPA required public scoping meeting on February 21, 2002 and the scoping meeting on April 12, 2002, a number of other meetings with the public and agencies have discussed critical project issues including "salinity, Dissolved Oxygen (DO) levels, conversion of freshwater to brackish marsh, nekton, benthos, contaminated sediments, economics, and other impacts related to the proposed harbor deepening." EPA notes that a NEPA public information meeting was held 30 days after release of the DEIS to provide opportunity for public and agency input.

EPA FEIS Conclusions

EPA notes that the FEIS substantially addresses most of our technical concerns over SHEP's impacts and provides important additional information that we requested, including a recommendation that an interagency team be created to work with the COE and GPA. Therefore, EPA requests that the COE address these following issues and comments, and document the results in the ROD:

- **Monitoring:** Pre-Construction Monitoring should be used to establish the baseline data bank for the Savannah Harbor estuary to assist with impact assessment during the Construction Monitoring and Post-Construction Monitoring phases of the project. The Monitoring should establish ranges of acceptable performance parameters for the Savannah Harbor estuary.
- **Adaptive Management:** This program should have three components, each with their own goal. The first component should consist of evaluating the accuracy of the predicted environmental impacts. The corresponding goal is to improve the predictive capability of the models used to identify and quantify project-induced impacts. The second component should consist of assessing the effectiveness of the mitigation features. The final component should include modifying the project as needed to ensure the levels of environmental effects predicted in the EIS are not exceeded.
- **Financial Assurance:** The adequacy of the financial assurance to ensure continued operation of the oxygenation system throughout the life of the project is critical to protecting the water quality of the Harbor, and ensuring that the additional deepening does not further contribute to the ongoing dissolved oxygen impairment. EPA wants to ensure that appropriate documentation of the financial assurance being put forth on the project is available from all related entities. EPA also requests a role in the review and approval of the adequacy of the specific financial assurance mechanism(s) proposed by GPA prior to the initiation of any dredging.
- **Completion of the 103 Process:** EPA will review the submitted Section 103 Evaluation for completeness, conduct an evaluation of the results and make an independent determination of compliance with the Ocean Dumping Criteria. Additionally, the required Site Management and Monitoring Plan for the Savannah ODMDS must be completed and signed by EPA and COE before EPA can issue a concurrence for disposal of material from the SHEP into the Savannah ODMDS. Any portions of this material that fail to meet the Ocean Dumping Criteria must be placed within an upland Confined Disposal Facility (CDF) that has sufficient capacity for the volume of proposed dredged material that fails to meet the Ocean Dumping Criteria.
- **Air Issues:** EPA appreciates GPA commissioning the current Georgia Tech study, which builds upon the previous air quality impact assessments by developing a detailed spatial, temporal, and chemically speciated emission inventory for the Savannah Harbor, including all activities related to GPA's Garden City and Ocean Terminals, and the other privately-owned terminals in the Port of Savannah. Additionally, contemporaneous inventories are also being developed for the Savannah metro area so that harbor emissions may be more readily and directly evaluated in the larger air quality context. EPA recommends that the current air study being conducted by Georgia Tech continue as a way to build upon the previous studies and provide a

basis for understanding the Savannah Harbor emissions within the context of the larger metro area.

- **Environmental Justice:** The FEIS indicates that no significant adverse impacts to communities with EJ concerns are anticipated with the port expansion project and ongoing port activities. EPA's recommended strategies include the formation of a formal community advisory group (CAG) with neighboring communities that meets periodically to identify and address community concerns or recommendations that may arise associated with ongoing port activities. To assure community residents living in close proximity to port and transportation corridor that the port's future growth and expansion efforts will not result in substantive localized impacts (i.e., air, traffic), a monitoring program should also be established. Finally, EPA recommends that GPA develop strategies to support or establish local jobs training programs that are targeted at communities with EJ concerns, with a goal of creating opportunities for residents living in close proximity to the port to effectively compete for future port-related employment.

EPA appreciates the opportunity to review the FEIS and the extensive opportunities for collaboration with the COE. We also appreciate the ability to work closely with the USFWS, NMFS, GADNR, SCDNR, SCDHEC, and many other stakeholders and community organizations in order to develop innovative environmental solutions for a range of SHEP issues. Should you have questions regarding our comments or would like to discuss our sustainability recommendations, please contact me at 404-562-9611 or mueller.heinz@epa.gov.

Sincerely,

Heinz J. Mueller, Chief
NEPA Program Office

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
(727) 824-5312; FAX 824-5309
http://sero.nmfs.noaa.gov

F/SER31:KD

JUN 05 2012

Colonel Jeffrey M. Hall, USA
District Commander
U.S. Army Engineer District, Savannah
ATTN: PD
Post Office Box 889
Savannah, Georgia 31402-0889

Dear Colonel Hall:

The NOAA Fisheries Service, Southeast Region (NMFS), has reviewed the Final Environmental Impact Statement (FEIS) for the Savannah Harbor Expansion Project, issued on April 11, 2012. We note all of the requested changes provided in our February 17, 2012, letter concerning the draft FEIS have been incorporated. We thank you for incorporating those changes. However, apart from our February 17 comments, we note a few discrepancies in the FEIS. While these discrepancies do not change the intent of the document, they could cause confusion to some of its readers. The enclosed comments describe these discrepancies between the DEIS and FEIS and suggest corrections meant to improve the FEIS. For the record, we request that these items be addressed by the Army Corps or at least duly noted. In addition, we provide one comment on the proposed Chief of Engineers Report, and use this opportunity to update the Corps on the status of our Endangered Species Act consultation on the Savannah Harbor Expansion Project.

We have not previously provided comments on the proposed report of the Chief of Engineers. We request a modification of paragraph 5.e., to reflect our understanding of operation and maintenance funding for the project's mitigation features. Based on conversations over several regional Executive Steering Committee meetings for the project, we understood that operation and maintenance funds, which will be determined by future appropriations, will be prioritized to ensure proper functioning of required environmental mitigations (e.g., the Speece oxygen injection cones and the fish passage) over other navigation features (e.g., maintenance dredging). The final sentence of paragraph 5.e., states that operation and maintenance for the environmental mitigation features will be handled "in the same manner" as other navigation features. We request this language be modified to clarify that the Corps will first ensure the proper functioning of the environmental mitigations in applying future funding for project operation and maintenance.

In addition, we wish to take this opportunity to update the status of our Endangered Species Act consultation on the Savannah Harbor Expansion Project. For Atlantic sturgeon, we issued a conference opinion for the South Atlantic Distinct Population Segment (DPS), which was proposed to be listed as endangered. The final listing of the South Atlantic DPS of Atlantic

sturgeon as endangered subsequently became effective on April 6, 2012. Regulations at 50 CFR 402.10 (d) provide, "An opinion issued at the conclusion of the conference may be adopted as the biological opinion when the species is listed...but only if no significant new information is developed...and no significant changes to the Federal action are made that would alter the content of the opinion." Based on our review of the FEIS, these criteria have been satisfied. Therefore, NMFS is adopting the conference opinion for the South Atlantic DPS of Atlantic sturgeon as the biological opinion for that species. The incidental take statement provided for Atlantic sturgeon is also now in effect. We request the Record of Decision and final report from the Chief of Engineers also include specific mention of Atlantic sturgeon together with existing references to shortnose sturgeon.

Our primary contact for endangered species issues associated with the Savannah Harbor Expansion Project is Ms. Kay Davy. She may be reached by phone at (954) 356-6791 or by e-mail at Kay.Davy@noaa.gov. Questions regarding essential fish habitat issues may be addressed to Dr. Pace Wilber at (843) 762-8601 or by e-mail at Pace.Wilber@noaa.gov. Thank you for your continued cooperation in the conservation of listed species and habitats.

Sincerely,

Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosures

cc: F/SER – Croom, Lugo, Keys
F/SER3 – Bernhart, Hoffman, Tortorici, Davy
F/SER4 – Fay, Wilber

File: 1514-22. f.3

NMFS - Protected Resources Division supplemental review of the Savannah Harbor Expansion Project - Final Environment Impact Statement (FEIS)

The following additional comments are associated with our review of the FEIS for the Savannah Harbor Expansion Project (SHEP) issued on April 11, 2012. They are intended to supplement the comments we previously provided on the draft FEIS. Our comments on the draft FEIS, dated February 17, 2012, primarily pertained to the incorporation of all of the specific terms and conditions and conservation measures intended to assure that the impacts of the project do not threaten the continued existence of the endangered species under our purview.

- In the FEIS, all of the figures depicting the conceptual design for the off-channel rock ramp fish passage describe the steel sheet pile guide wall's top elevation above the channel bottom as being 4 inches; this should be corrected to 4 feet. The figures with the incorrect height appear in Appendix C (Mitigation Planning) on page 75 as Figure 26 and on page 130 as Figure 48, in Appendix L (Cumulative Impacts Analysis) on page 98 as Figure 11, in Section 5 on page 5-120 as Figure 5-52, in Appendix B (Biological Assessment) on page 177 as Figure 8-19, and on page 235 of the GRR Appendix C. Note: all of the figures in the draft FEIS had the top elevation of the guide wall at the correct height (4 feet), and not 4 inches.

- The reasonable order of magnitude cost estimate for the off-channel rock ramp fish passage was stated as $26 million on pages 77 and 80 of Appendix C, but on page 97 of Appendix L the cost estimate is shown as $32 million in Table 22. The $32 million cost estimate also appears in Table 8-16 of Appendix B on page 176. The cost estimate in Appendix C should be corrected to $32 million.

- The list of threatened and endangered species in Appendix B shows Atlantic sturgeon as a candidate species. The federal status should be changed to endangered, as the effective date of the listing was April 6, 2012, before the FEIS was issued.

- Our final comment concerns the significant change in the fish passage design that occurred between the completion of our biological opinion on November 4, 2011, and the issuance of the FEIS. We note that the conceptual design for the off-channel rock ramp in the FEIS has been modified from the design that was originally provided by the Corps in its May 11, 2011, *SHEP Information Paper*, and is included in our biological opinion. Using information about the Corps' proposed fish passage designs provided in the *SHEP Information Paper*, NMFS consulted (via a conference call on May 16, 2011) with sturgeon experts representing the United States Fish and Wildlife Service, South Carolina Department of Natural Resources, University of Georgia, and The Nature Conservancy. The consensus was that the group had many questions about the efficacy of the Corps' proposed fish passage design. On August 25, 2011, NMFS coordinated an interagency site visit to the New Savannah Bluff Lock and Dam where Dr. Luther Aadland (an expert on fish passage design for passing sturgeon) met with many of these sturgeon experts. Following the site visit, Dr. Aadland prepared a technical report for NMFS, dated September 12, 2011, that analyzed the Corps' proposed designs for fish passage at the New Savannah Bluff Lock and Dam. The report also provided recommendations for

modifications that would improve the Corps' preferred design. On page 27 of our biological opinion (the biological opinion is included in Appendix Z of the FEIS), we requested that the Corps review and incorporate the recommendations provided by Dr. Aadland in his technical report. We note that the new fish passage design provided in the FEIS shows the entrance to the lower ramp located closer to the dam, the steel sheet pile guide wall on the upstream side of the dam repositioned farther upriver, and the guide wall for the downriver portion of the ramp removed. These changes reflect the recommendations that were made by Dr. Aadland in his technical report, and we are pleased to see that his recommendations were incorporated into the proposed fish passage design.

NMFS - Habitat Conservation Division review of the Savannah Harbor Expansion Project - Final Environment Impact Statement (FEIS)

The following comments are provided on the Savannah Harbor Expansion Project (SHEP) FEIS issued April 11, 2012. They are intended to supplement the comments provided on the draft FEIS, dated February 17, 2012. Our comments on the draft FEIS focused on the response from the U.S. Army Corps of Engineers Savannah District (COE) to the essential fish habitat (EFH) conservation recommendations provided July 1, 2011. The February letter indicated the COE had adequately responded to the EFH conservation recommendations in accordance with Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act and its implementing regulation at 50 CFR Section 600.920(k). Please consider the following additional comments when preparing the Record of Decision and final report from the Chief of Engineers.

- As noted in past correspondence, NMFS is concerned that live/hardbottom habitat may be present within or adjacent to the proposed footprint of the Ocean Bar Channel extension. We appreciate the COE allowing us to contribute to the statement of work entitled, "Remote Sensing Survey for Cultural Resources and Hardbottom Habitat of a Proposed Bar Channel Extension with Diver Investigation of Anomalies/Targets in Offshore and Inner Harbor Areas, Savannah Harbor Expansion Project." We also appreciate the COE acknowledges (in Appendix S) that they will work with NMFS to develop a course of action, including selection of appropriate mitigation options, should live/hardbottom habitat be found in these surveys. We request the Record of Decision and final report from the Chief of Engineers clearly acknowledge this commitment, given its importance for the Secretary of Commerce to determine whether the mitigation plan adequately addresses the potential environmental impacts of the project, as required under the Water Resources Development Act of 1999.

- The FEIS portrays disposal of dredged material in nearshore areas off Tybee Island as an option that may be investigated in the future. We opposed this practice in earlier correspondences, and we expect the COE to reinitiate EFH consultation should the COE pursue this disposal option, regardless of whether live/hardbottom is present.

- To mitigate direct impacts to 15.7 acres of salt marsh, the COE intends to restore 42 acres of salt marsh at Disposal Area 1S. However, the COE is reserving 11.5 acres of this mitigation for future federal projects in the watershed, rather than applying the full mitigation acreage to the impacts from SHEP. As noted in past correspondence, We continue to oppose operating Disposal Area 1S as if it were a migration bank, unless it fully complies with the regulation *Compensatory Mitigation for Losses of Aquatic Resources*, promulgated by the COE (33 CFR Parts 325 and 332) and Environmental Protection Agency 40 CFR Part 230.

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

TAKE PRIDE IN AMERICA

9043.1
PEP/NRM

MAY 11 2012

ER 12/268

Mr. 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: Chief of Engineers and the Report of the District Engineer on the Savannah Harbor Expansion Project, Chatham County, GA and Jasper County, SC

Dear Mr. Brown:

The U.S. Department of the Interior (Department) has reviewed the U.S. Army Corps of Engineers (Corps), Chief of Engineers Report, including the General Re-evaluation Report (GRR) and Final Environmental Impact Statement (FEIS) for the Savannah Harbor Expansion Project (SHEP), Chatham County, GA and Jasper County, SC. We offer the following general and specific comments based upon the analysis, jurisdiction, and special expertise of our U.S. Fish and Wildlife Service (Service).

General Comments

The SHEP involves deepening the harbor from the current inner-harbor depth of 42 feet by as much as 6 feet to a maximum authorized depth of 48 feet. Authorizing language in the Water Resources Development Act of 1999 stipulates that the project may proceed only after the Secretary of the Interior, Secretary of Commerce, and Administrator of the Environmental Protection Agency approve the selected plan and determine that the associated mitigation plan adequately addresses its potential environmental impacts. The Secretary of the Interior has designated the Service's Director as the Department's representative for final plan approval.

The documents describe various models that were developed to predict changes to the environment resulting from alternative channel depths and mitigation measures. Predicted changes to the environment include: salinity increases, loss of tidal freshwater marsh, reduced striped bass reproduction and recruitment, negative impacts to Shortnose Sturgeon habitat, reduced dissolved oxygen, and potential exposure of wildlife to cadmium in dredged sediments.

The SHEP potentially affects several species listed under the Endangered Species Act (ESA). The Corps has coordinated with both the National Marine Fisheries Service (NMFS) and the Service. The NMFS provided a biological opinion concerning the proposed action for species under their purview. By letter dated April 28, 2011, the Service concurred with the findings of the Corps' biological assessment for the effects of the SHEP on species under our purview; however, the Corps has since modified the proposed action. Specifically, the Corps has removed from the project plans the use of Tybee Island near-shore sites for dredged material placement. The Biological Assessment for Threatened and Endangered Species (BATES), Appendix B of the FEIS, addresses this change. The Service has evaluated this information and concludes that it does not affect listed species or critical habitat under our purview in a manner or to an extent not previously considered. Therefore, our previous determination that the proposed action is not likely to adversely affect listed or proposed species or their critical habitat is still valid.

Specific Comments

General Reevaluation Report – Appendix B: Real Estate

Page 3 – Lines 26-29: The Real Estate Appendix describes the standard and non-standard estates to be acquired for the project. Item 'C' states that a Special Use Permit (SUP) from the Service is required for lands impacted within the refuge and a land exchange between the Non-Federal Sponsor (NFS) and the Service. This is incorrect, a SUP is needed only for the areas of the refuge that are involved with the flow modifications associated with the mitigation features of the project. A SUP is for permitting activities on refuge lands, not for the permanent exchange of land. The land exchange is a value-for-value exchange and will not require a SUP; therefore, we recommend separating the SUP from the land exchange in this list.

Page 5 – Lines 26-27: states that the cost of six acres of refuge land (for excavation as part of the channel widening) is estimated at $70,500 ($11,750 per acre). This estimate appears to be low. The land exchange necessary for the project to acquire these refuge lands is a value-for-value exchange. We request language be included in this section noting that the actual cost for the exchange will be based upon an approved real estate appraisal meeting Federal appraisal standards and conducted at the time of the transfer, and may differ from this estimate.

Page 6 – Lines 1-4: states that a SUP between the NFS and the Service is required covering 66 acres of refuge lands. This is incorrect, the SUP will cover approximately 48 acres of refuge lands that are involved with the project's flow-modification mitigation features and the restoration of wetlands at disposal site 1S.

Page 7 – Lines 33 – 37: states that a total of 7.2 acres of wetlands will be lost as a result of widening the turning basin. Because the Corps will not "assert the navigational servitude to a sister agency," the Corps includes these acres in its mitigation plan. The real estate section should clarify how the Corps will compensate the Service for the loss of these 7.2 acres of wetlands. The loss of these wetland acres need to be included as part of the land exchange

acreage, otherwise the Service cannot find this activity (enlarging the turning basin) compatible with the mission of the refuge.

Page 21 – Lines 5-8: addresses impacts to the refuge. In line 6, insert the words 'and wetlands' after "high ground." The total acreage of refuge lands needed for enlarging the turning basin, including wetlands, must be included in the land exchange.

Page 34 - Government Owned Property: This section is unclear. It states that the NFS is required to pursue a land exchange for six acres (acres above the ordinary mean high water mark within and adjacent to the turning basin) with the Service; however, the turning basin also affects 7.2 acres of wetlands for which a land exchange is necessary in order to make the project compatible with the refuge mission and purpose. Line 42 states that "credits will be afforded for the 6 acres in easements by the NFS." This is incorrect; the Service will only accept lands in fee title, not as easements.

Environmental Impact Statement - Section 4 – Affected Environment

Page 4-70 – The list of conservation areas should include Tybee National Wildlife Refuge. This list should also refer to the Savannah National Wildlife Refuge as "on site," instead of "near project area," since some portions of the Savannah National Wildlife Refuge are within the footprint of the project and its mitigation features.

Appendix C – Mitigation Planning

Page 174 - Figure 59 shows the Refuge acquisition boundary, with two parcels circled for acquisition: Mill Creek and Abercorn Island. Page 175 gives the size of the Mill Creek tract as 4,600 acres, which is incorrect. The Mill Creek tract is 1,184 acres. To avoid price inflation through land speculation, the Service has previously requested that the Corps not identify specific tracts for acquisition; therefore, we request that the Corps remove the circles from Figure 59 and adjust the corresponding text accordingly.

Page 175 – Please change the reference to the Service's "Draft Comprehensive Plan" to the "2011 Final Comprehensive Conservation Plan."

Page 178 – The Corps states that "preservation of the 2,245 acres will include a restrictive covenant and the recording of a conservation easement with conveyance of the property to the USFWS." This statement is inconsistent with Service policies. The Service will accept only fee-title conveyance of lands for addition to the refuge, and we will not accept lands with restrictive covenants or conservation easements. We request the Corps revise this text accordingly.

Page 190 – The Corps states that "The Savannah National Wildlife Refuge (SNWR) is a conservation area of national importance with habitats that are important to many unique plant

and animal species, including threatened and endangered species. It is located in the vicinity of the SHEP project (i.e., "In basin"), but it is sufficiently removed from the project area so as not to be *directly* impacted by excavation and/or dredging activities." We believe that this is a mischaracterization of project impacts, as portions of the refuge are directly affected by widening the turning basin, dredging, and construction of flow-modification structures. We request the Corps revise this text accordingly.

Appendix M – Cadmium Monitoring

Page 88 – In the second paragraph under "7.4.3.1.1 Wildlife and Avian Abundance Surveys" (lines 23-32); the paragraph should begin with a sentence indicating that it refers to cadmium concentration thresholds in plant tissues. We also recommend moving this paragraph to section "7.4.3.1.4 Potential Vegetation Tissue Monitoring."

Page 91 – In the second paragraph under "7.4.3.1.4 Potential Vegetation Tissue Monitoring" (lines 24-30); the Service does not believe the marsh wren is an appropriate species for deriving plant tissue threshold concentrations, because it is insectivorous. The Service recommends either clarifying or deleting the exposure concentrations in this paragraph.

We appreciate the opportunity to comment on this project. If you have any questions regarding our comments please contact the following Service representatives: Mr. Jerry Ziewitz, Conservation Planning Assistance Coordinator, at 850-877-6513, jerry_Ziewitz@fws.gov, or Mr. Jack Arnold, Deputy Assistant Regional Director, Ecological Services, at (404) 679-7311.

Sincerely,

Willie R. Taylor

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

cc: FWS, Field Supervisor, Athens, GA
FWS, Refuge Manager, Savannah NWR

NLC 10

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
355 East Hancock Avenue
Athens, GA 30601

May 3, 2012

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: Review of Chief of Engineers and District Engineer Report and Final Environmental Impact Statement for the Savannah Harbor Expansion Project, Chatham County, Georgia and Jasper County, South Carolina

Dear Mr. Brown:

This letter is in response to your April 11 request for the Natural Resources Conservation Service (NRCS) review and comment on the subject reports.

The NRCS engineering staff has reviewed the reports and has no comments or recommendations regarding the subject reports at this time. Based on our review the project will not impact any area where the NRCS has jurisdiction by law.

Thank you for the opportunity to review the report.

Sincerely,

Acting for

JAMES E. HILLMAN, SR.
State Conservationist

Helping People Help the Land

An Equal Opportunity Provider and Employer

Scerno, Deborah HQ

From: Bee, Patricia L HQ02
Sent: Tuesday, May 29, 2012 10:18 AM
To: Ware, Charles L HQ02; Scerno, Deborah HQ
Subject: FW: Savannah Harbor Expansion Project (UNCLASSIFIED)

Categories: Red Category

Classification: UNCLASSIFIED
Caveats: NONE

Coast Guard response.

-----Original Message-----
From: Joseph.B.Embres@uscg.mil [mailto:Joseph.B.Embres@uscg.mil]
Sent: Tuesday, May 29, 2012 9:55 AM
To: Bee, Patricia L HQ02
Cc: Haley, Andrew S LTJG
Subject: FW: Savannah Harbor Expansion Project (UNCLASSIFIED)

Sorry for the delay on this but we have already responded to ACOE Savannah District Office.

We again reviewed what you have sent us and provide the below.

For planning purposes, do you have any dates for the projects progress?

Thank you for allowing the Coast Guard to comment on the EIS and FRR for the Savannah Harbor Expansion. After reviewing the documents, it is clear that the Army Corps have incorporated the earlier Coast Gaur comments. The cost estimate for ATON has been increased from $0.8M to $5M. That should be sufficient to mark the channel and construct any new ranges. The Seventh District Waterways Management Office has no further comments concerning the EIS. Once again, thanks for the opportunity to comment.

v/r

Classification: UNCLASSIFIED
Caveats: NONE

#5

Catawba Indian Nation
Tribal Historic Preservation Office
1536 Tom Steven Road
Rock Hill, South Carolina 29730

Office 803-328-2427
Fax 803-328-5791

May 4, 2012

Attention: William G. Bailey
Department of the Army
P. O. Box 889
Savannah, Georgia 31402-0889

Re. THPO #	TCNS#	Project Description
2012-46-1		Final EIS and Final GRR and continued maintenance of the existing Savannah Harbor Federal Navigation Project, Chatham Co., GA and Jasper Co., SC

Dear Mr. Bailey,

The Catawba have no immediate concerns with regard to traditional cultural properties, sacred sites or Native American archaeological sites within the boundaries of the proposed project areas. **However, the Catawba are to be notified if Native American artifacts and / or human remains are located during the ground disturbance phase of this project.**

If you have questions please contact Caitlin Totherow at 803-328-2427 ext. 226, or e-mail caitlinh@ccppcrafts.com.

Sincerely,

Caitlin Totherow for

Wenonah G. Haire
Tribal Historic Preservation Officer

Rec'd 5/17

OFFICE OF PLANNING AND BUDGET

Nathan Deal
Governor

Debbie Dlugolenski Alford
Director

GEORGIA STATE CLEARINGHOUSE MEMORANDUM
EXECUTIVE ORDER 12372 REVIEW PROCESS

TO: Headquarters
U. S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

FROM: Barbara Jackson
Georgia State Clearinghouse

DATE: 5/11/2012

APPLICANT: Dept. of the Army - U.S. Army Corps of Engineers

PROJECT: Proposed Report of the Chief of Engineers; Final General Re-Evaluation Report and Environmental Impact Statement for Savannah Harbor Expansion Project (located in Chatham County, GA and Jasper County, SC)

STATE ID: GA120413004

The applicant/sponsor indicated that they already coordinated directly with the following reviewing agencies: DNR's Coastal Resources Division; DNR's Wildlife Resources Division; DNR's Environmental Protection Division; DNR's Historic Preservation Division; Georgia Ports Authority.

Provided that there is continued coordination on this project and any future issues and/or concerns are addressed satisfactorily, the State level review of the above-referenced proposal has been completed, and the proposal found to be consistent with those state or regional goals, policies, plans, fiscal resources, criteria for Developments of Regional Impact (DRI), environmental impacts, federal executive orders, acts and/or rules and regulations with which the state is concerned.

/bj
Enc.: CSMPC, May 11, 2012
Coastal RC of Georgia, May 4, 2012
GA DOT, Apr. 24, 2012

Form NCC
Oct. 2008

Barbara Jackson

From: Jackie Jackson Teel <jackson@thempc.org>
Sent: Friday, May 11, 2012 11:39 AM
To: Barbara Jackson; Tom Thomson
Subject: RE: GA120413004 project review comments

Ms. Jackson,
The MPC had no comments on this project, but thank you for checking.

Have a great weekend-
Jackie

Jackie Jackson Teel, LEED - AP BD+C
Director of Comprehensive Planning
Chatham County - Savannah
Metropolitan Planning Commission

www.MPCNaturalResources.org

Phone: (912) 651-1454/1440
Fax: (912) 651-1480

From: Barbara Jackson [mailto:Barbara.Jackson@opb.state.ga.us]
Sent: Friday, May 11, 2012 11:06 AM
To: Jackie Jackson Teel; Tom Thomson
Subject: GA120413004 project review comments

Hi:

The following project was sent to Mr. Thomson, but we have not received review comments. Would you please check status of this for me and fax?

State ID: GA120413004

Applicant: Dept. of the Army - U.S. Army Corps of Engineers

Project: Proposed Report of the Chief of Engineers; Final General Re-Evaluation Report and Environmental Impact Statement for Savannah Harbor Expansion Project (located in Chatham County, GA and Jasper County, SC)

Comments were due: 5/4/2012

RECEIVED
MAY 11 2012
GEORGIA
STATE CLEARINGHOUSE

Thank you,

Barbara J.

GA Voicemail Fax
D 00 Remote ID: R page 01 of

GEORGIA STATE CLEARINGHOUSE MEMORANDUM
EXECUTIVE ORDER 12372 REVIEW PROCESS

TO: Barbara Jackson
Georgia State Clearinghouse
270 Washington Street, SW, Eighth Floor
Atlanta, Georgia 30334

FROM: MR. DAVID DANTZLER
COASTAL RC OF GEORGIA

APPLICANT: Dept. of the Army – U.S. Army Corps of Engineers

PROJECT: Proposed Report of the Chief of Engineers; Final General Re-Evaluation Report and Environmental Impact Statement for the Savannah Harbor Expansion Project (located in Chatham County, GA and Jasper County, SC)

STATE ID: GA120413004

FEDERAL ID:

DATE: 4/13/2012

X This notice is considered to be consistent with those state or regional goals, policies, plans, fiscal resources, criteria for developments of regional impact, environmental impacts, federal executive orders, acts and/or rules and regulations with which this organization is concerned.

Comment: Please see attached review.

This notice is not consistent with:

☐ The goals, plans, policies, or fiscal resources with which this organization is concerned. (Line through inappropriate word or words and prepare a statement that explains the rationale for the inconsistency. (Additional pages may be used for outlining the inconsistencies. Be sure to put the GA State ID number on all pages).

☐ The criteria for developments of regional impact, federal executive orders, acts and/or rules and regulations administered by this agency. Negative environmental impacts or provision for protection of the environment should be pointed out. (Additional pages may be used for outlining the inconsistencies). Be sure to put the GA State ID number on all pages).

☐ This notice does not impact upon the activities of the organization.

NOTE: Should you decide to FAX this form (and any attached pages), it is not necessary to mail the originals to us. [770-344-3568]

Form SC-3
Aug. 2010

RECEIVED
MAY 04 2012
GEORGIA
STATE CLEARINGHOUSE

Coastal Regional Commission Clearinghouse Review of the Regional Plan for Coastal Georgia
Adopted June 9, 2010
Dept. of the Army – U.S. Army Corps of Engineers
Proposed Report of the Chief of Engineers; Final General Re-Evaluation Report and Environmental Impact Statement for the Savannah Harbor Expansion Project (located in Chatham County, GA and Jasper County, SC)
Review By David Dantzler, May 4, 2012 (Faxed)

Project: Environmental Impact Statement on the proposed deepening of the Port of Savannah Ship Channel. 6 Alternatives reviewed and the NED Plan was selected with recommendations for dredging to -47 ft to support larger container ships in use or being constructed. This will provide the Port of Savannah the channel capacity equivalent to the modifications to the Panama Canal being completed in 2014. The EIS proposes mitigation measures for the identified impacts.

Regional Plan Compliance:
Future Development Pattern – Conservation and Developed (Savannah and Garden City)
ARSA – Areas of Significant Natural Resources, Areas of Significant Infill (South bank within the developed areas of Savannah and Garden City)
QCO – For Areas of Significant Natural Resources Green Infrastructure – existing shipping channel within the Savannah River (waterway) bordered by wetlands/marsh along much of the distance of the project within the River Channel). South bank within the cities of Savannah and Garden City exist opportunities for Infill.

Regional Plan Issues and Opportunities:

IWW-3	Affect of salt water intrusion on the Upper Floridan Aquifer leading to withdrawal limits.
IT-5	Impacts of port development on highway infrastructure and natural resources.
NR-1	Loss of environmentally sensitive and ecologically valuable resources.
O-ED-4	Promote proximity to the ports and regional transportation.
O-ED-13	Attract businesses with airports, transit systems, and other regional transportation initiatives.

Implementation:
CR – PS1 - 5. Require mitigation to significant resources impacted by development.
NR - GP - 2. Continue the traditional use of land and water (such as farming, forestry, fishing, etc.) as feasible, provided that any significant impacts on resources can be prevented or effectively mitigated.
EDB&I – GP – 4. Coordinate with the Georgia Ports Authority (GPA) to identify their needs and identify mechanisms for the economic development industry to strengthen the GPA and its presence in logistics, distribution, and workforce development.

Comment:
Issues identified in the plan relating to the deepening of the Savannah Harbor include:

- Salt water intrusion into the area aquifers used as the primary water supply. The EIS addresses this concern stating that there is separation by depth and confining layers from the water supplying aquifers. There is the possibility of interconnection between the shallow and deeper aquifers within the Coastal Georgia Region.
- Impact of additional traffic related to the continued growth of the port on the Region's transportation infrastructure. While not directly related to the deepening project, the ability of the Port to handle increasing cargo related to the ability to accommodate larger ships will result in greater demands on the Region's transportation infrastructure. The Port of Savannah needs to continue to be a partner in the development and improvement of the transportation infrastructure in the Region.
- The impact on environmentally sensitive and ecologically valuable resources. The EIS does address identified environmental and cultural impacts and proposes mitigation measures to address these impacts. The proposed mitigation measures need to be flexible enough to adjust to actual impacts of the project.
- Economic value of the port to the Region. The Port of Savannah is a major economic engine for the Coastal Region. It is important for the Port to continue to be a partner in the development of the Region, as well as a Partner in the protection of the natural and cultural assets that make Coastal Georgia the desirable Region to live and work.

RECEIVED
MAY 04 2012
GEORGIA
STATE CLEARINGHOUSE

Source: The Regional Plan of Coastal Georgia; Adopted June 9, 2010;
http://www.crc.ga.gov/planning/docs/Final_Agenda_Adopted_060910.pdf

GEORGIA STATE CLEARINGHOUSE MEMORANDUM
EXECUTIVE ORDER 12372 REVIEW PROCESS

TO: Barbara Jackson
Georgia State Clearinghouse
270 Washington Street, SW, 8th Floor
Atlanta, Georgia 30334

FROM: MS. CAROL COMER
GA DOT OFC OF INTERMODAL PROGRAMS

APPLICANT: Dept. of the Army - U.S. Army Corps of Engineers

PROJECT: Proposed Report of the Chief of Engineers; Final General Re-Evaluation Report and Environmental Impact Statement for Savannah Harbor Expansion Project (located in Chatham County, GA and Jasper County, SC)

STATE ID: GA120413004

FEDERAL ID:

DATE: 4/18/12

☑ This project is considered to be consistent with those state or regional goals, policies, plans, fiscal resources, criteria for developments of regional impact, environmental impacts, federal executive orders, acts and/or rules and regulations with which this organization is concerned.

This project is not consistent with:

☐ The goals, plans, policies, or fiscal resources with which this organization is concerned. (Line through inappropriate word(s) and prepare a statement that explains the rationale for the inconsistency. (Additional pages may be used for outlining the inconsistencies. Be sure to put the GA State ID no. and any Federal ID no. on **all** pages).

☐ The criteria for developments of regional impact, federal executive orders, acts and/or rules and regulations administered by your agency. Negative environmental impacts or provision for protection of the environment should be pointed out. (Additional pages may be used for outlining the inconsistencies. Be sure to put the GA State ID no. and any Federal ID no. on **all** pages).

☐ This project does not impact upon the activities of the organization.

NOTE: Should you decide to FAX this form (and any attached pages), it is not necessary to mail the originals to us. [770-344-3568]

RECEIVED
APR 24 2012
GEORGIA
STATE CLEARINGHOUSE

Form SC-3
Mar. 2012

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
WILDLIFE RESOURCES DIVISION

MARK WILLIAMS
COMMISSIONER

DAN FORSTER
DIRECTOR

June 4, 2012

Mr. William Bailey
US Army Corps of Engineers
Savannah District
100 West Oglethorpe Avenue
Savannah, Georgia 31401-3640

Subject: Comments on Final Environmental Impact Statement (EIS) and General Re-evaluation Report (GRR) for Savannah Harbor Expansion Project

Dear Mr. Bailey:

Thank you for the opportunity to review and provide comment on the final Environmental Impact Statement (EIS) and General Re-evaluation Report for the Savannah Harbor Expansion Project. The Georgia Department of Natural Resources, Wildlife Resources Division (WRD) has worked closely with you and your colleges at the Corps of Engineers and other cooperating agencies on this project for many years. Through this process, our involvement has been primarily focused on the assessment of potential impacts on fishery resources, including the Savannah River striped bass fishery. This once thriving population nearly collapsed in the late 1980's due to changes in bathymetry and increased salinity levels in important spawning grounds in the Savannah Estuary. WRD has made a long term commitment to the recovery of the Savannah River striped bass population and has made tremendous strides toward recovering this fishery. Recovery efforts between state and federal agencies included closing new cut, removing tide gate operations, closing the fishery to harvest, and conducting an intense stocking and monitoring program. Recent signs of population recovery include increased numbers of adult striped bass and a measurable amount of natural recruitment. Since the mid 1990's the Savannah River striped bass fishery has become a popular sport fishery once more as stocked fish have grown in size and abundance. After nearly 17 years, the fishery was successfully re-opened to limited harvest in October 2005. We continue our commitment to the striped bass fishery through annual population monitoring and stocking.

The EIS identifies the predicted impacts at alternative project depths from 44 to 48 feet and predicts the effectiveness of mitigation features at each depth. The selected depth of the current project of 47 feet was identified by the Corps as the National Economic Development (NED) Plan. This depth predicts the loss of 26.9 percent of the remaining critical striped bass habitat in the Savannah River estuary after all proposed mitigation features are in place. The EIS acknowledges that this habitat loss warrants mitigation. Permanent loss of this critical habitat will likely preclude the restoration of a naturally self-sustaining population in the Savannah River and require annual stocking of 6 to 8 inch striped bass in perpetuity. The striped bass

2070 U.S. HIGHWAY 278 S.E. | SOCIAL CIRCLE, GEORGIA 30025-4711
770.918.6400 | FAX 706.557.3030 | WWW.GEORGIAWILDLIFE.COM

compensatory mitigation as outlined in the EIS is scheduled for the first year of construction. Monitoring efforts to evaluate project effects are scheduled to take place 2, 4, and 9 years post construction. If post construction monitoring show that more habitat was lost than predicted, then we would ask that the loss be calculated and mitigated using the same methodologies that were used to determine the initial 26.9 percent loss.

Impacts to shortnose sturgeon remain after mitigation features are included. To compensate for this loss, a fish passage structure at the New Savannah Bluff Lock and Dam (NSBLD) is proposed. The fish passage structure is intended to allow shortnose sturgeon to access historical spawning grounds above NSBLD. The Corps is planning a passage study during construction to ensure the structure performs as intended. A post-construction monitoring plan will be designed by cooperating agencies to continue to monitor shortnose sturgeon passage at the New Savannah Bluff Lock and Dam.

Moving forward, our focus will be assessing the impacts of the project on the fishery resources including striped bass and ensuring that the adaptive management plan will be used effectively to rectify unanticipated impacts. Thank you for the opportunity to provide additional input and review in this important process. We look forward to continuing our work together on this project.

Sincerely,

Dan Foster

Dan Foster

DF/tab

cc: John Biagi

South Carolina Department of
Natural Resources
DNR

Alvin A. Taylor
Director

June 4, 2012

Col. Jeffrey M. Hall
U.S. Army Corps of Engineers
Savannah District
100 West Oglethorpe Avenue
Savannah, Georgia 31401-3640

REFERENCE: Final General Re-Evaluation Report and Final Environmental Impact Statement for the Savannah Harbor Expansion Project Chatham County, Georgia and Jasper County, South Carolina

Dear Col. Hall,

Personnel with the South Carolina Department of Natural Resources (DNR) have reviewed the Final Environmental Impact Statement (FEIS) for the Savannah Harbor Expansion Project (SHEP or Project). Specific comments on the FEIS are attached to this letter. Many of these comments apply to the Final General Re-Evaluation Report (FGRR), as well, so a copy of this letter and attachment should be included in the administrative record for each of these documents.

DNR submitted detailed comments on the Draft Environmental Impact Statement (DEIS) by letter dated January 25, 2011. The attached comments on the FEIS focus on the U.S. Army Corps of Engineers' (USACE) response to those comments, as well as on specific revisions made to the DEIS in response to federal and state agency concerns.

Based on the assessment of the environmental impacts as presented in the FEIS, and on the adequacy of the mitigation proposed, DNR has not changed its position that the only environmentally acceptable deepening alternatives are the 44-ft alternative or the 45-ft alternative, provided the proposed mitigation for each alternative proves to be successful. DNR continues to recommend that deepening of the Savannah Harbor navigation channel be limited to that depth necessary to alleviate draft restrictions on the existing fleet of vessels, but in no case greater than -45 ft MLW.

If you have any questions regarding our comments, please contact Bob Perry of my staff.

Sincerely,

Alvin A. Taylor
Director

ec: Jay Herrington – FWS
Pace Wilber – NMFS
Heather Preston – DHEC-EQC
Rheta DiNovo – DHEC-OCRM
John P. Evans, Chairman DNR Board
Robert Boyles
Emily Cope
Ken Rentiers
Breck Carmichael
Bob Perry
Priscilla Wendt

South Carolina Department of Natural Resources
Comments on the Final Environmental Impact Study
for the Savannah Harbor Expansion Project

General Comment: The USACE's *response to comments* on the Draft Environmental Impact Study (DEIS) for the Savannah Harbor Expansion Project (SHEP) is included in Appendix A of the Final Environmental Impact Study (FEIS). Some changes were made to the DEIS in response to agency comments; however, the U. S. Army Corps of Engineers (USACE) still maintains that the 47-foot National Economic Development (NED) Plan adequately balances the national interest with environmental concerns. DNR disagrees with this conclusion and continues to recommend that the deepening project be limited to a maximum depth of -45 feet (MLW), in order to reduce the environmental impacts.

Adverse Impacts of the NED Plan: The FEIS acknowledges that the following adverse impacts would still occur with the selected 47-foot depth alternative, even with the proposed mitigation measures:

1. Loss of 15.68 acres of brackish marsh due to project excavation requirements.
2. Increase in chloride levels at the City of Savannah's water intake (municipal and industrial) during low flows and high tides.
3. Adverse impacts to striped bass (*Morone saxatilis*) habitat.
4. Adverse impacts to shortnose sturgeon (SNS) (*Acipenser brevirostrum*) foraging habitat for both juveniles and adults.
5. "Minor increase" in saltwater intrusion into the aquifer.
6. Temporary, localized dredging and disposal impacts on water quality and benthic communities during construction.
7. Conversion of 223 acres of tidal freshwater marsh to brackish marsh (assuming flow-altering mitigation is successful in limiting salinity intrusion).
8. Conversion of 740 acres of saltmarsh to brackish marsh (assuming flow-altering mitigation is successful in limiting salinity intrusion).
9. Adverse impacts to the remains of the *CSS Georgia*.

Selected Means to Mitigate Adverse Environmental Impacts: The FEIS includes the following mitigation measures:

1. Restoration of 40.3 acres of brackish marsh at Disposal Area 1S.
2. Construction of flow rerouting features at McCoy's Cut, Rifle Cut, Middle and Little Back rivers and the Sediment Basin.
3. Removal of the Tidegate.
4. Construction and operation of an oxygen injection system.
5. Construction of a freshwater storage impoundment to mitigate for increased chloride levels.

6. Restoration of access for SNS and other anadromous fish species to historic spawning areas at the Augusta Shoals through construction of a fish bypass at the New Savannah Bluff Lock and Dam (NSBL&D).
7. Increase in the number of striped bass fingerlings stocked in the estuary.
8. Recovery and preservation of the remains of the *CSS Georgia*.
9. Construction of a public boat ramp on Hutchinson Island.

Comparison of Draft and Final Environmental Impact Statements: Major changes to the DEIS and DNR's responses to those changes are as follows:

1. The FEIS includes a revised summary table of project-related impacts <u>with</u> mitigation (Table 3-8); however, no such revisions are made to the summary table of project-related impacts <u>without</u> mitigation (Table-3-7). Predicted changes in the acreage of freshwater wetlands and saltmarsh, as shown in the DEIS, were subdivided into categories representing direct impacts due to excavation (resulting in the complete loss of brackish marsh), and indirect impacts due to changes in the salinity regime (resulting in the conversion of freshwater wetlands, brackish marsh, and saltmarsh into different wetland types). In addition, Table 3-8 of the FEIS includes revised acreages of SNS habitat gained or lost. These revisions resulted from changing the salinity "habitat suitability" criterion for juvenile SNS in January from a maximum of 4.0 ppt to a maximum of 14.9 ppt, and from incorporating loadings from point source discharges in the calculation of dissolved oxygen requirements. No such revisions to wetland categories or suitable habitat for juvenile SNS were made to the summary table of project-related impacts without mitigation (Table 3-7). <u>DNR believes it is inappropriate and misleading to present project-related impacts based on different criteria for the "with" and "without" mitigation scenarios. The FEIS should be revised to include summary tables of project-related impacts based on the same set of criteria for the "with" and "without" mitigation scenarios.</u>

2. The FEIS incorporates a larger fish passage design at the NSBL&D near Augusta, Georgia, as mitigation for impacts to habitat of the endangered SNS. <u>DNR continues to oppose this "out-of-kind" mitigation for loss of SNS foraging habitat, and recommends that impacts to SNS foraging habitat be minimized by limiting dredging to a maximum depth of -45 ft (MLW).</u>

3. The FEIS eliminates the construction of an underwater sill that was intended to minimize salinity intrusion into the Middle River. <u>Given the high cost, minimal benefit, and possibility of unintended consequences, DNR concurs with the elimination of this particular aspect of the project.</u>

4. The FEIS increases Post-Construction Monitoring from 5 to 10 years for several elements of the project. <u>DNR continues to support increasing the duration of post-construction monitoring, should the project be approved.</u>

5. The FEIS adds 2 Speece cones to the Dissolved Oxygen (DO) Injection System. DNR has expressed serious concerns about the efficacy of the proposed DO injection system; the addition of 2 Speece cones does not allay those concerns.

6. The FEIS eliminates nearshore placement of new work dredged sediments near Tybee Island, Georgia from the project, because of the high percentage of fine grained sediments. DNR generally opposes open-water disposal of dredged sediments, except in an approved ODMDS or for the purpose of nourishing seriously eroding beaches with beach-compatible sands. Therefore, we concur with eliminating the nearshore placement of fine-grained sediments.

7. The FEIS includes additional real estate acquisition to accommodate the larger fish passage system and construction of a freshwater storage impoundment for the City of Savannah. DNR continues to oppose the construction of a fish passage system as mitigation for the loss of SNS foraging habitat, and does not support further encroachment of the proposed system into South Carolina, which is likely to only occur through condemnation of valuable recreational and agricultural lands.

8. The FEIS includes increased costs for planning, engineering and design of all Project features, and includes increased costs to construct, operate and maintain a larger fish bypass system. DNR continues to oppose the construction of a fish passage system as mitigation for the loss of SNS foraging habitat, and believes the cost increase from $4.3 million to $32 million for a system that may not even be effective in passing SNS is neither warranted nor advisable.

USACE Response to SCDNR Comments on the DEIS: In Appendix A of the FEIS (pp. 482 - 502), USACE responds to DNR's earlier comments on the DEIS. Some of those responses adequately address our concerns; however, the responses below do not, and are followed by DNR's replies to USACE responses. The page numbers refer to Appendix A of the FEIS.

1. Appendix A, p. 485

DNR Comment: *Based on our assessment of the environmental impacts as presented in the DEIS and DGRR, and on the adequacy of the mitigation proposed, DNR has concluded that the only deepening alternatives that could be considered minimally environmentally acceptable are the 44-ft alternative or the 45-ft alternative, provided the proposed mitigation for each of these alternatives proves to be successful....*

USACE Response: *The position of the SC DNR that only the 44-foot project or the 45-foot project can be considered minimally environmentally acceptable provided the proposed mitigation proves successful is acknowledged.*

DNR Reply to USACE Response: *Acknowledgment* of our position is not synonymous with *concurrence*. DNR urges USACE to reconsider its selection of the 47-ft alternative as the preferred alternative.

2. Appendix A, p. 487

DNR Comment: *In view of these concerns, DNR has concluded that a better alternative to consider is to conduct minimal deepening of the channel now and to a depth of -44 or -45 ft in order to alleviate draft restrictions on the existing fleet of vessels, and then to conduct additional studies and hydrodynamic modeling to evaluate the economic and environmental impacts of deepening to a greater depth only as far as the site of proposed Jasper Port Terminal. Since this site is several miles closer to the ocean than the Garden City Terminal, this alternative could potentially reduce the environmental impacts and cost of deepening, while increasing navigational safety and efficiency for the next generation of vessels predicted to call on the proposed Jasper Port Terminal. DNR recommends that this alternative be given serious consideration.*

USACE Response (excerpt): *...The proposed Jasper County Terminal was not included as a without or with project condition due to the high level of uncertainty concerning the proposed terminal. Much of the uncertainty centered around whether a terminal may be constructed in Jasper County, and if it is constructed, when will it be constructed and how would it operate. Although the proposed Jasper terminal was not considered in the detailed analyses, a series of sensitivity analyses were conducted to identify the potential impact that a Jasper County Terminal might have on the justification and recommendation of a proposed channel deepening to GPA's Garden City Terminal if the Jasper facility was constructed. ... Overall, this analysis showed that economic justification* [emphasis added] *for construction of the channel increment between a Jasper County Terminal and the Garden City Terminal is not particularly sensitive to the development of a terminal in Jasper County. In other words, if the Jasper County Terminal was already constructed, deepening the channel to GPA's Garden City Terminal would still be economically justified* [emphasis added].

DNR Reply to USACE Response: The sensitivity analysis cited above considered *only* economics, and did not include a comparative assessment of the relative environmental impacts of deepening the channel only as far as the proposed Jasper Ocean Terminal, or the relative cost of mitigating those impacts. Therefore, the economic justification presented in the sensitivity analysis is flawed. DNR recognizes that a full environmental impact assessment of the proposed alternative (i.e., constructing the proposed Jasper Ocean Terminal and deepening the channel only as far as the site of that terminal) may be beyond the scope of the SHEP FEIS. Nevertheless, DNR believes it would be prudent to limit the maximum depth of dredging for SHEP to -45 feet (MLW) in light of the significantly greater environmental impacts of the 47-ft alternative, and in anticipation of considering a wider range of alternatives as part of a full environmental impact assessment for the proposed Jasper Ocean Terminal.

3. Appendix A, p. 488

DNR Comment: *The NED Plan, the 47-ft alternative, would involve the initial excavation of about 28 million yd^3 of dredged sediment, and would result in both direct and indirect impacts to natural resources. Direct impacts would result from the physical removal and disposal of sediments, while indirect impacts would result from increased salinity intrusion and reduced dissolved oxygen (DO) levels. Overall impacts include adverse effects on managed freshwater wetlands in the Savannah National Wildlife Refuge (SNWR), loss of tidal freshwater wetlands, impacts to public use of the estuarine/riverine system, loss of foraging and nursery habitat for the endangered shortnose sturgeon (Acipenser brevirostrum) (SNS), loss of salt and brackish marsh and loss of habitat for Striped bass (Morone saxatilis).*

USACE Response (excerpt): *The SHEP would not have adverse effects on the managed wetlands in the Savannah National Wildlife Refuge. Based on evaluations conducted during the SHEP, none of the five deepening alternatives with mitigation in place* [emphasis added] *would increase salinity levels at the Savannah National Wildlife Refuge diversion canal entrance. With the proposed mitigation,* [emphasis added] *salinity levels are projected to decrease in that portion of Back River...*

DNR Reply to USACE Response: While we recognize the hydrodynamic model predicts lower salinity in the Back River *with* the flow-altering mitigation features in place (therefore, presumably resulting in no adverse impacts on managed freshwater wetlands in the Savannah National Wildlife Refuge), DNR remains skeptical that the proposed mitigation features will function as predicted.

USACE Response (continued): *...Shortnose sturgeon spawning habitat is located well above Savannah Harbor. Thus, the SHEP would have no impacts on nursery habitat [emphasis added]. As discussed in the DEIS, there would be impacts to adult and juvenile Shortnose sturgeon habitat.*

DNR Reply to USACE Response (continued): By definition, nursery habitat is where juvenile fish tend to aggregate and mature. USACE is confusing spawning habitat with nursery habitat. The most intensively utilized nursery habitat for SNS in the Savannah River is near the freshwater/brackish water interface, which is well below the typical spawning habitat for this species and well within the area likely to be impacted by the proposed deepening project.

4. Appendix A, p. 500

DNR Comment (excerpt): *DNR recommends that Atlantic sturgeon (Acipenser oxyrinchus), recently proposed to be listed as an endangered species, and striped bass be added to the list of biological resources to be monitored. ...Development of a monitoring*

protocol for Atlantic sturgeon should be closely coordinated with federal and state natural resource agencies. The estimated cost of adding these monitoring components should be factored into the total monitoring cost of the project.

USACE Response: *As requested by the USDI, the Monitoring Plan has been modified to include an assessment of post-project impacts on the Striped bass. The monitoring data that is collected and the updated models would be used to evaluate impacts to the Striped bass during years 2, 4, and 9 of the Post-Construction Monitoring. The Atlantic sturgeon was not identified by the Interagency Coordination Team as a species of concern that should be included in the SHEP monitoring plan. If the Atlantic sturgeon becomes listed as an endangered species, the Corps would consider including this species in the monitoring plan* [emphasis added].

DNR Reply to USACE Response: The Atlantic sturgeon (ATS) was listed as an endangered species shortly before the release of the FEIS. The NMFS Biological Opinion (Bi-Op) determined that construction of the SHEP would "likely adversely affect" ATS. The impacts to juvenile and adult foraging habitat for ATS are predicted to be similar to those for SNS, and the proposed mitigation (providing fish passage to historic spawning habitat) is the same as that for SNS. The stated goal of the fish passage alternative is to achieve at least 75 percent upstream passage effectiveness for both SNS and ATS, at least 85 percent downstream passage effectiveness, and cause no serious injury to sturgeon that come into contact with the passage or dam structures. As stated on p. 5-158 of the FEIS:

> *The COE shall develop a Monitoring and Adaptive Management Plan specifically for the fish passage that will, to the maximum extent practicable, ensure the performance criteria will be achieved. The plan will also identify triggers for passage modification. Post-construction monitoring shall be designed and conducted to assess the effectiveness of the fish passage in safely passing sturgeon upstream and downstream.*

DNR takes the same position on ATS as it has on SNS, i.e., constructing a fish passage structure to provide access to historic spawning habitat, even if successful, is not appropriate mitigation for the loss of foraging and nursery habitat. Leaving that position aside, however, DNR notes that there is no mention of ATS in the revised (January 2012) Monitoring and Adaptive Management Plan (Appendix D of the FEIS). This omission should be rectified by including a detailed plan to monitor the distribution and abundance of ATS in the Savannah River estuary before and after any further deepening is undertaken. Furthermore, if the deepening project is approved in some form, and fish passage is implemented (despite DNR's objection to this mitigation feature), a plan to monitor the effectiveness of passing ATS, including triggers for passage modification or removal, should be included in the Monitoring and Adaptive Management Plan before the FEIS is approved.

8. New Comments on FEIS and GRR

Section 3.05, page 3-22, 1st paragraph identifies the agency's Selected Plan as the NED Plan. It is assumed that this is the Corps' "preferred alternative;" however, the FEIS should have clearly stated it as such. Additionally, the FEIS should have identified the "environmental preferable" alternative, which is not necessarily the "preferred alternative."

8.1. Cumulative Impact Analysis

CEQ Guidance on the preparation of Cumulative Impacts Analysis states that "the analyst's primary goal is to determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative effects of other past, present, and future actions. " Appendix L addresses seven major resources or issues of concern with regard to cumulative impacts. However, the analysis of each of the resources/issues lacks a statement of the magnitude and significance of the cumulative impact.

8.2. Wetlands

CEQ NEPA regulations (1502.24) requires that agencies "shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement." The SDC has failed to provide the methodology used to conduct the functional assessment of direct and indirect wetland impacts.

There is no clear accounting of the functions lost and gained by the project and the compensatory wetland mitigation, respectively. Typically for a project of this size a Functional Assessment would be conducted for each project alternative as well as the mitigation alternatives using an accepted protocol (i.e., WET, EMAP-Wetlands, HGM). This quantification or semi-quantitative analysis of the net impact on the wetland functions would be ranked and considered in the final selection of preferred alternative.

Based on the impacts and mitigation reported in the FIES and GRR, there is a significant net-loss when viewed based on wetland type. The SDC has proposed to mitigate for 32 acres of freshwater wetlands loss and 828 of salt marsh conversion to brackish marsh with a combination of salt marsh to brackish marsh conversion and bottomland hardwood forest preservation. Every wetland type has a particular set of functions and values unique to that particular wetland type. Without a functional assessment being conducted, therefore, there is no way to know if the mitigation plan provides at least as much

functional value as it impacts. And with the lack of in-kind mitigation presented in the plan it is very likely that functions will be lost.

Typically, a project of this size proposed by an applicant other than the SDC would be required by permit review agencies to conduct a thorough and quantitative functional assessment to ensure that there is not a loss of wetland function. Michele Gomez, biologist for Civil Project Development Branch of the Baltimore District Corps made several comments in the *Independent Technical Review (ITR) of the Use of the Regulatory SOP* suggesting that the SHEP needed to conduct a functional assessment.

Section 1502.8 of NEPA states "Environmental impact statements shall be written in plain language and may use appropriate graphics so that decision makers and the public can readily understand them." .
The SDC identifies a scale, north arrow and several other items as necessary for them to review maps, a type of graphic in the SDC's Individual Permit Checklist. If a scale and north arrow is necessary for the Corps to evaluate a map or graphic, then it would be logical that the public would also need the same items in order to readily understand them. That being said, why then has the SDC not provided these critical elements necessary to understand a map, graphic or figure in the NEPA documents associated with the SHEP. A review of the main body of the FEIS and Appendix C of the FEIS has identified 45 and 37 figures respectively that did not have a north arrow and/or a scale.

To some this may seem to a small or trivial matter, but as required by Section 1502.8 of NEPA, language and graphics are to be readily understandable by the public. Without a orth arrow and/or a scale, figures become less understandable or even meaningless.

It should be noted, that during the review of the SHEP DEIS, numerous comments were made about figures not having critical components that prevented the public from understanding or independently evaluating the figures. SDC in the response to comments stated that the critical components (north arrow and scale) had been added to the figures.

Figures from the FEIS that have insufficient information to allow the public to review includes: Figures 4-2, 4-6 through 4-14, 5-6 though 5-14, 5-18, 5-24, 5-25, 5-27, 5-29 through 5-48, 5-52, 5-57 and 5-59. Figures from Appendix C of the FEIS that have insufficient information to allow the public to review includes: Figures 2, 4 through 15, 22 25 through 28, 31 through 34, 36 through 43, 48, 50 through 52, 56, 57, and 60.

CEQ NEPA regulations (1502.24) requires that agencies "shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement." The SDC has failed to provide the explicit reference for conclusions in the statement. A review of the main body of the FEIS and Appendix C of the FEIS has identified 27 and 15 references not identified with the documents reference section. Not providing proper citations to each of these references, impedes the public review of the action as prohibited by Section 1502.21.

FEIS			Appendix C of the FEIS		
Citation	Paragraph	Page	Citation	Paragraph	Page
Anderson 1955	2	4-23	Aadland 2010	4	66
ANSI 2003	1	5-201	Burn & Honlala 1990	3	146
Bent 1923	3	4-55	Kitchens 2003	1	183
Bent 1923	3	4-55	Kossuth & Michele 1990	4	149
Bent 1926	1	4-53	Kucher 1964	1	142
Bent 1929	5	4-55	NRCS 1997	4	65
Blair et al 1990	2	5-141	Odum 1984	1	168
Bulter 1966	1	4-23	Outcalt	4	149
Carrier et al 1968	6	5-139	Schafale & Weakley 1990	2	149
Cushing 1988	2	5-140	Sharith and Mitsch 1993	1	143
Galtsoff 1964	1	4-23	USFWS 2007	3	172
Helmers 1992	4	4-59	Welch 2006	3	156
Howe 1989	7	4-52	Wharton 1978	3	146
Howe 1989	4	4-59	Wharton et al 1982	2	146
Kutkuhn 1966	2	4-23	WRDA 2000	3	65
Lantham 1994	3	5-30			
McLellan 1989	2	5-142			
Nicholos and Keney 1963	3	4-23			
NMFS March 23, 2006	1	5-157			
NMFS Nov. 4, 2011	6	5-159			
NOS 1999	Ft. Note	4-5			
P&G 1989	2	4-60			
Parasiewiez 1998	4	5-115			
Post & Gauthreaux 1989	5	4-54			
Van and Engel 1958	3	4-23			
Wallace 1996	1	4-23			
Wilbur 1974	2	4-52			

SDC used the SOP for determining the amount of mitigation to be provided. The SOP is unsuitable for a project of this magnitude. The SOP was developed for projects under 10 acres in size. However, the SOP has language allowing its use on large sites.

> "...This SOP may be used as a guide in determining compensatory mitigation requirements for projects with impacts greater than the above wetland and stream limits..."
> It also states that,

"...higher than calculated credit requirements would likely be applicable to larger impacts".

It is not apparent that "higher than calculated credit requirements" were used in the application of the SOP for this project. Indeed, as illustrated lower than calculated credit requirements appears to have been used in cases.

Several of the weighting factors used in the SDC's SOP calculations did not seem properly applied. All discrepancies in the weighting assigned by SDC worked towards reducing the total amount of mitigation required. Weighting factors believed not to be properly applied include:

Factor	SOP Worksheet
Adverse Effects/Impact Factors	
Dominant effect – Freshwater Marsh	Required Mitigation Credits
Dominant effect – Salt Marsh	Required Mitigation Credits
Preventability – Freshwater Marsh and Salt Marsh	Required Mitigation Credits
Restoration, Enhancement Creation Factors	
Net improvement Vegetation	Proposed Restoration / Enhancement
Net improvement Hydrology	Proposed Restoration / Enhancement
Kind	Proposed Restoration / Enhancement

Changing the weights to the more reasonable values would increase mitigation requirements.

There is not a comprehensive accounting of all impact associated with the proposed project that extends beyond the consideration for saltwater intrusion. Specifically, the project does not appear to have accounted for and mitigated for aquatic ecosystem impacts associated with: Intake, pipeline and freshwater storage lagoon to mitigate for chloride impacts to the City of Savannah surface water Municipal and Industrial water treatment plant. The SDC has not fully determined the need for these features yet; nor, has it quantified any of the impacts that would be associated with any alternatives. It states that if it decides to implement this chloride mitigation measure, it would quantify those impacts, identify the mitigation required using the Regulatory SOP, and mitigate for those impacts by acquiring the necessary credits from a USACE-approved mitigation bank. It also indicates that no matter which dredge alternative is selected; this measure will likely be required. Thus, it is difficult to accurately determined mitigation requirements if the impacts have not been fully quantified.

Figure 5-4 of the FEIS shows a channel being excavated within the preexisting mitigation site. If a channel is excavated within the preexisting mitigation site, wetlands will be lost. How will this loss of wetlands be mitigated?

8.3. Air Quality

FEIS, Section 5.06.1, Page 5-137
Comment: The national ambient air quality standards are shown in Table 5-47 on page 5-137. This table does not include many of the newer standards established by EPA and therefore should be updated to reflect the current standards. Table 5-47 should be revised as follows:

- For $PM_{2.5}$, include an annual standard of 15 $\mu g/m^3$
- For NO_2, include a 1-hour standard of 100 ppb
- For SO_2, the annual and daily standards shown in the table are no longer in effect and there is now a 1-hour standard of 75 ppb
- For lead, the applicable standard is 0.15 $\mu g/m^3$ (rolling 3-month average)
- For ozone, the applicable standard is 0.075 ppm

FEIS, Section 5.06.1, Page 5-137
Comment: In the paragraph following Table 5-47 on Page 5-137, ozone monitoring data for Savannah from 2006 is referenced. Since this data is now more than five years old, more recent ozone data should be used as the basis of the discussion.

FEIS, Section 5.06.1, Pages 5-138 and 5-139
Comment: There is no discussion or mention of the 1-hour NO_x and SO_2 ambient standards in this section. These new short-term federal standards have received significant attention on recent projects nationally as they can be substantially more difficult to meet in comparison with the daily and annual standards. Consideration of the harbor deepening project's expected impacts with respect to these new ambient air quality standards should be addressed.

8.4. Chlorides in Groundwater

Comment: While the overall conclusion that the impacts to groundwater are not expected to be significant appear reasonably well substantiated, quantifying the increased flow through the confining unit to 3-4% does not appear to be well substantiated given the uncertainty in leakance though this unit.

Comment: The groundwater analysis maintained groundwater withdrawals from the Floridan aquifer constant at 2000 levels, with the assumption that future use will decrease. Cited in the report was the GAEPD document entitled "Coastal Georgia Water and Waste Water Permitting Plan for Managing Salt-Water Intrusion" (2006) that indicated Georgia would reduce withdrawals from the Upper Floridan aquifer by 5 MGD by the end of 2008. It is not clear if the model assumption of decreasing groundwater use is valid:

a. Has groundwater use in the Upper Floridan aquifer decreased in Georgia and South Carolina as assumed in the model and analysis?
b. Did groundwater withdrawals from the Upper Floridan aquifer decrease by at least 5 MGD between 2006 and 2008 in Georgia?

Groundwater use trends and restrictions by GAEPD are discussed in various sections of the GRR and supporting appendices. There appears to be a lack of corresponding discussion on groundwater use and restrictions by SDHEC in South Carolina.

Comment: There has been a great deal of effort in characterizing the pore water for the Miocene confining unit and underlying Floridan aquifer. One key question evaluated in the DEIS is the rate of vertical movement through the clay, in particular the area near the mouth of the harbor where 1) the confining unit is thinnest; 2) surface water salinity is greatest; 3) paleochannels are abundant. Were any efforts made to age date the pore water and underlying groundwater from the Upper Floridan aquifer as a more direct measure of transport time?

Comment: One of six tasks to be completed related to the groundwater investigation was an *Aquitard Test Feasibility* that consisted of a "trial step-drawdown pumping test on two recently installed Upper Floridan wells located adjacent to river channel to determine feasibility of hydraulic testing of confining unit. If results indicate hydraulic testing of confining unit is feasible, estimate design parameters and assumptions for full aquitard testing." This test was not completed.

c. The groundwater model was used in place of the step drawdown test. Given that the model is developed from available field data and assumptions on characteristics of the aquifers and confining units, it is not at all clear how the model replaces the field test.

It would seem more reasonable to use the model to design an adequate aquitard test that may or may not include pumping directly from the Floridan aquifer, rather than use the model to try and disprove the need to conduct a "trial step-drawing" test altogether.
Comment: Conceptual mitigation measures to address potential chloride impacts to the Floridan aquifer:

a. Deposit channel sediments in nearshore areas where the groundwater aquifer is near the ocean floor.

b. Acquire but not use a permit from the State to withdrawal fresh water from the Upper Floridan aquifer.
c. Reduce pumping of groundwater by acquiring – but not using – permitted rights from industries to remove freshwater from the Upper Floridan aquifer.

These potential mitigation measures, in particular the last two, have significant ramifications on water use in the region by reducing overall water availability. The ability to acquire permitted rights in Georgia and presumably South Carolina, including existing permitted rights without replacing them with an alternate source raise significant questions regarding the viability of these conceptual mitigation alternatives.