112th Congress, 2d Session – – – – – – – – – – – – House Document 112–154

BROWARD COUNTY WATER PRESERVE AREAS PROJECT, COMPREHENSIVE EVERGLADES RESTORATION PLAN, CENTRAL AND SOUTHERN FLORIDA PROJECT, BROWARD AND MIAMI-DADE COUNTIES

COMMUNICATION

FROM

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

TRANSMITTING

A COMPREHENSIVE RESTORATION PLAN

PART 3 OF 3

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

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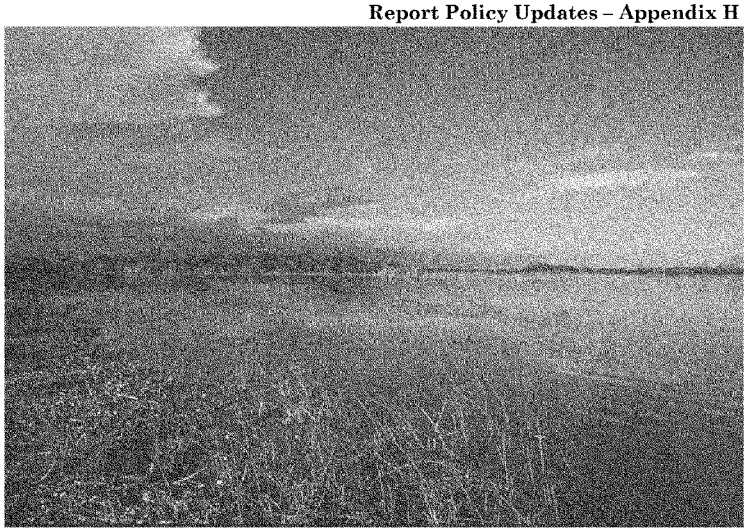
CENTRAL AND SOUTHERN FLORIDA PROJECT
BROWARD COUNTY WATER PRESERVE AREAS

REVISED FINAL
INTEGRATED PROJECT IMPLEMENTATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT

Cost Estimate – Appendix B
Environmental Information – Appendix C
Real Estate Plan – Appendix D
Agency and Public Coordination – Appendix E
Economic and Social Considerations – Appendix F
Recreation – Appendix G
Report Policy Updates – Appendix H



U.S. ARMY CORPS OF ENGINEERS
JACKSONVILLE DISTRICT

SOUTH FLORIDA WATER
MANAGEMENT DISTRICT

APRIL 2007 (REVISED MAY 2012)

This Report Contains 5 Volumes
You Are Here

Volume 1 – Main Report

- Abstract
- Executive Summary
- Table of Contents
- Section 1 – Introduction
- Section 2 – Existing Conditions/Affected Environment
- Section 3 – Future Without Project Condition
- Section 4 – Identification of Problems and Opportunities
- Section 5 – Formulation and Evaluation of Alternative Plans
- Section 6 – Environmental Effects
- Section 7 – The Selected Plan
- Section 8 – Plan Implementation
- Section 9 – Summary of Coordination, Public Views and Comments
- Section 10 – District Engineer's Recommendation
- Section 11 - List of Report Preparers
- Section 12 - Index
- Section 13 - Glossary of Terms
- Section 14 – Acronyms
- Section 15 – References

Volume 2 – Annexes A - B

- Annex A – FWCA and Endangered Species Act Compliance
- Annex B – NEPA Information

Volume 3 – Annexes C – F

- Annex C – Analyses Required by WRDA 2000 and State Law
- Annex D – Draft Project Operating Manual, Monitoring Plans and Vegetation Management Plan
- Annex E – Project Monitoring Plan
- Annex F - RECOVER Reports

Volume 4 – Appendix A

- Appendix A – Engineering

Volume 5 – Appendix A Part 2

- Appendix B – Cost Estimates
- Appendix C – Environmental Information
- Appendix D – Real Estate Plan
- Appendix E – Agency and Public Coordination
- Appendix F – Economic and Social Considerations
- Appendix G – Recreation
- Appendix H – Report Policy Updates

APPENDIX B

COST ESTIMATE

TABLE OF CONTENTS

B.0 COST ESTIMATES B-1
B.1 GENERAL INFORMATION B-1
B.1.1 Project Scope B-2
B.1.2 Estimating Methodology B-3
B.1.3 Project Schedule B-4
B.1.4 Total Project Cost Summary B-4
B.2 MCACES Cost Estimate B-6
B.3 SCHEDULE B-29
B.4 RISK AND UNCERTAINTY ANALYSIS B-33
B.4.1 Risk analysis methods B-33
B.4.2 Risk analysis results B-33
B.4.2.1 Construction Risk Register B-35
B.4.2.2 Real Estate Risk Register B-39
B.4.2.3 Construction Costs Risk ModelTable 3 ..... B-43
B.4.2.4 ** Note: This cost table does not include escalation and contingency B-44
Construction Costs Risk Model B-44
B.4.2.5 Construction Costs Results B-45
B.4.2.6 Schedule Risk Model B-49
B.4.2.7 Schedule Results B-57
B.5 TOTAL PROJECT COST SUMMARY B-60

LIST OF FIGURES

Figure 1. Project Risk Analysis Summary Graph B-45
Figure 2. Cost Risk Sensitivity Chart B-46
Figure 3. Frequency Chart Construction Duration (Months) B-57
Figure 4. Sensitivity Chart Construction Duration B-58

LIST OF TABLES

Table 1. Construction Risk Register B-35
Table 2. Real Estate Risk Register B-39
Table 3. Construction Costs Risk Model B-43
Table 4. Total Contingency Values B-47
Table 5. Schedule Risk Model B-49
Table 6. Forecast Values/Construction Duration B-59
Table 7. Total Project Cost Summary B-61

B.0 COST ESTIMATES

B.1 GENERAL INFORMATION

Corps of Engineers cost estimates for planning purposes are prepared in accordance with the following guidance:

- Engineer Instructions (EI) 01D010, Construction Cost Estimates, 1 September 1997 (also known as Unified Facilities Criteria 3-700-02A)
- Engineer Regulation (ER) 1110-1-1300, Cost Engineering Policy and General Requirements, 26 March 1993
- ER 1110-2-1302, Civil Works Cost Engineering, 31 March 1994
- ER 1110-2-1150, Engineering and Design For Civil Works Projects, 31 August 1999
- ER 1105-2-100, Planning Guidance Notebook, 22 April 2000, as amended
- Engineer Manual (EM) 1110-2-1304 (Tables revised 30 March 2007), Civil Works Construction Cost Index System, 31 March 2000
- CECW-CP Memorandum For Distribution, Subject: Initiatives To Improve The Accuracy Of Total Project Costs In Civil Works Feasibility Studies Requiring Congressional Authorization, 19 Sep 2007
- CECW-CE Memorandum For Distribution, Subject: Application of Cost Risk Analysis Methods To Develop Contingencies For Civil Works Total Project Costs, 3 Jul 2007
- Cost and Schedule Risk Analysis Process, March 2008
- ETL 1110-2-573, Construction Cost Estimating Guide for Civil Works, 30 September 2008

The goal of the Planning Level cost estimate for the Broward County Water Preserve Areas (BCWPA) study is to present a Total Project Cost (construction and non-construction costs) for the selected plan, in today's dollars, for project justification/authorization. Additionally, the total project cost summary sheet calculates a fully funded estimate (escalated for inflation through project completion) for budgeting purposes. The intent of these costing efforts is to produce a final product (cost estimate) that is reliable and accurate and that supports the definition of the Government's and the non-Federal sponsor's obligations. This estimate was prepared with the project at the primary level and the Civil Works Breakdown Structure (CWBS) feature code at the secondary level and is supported by labor, equipment, and materials for the majority of the cost items; however a few cost items are priced based upon subcontractor's quotes. A risk analysis was prepared that addresses uncertainties in the project and sets contingencies for selected plan cost items. A discussion of the risk analysis is included at the end of this appendix.

B.1.1 **Project Scope**

The Recommended Plan consists of three major features: C-11 Impoundment, WCA 3A/3B Seepage Management Area and the C-9 Impoundment. The recommended plan, Alt-A4 from the final array of proposed alternative plans, represents an optimal configuration of storage volume, conveyance and seepage control features, and water control structures (including pump stations, weirs, and culverts). The project also includes features for access and flood protection to protect existing structures within project features, and features to protect or compensate for existing wetlands mitigation projects within project features.

The C-11 Impoundment consists of an above-ground impoundment located in the C-11 Canal Basin in western Broward County. Major elements of this feature includes dam (D-511), a containment berm (L-511), a seepage collection canal (C-511), a mitigation canal (C-512) and a mitigation berm (L-512), on-site soil borrow and disposal areas, and miscellaneous demolition. The project also includes a 475 acre wetland mitigation area, recreational facilities, water control structures, and buffer marsh areas. Water control structures consist of pump stations, a gated spillway, gated and non-gated culverts, and a non-gated fixed weir.

The WCA 3A/3B SMA is an approximately 4,353-acre area bounded by WCAs 3A and 3B to the west and U.S. Highway 27 to the east. Major elements of this feature include levees, borrow canals and water control structures.

The C-9 Impoundment project includes approximately 1,804 acres of land to construct an above-ground impoundment with an effective interior storage area of 1,641 acres with water levels fluctuating up to 4.3 feet above grade. Primary earthwork features include a dam (D-509), seepage collection canals (C-509, C-509 East & C-509W), mitigation canals (C-509A & C-509B), southern mitigation berm (L-509A) and northern mitigation berm (L-509B), on-site soil borrow and disposal areas, and miscellaneous demolition. The project also includes an optional area of approximately 339 acres of wetland mitigation area.

B.1.2 **Estimating Methodology**

The MCACES/MII cost estimate for the Selected Plan (Section B.2, below) is based on the Plates G-3, G-11A thru G-11G and G-14 from the Final BCWPA PIR and Final EIS April 2007 report dated April 2007, Revised PIR Report and Plate G-15A the revised C-11 Typical Section provided. The estimate is formatted per the CWBS feature codes.

The estimate includes both construction and non-construction costs. The construction costs fall under the following feature codes:

- 02 Relocation
- 03 Reservoirs
- 08 Roads, Railroads, and Bridges
- 09 Channels and Canals
- 11 Levees and Floodwalls
- 13 Pumping Plant
- 14 Recreation Facilities
- 15 Floodway Control-Diversion Structures
- 18 Cultural Resource Preservation

The non-construction costs fall under the following feature codes:

- 01 Lands and Damages
- 30 Planning, Engineering and Design
- 31 Construction Management

Direct Costs. The direct cost for project elements identified in the plans and specifications were developed in the MCACES/MII estimate using labor, equipment, and materials for the majority of the cost items. However, a few cost items are priced based upon subcontractor quotes from various suppliers. Installed unit price quotes were obtained from sub-contractors for items such as soil cement. The database line item productivities have been used where possible with productivity adjustments made as necessary. Where required, new crews have been created using the appropriate number of equipment, size of equipment, and labor trades to fit the work activity. The Caterpillar Performance Handbook was the basis for the earthwork crew productivities used in this estimate.

This estimate assumes the prime contractor shall be a heavy civil contractor and will self-perform embankment placement, excavation, foundation drain installation, rip-rap placement, as well as the placement of various gravel drainage layers and aggregate bases/surfacing. The structural concrete, mechanical, electrical, controls, and general construction work will be subcontracted.

A 7.0% material sales tax has been included in the estimate.

The following prime contractor's markups were applied to the direct and sub-contractor's costs:

- Job Office Overhead - 8.0% (included, insurance, payment and bid bonds).
- Home Office Overhead - 7.0%
- Profit – 7.35% - (calculated per the weighted guidelines)
- Performance Bond – 2.0%

The risk analysis performed resulted in project contingencies of 18.9% for C-11, 33.5% for 3A/3B Seepage Area and 19.1% for C-9. The feature code contingencies identified by the risk analysis are included in the MCACES estimate. Additional information follows on the risk analysis. Major risk factors are shown in the sensitivity analyses.

Non-construction costs include Real Estate, Planning, Engineering and Design (PED), and Construction Management (Supervision and Administration, S&A). All real estate costs were provided by Real Estate Division.

Planning, Engineering and Design costs were calculated based upon a percentage of 8.0%.

Construction Management costs were calculated based upon a percentage of 7.6%

B.1.3 Project Schedule

The project schedule was prepared by U.S.COST. The construction schedule will be changed as the design of the project proceeds into the plans and specifications phase. Once the contract is awarded, the contractor will provide a construction schedule which may different from this draft schedule based on different crews along with shift work and overtime. The project schedule is provided below.

B.1.4 Total Project Cost Summary

The Total Project Cost Summary (TPCS) includes escalation through project completion. The MCACES/MII estimate is priced in today's dollars and does not contain escalation to midpoint of construction since this is incorporated in the TPCS.

The cost estimate for the Selected Plan is prepared with an identified price level date. Inflation factors are used to adjust the pricing to the project schedule. This estimate is known as the Fully Funded Cost Estimate or Total Project Cost

Summary. It includes all Federal and non-Federal costs: Lands, Easements, Rights of Way and Relocations; construction features; Preconstruction Engineering and Design; Construction Management; Contingency; and Inflation.

B.2 MCACES Cost Estimate

10

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Title Page

BCWPA_PIR_050411

Estimated by	U.S.COST
Designed by	Jacksonville District
Prepared by	Howard Campbell/ Revisions by: Derek Martin
Preparation Date	5/4/2011
Effective Date of Pricing	2/6/2012
Estimated Construction Time	Days

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Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

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Library Properties Page 1

Designed by

Jacksonville District
Estimated by
U.S.COST
Prepared by
Howard Campbell/ Revisions by: Derek Martin

Design Document	Plates G-1 thru G-14, 2011 PIR Report, G15 A/B
Document Date	2/6/2012
District	Jacksonville District
Contact	Derek Martin
Budget Year	2012
UOM System	Original

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost
Other

Timeline/Currency

Preparation Date	5/4/2011
Escalation Date	3/31/2011
Eff. Pricing Date	2/6/2012
Estimated Duration	0 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB08EB: MII English Cost Book 2008

Labor LFL2010: Labor_Florida_2010B_4.1

Labor Rates
LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP09R03: MII Equipment Region 3 2009

03 SOUTHEAST

Sales Tax	8.50
Working Hours per Year	1,530
Labor Adjustment Factor	0.86
Cost of Money	2.00
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.089
Gas	3.440
Diesel Off-Road	3.500
Diesel On-Road	3.850

Shipping Rates

Over 0 CWT	14.96
Over 240 CWT	13.61
Over 300 CWT	11.62
Over 400 CWT	9.72
Over 500 CWT	5.42
Over 700 CWT	5.42
Over 800 CWT	8.01

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Print Date Thu 9 February 2012
Eff. Date 2/6/2012

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Project : BCWPA_PIR 050411
COE Standard Report Selections

Time 15:31:32

Project Notes Page ii

Date	Author	Note
11/5/2010	H Campbell	Alt A4 was the plan selected from the final array of proposed alternative plans. Project FeaturesThe Broward County Water Preserve Area consists of three major features: C-11 Impoundment, WCA 3A/3B Seepage Management Area and the C-9 Impoundment. The designed plan represents an optimal configuration of storage volume. conveyance and seepage control features, and water control structures (including pump stations, weirs, and culverts). The project also includes features for access and flood protection to protect existing structures within project features, andfeatures to protect or compensate for existing wetlands mitigation projectswithin project features.C-11 ImpoundmentThe C-11 Impoundment is located in western Broward County, adjacent to andeast of U.S. Highway 27. The northern boundary of this feature is approximately 3.5 miles south of the I-75/U.S.-27 interchange. The southern boundary of this component is the C-11 Canal. This component is approximately 2.3 miles in length from north to south, and is approximately 1.5 miles in width from east to west in the northern portion, and approximately 1.0 mile in width in the southern portion.The C-11 Impoundment consists of an above-ground impoundment located in theC-11 Canal Basin in western Broward County. Major elements of this featureinclude canals, levees, water control structures, and buffer marsh areas. Watercontrol structures consist of pump stations, a gated spillway, gated and nongatedculverts, and a non-gated fixed weir. The design of the impoundment includes approximately 1,253 acres to construct an above-ground impoundment to 4.3 feet above grade. The purpose of the C-11 Impoundment feature is to direct runoff events from the Western C-11 drainage basin into the impoundment instead of pumping the untreated runoff into WCA 3A through the S-9 pump station. The impoundment pool will also assist in reducing seepage from WCA 3A and the WCA 3A/3B SMA, thereby increasing groundwater recharge in the vicinity of the impoundment and providing an additional source of water for meeting the municipal and agricultural water supply demands and for preventing saltwater intrusion into drinking water aquifers. Water will be released from the impoundment to the C-11 Canal to help maintain canal stages during the dry season, recharge south Broward County wellfields, improvegroundwater elevations in the eastern C-11 Basin and to maintain water levelsin Pond Apple Slough. Seepage from the impoundment will be collected andreturned to the impoundment. The C-11 Impoundment includes approximately578 acres to construct an approximate 475-acre buffer marsh along the northernportion of the project area and an additional 13-acre created marsh. The recreation site of C-11 will include a parking area for visitors to the impoundment along with a proposed canoe launch with a platform walkway, an information kiosk, shaded benches, footbridges, and other small amenities.WCA 3A/3B Seepage Management AreaThe WCA 3A/3B SMA is an approximately 4,633-acre area bounded by WCAs 3Aand 3B to the west and U.S. Highway 27 to the east. Major elements of this feature include levees, canals, and water control structures. The purpose of this feature is to establish a buffer area creating a hydraulic head for reducing seepage out of WCAs 3A and 3B. This will improve hydropatterns for fish and wildlife habitat in those areas, particularly during dry periods by maintaining longer inundation periods within adjacent Everglades marsh areas. The WCA 3A/3B SMA also includes bridges to maintain access to existing structures within the SMA and flood damage reduction features (pumps, levees, seepage canals) to protect existing features within the SMA from higher water levels. The 3A/3B SMA includes a full-length protective levee that functions to separate wetland or natural area water (seepage and precipitation) from agricultural and urban runoff and other water sources with different water quality constituents. The 3B SMA also includes a diversion conveyance canal that functions in transference of excess water from the Western C-11 Basin to the C-9 Impoundment and in the future to North Lake Belt Storage Area (NLBSA). The C-502B Borrow Canal connecting the C-11 Impoundment to the C-9 Impoundment traverses the WCA 3A/3B SMA feature. The 3A/3B SMA recreation area will consist of a parking area for visitors along with a footbridge over the C-11 Canal that connects the north and south areas of the SMA. The foot bridge allows people to move around the S-9 pump. Twocanoe launches are proposed: one in 3A and one in 3B each accessing the borrowcanal inside the project along the L-37 levee. The conceptual design proposes aninformation kiosk, shaded benches, a footbridge, two canoe launches withplatform walkways, two bike racks, and other small amenities.C-9 ImpoundmentThe C-9 Impoundment is located in southwestern Broward County, adjacent toand east of U.S. Highway 27. The northern boundary of the project isapproximately 10.7 miles south of the I-75/US-27 Interchange. The southernboundary of this feature is the C-9 Canal. The impoundment is approximately1.4 miles in width from east to west and is approximately 1.3 miles in lengthfrom north to south. The C-9 Impoundment consists of an above-ground impoundment located in the western C-9 Basin. Major elements of this feature include canals, levees, and water control structures. The impoundment area includes approximately 1,804 acres to construct an above-ground impoundment with an effective interior storage area of 1,641 acres with water levels fluctuating up to 4.3 feet above grade. The purpose of the C-9 Impoundment feature is to collect and store runoff from the western C-9 Canal Basin in the impoundment, along with providing additional storage for runoff diverted from the western C-11 Basin. C-11 Basin runoff will be directed to the C-9 Impoundment via the C-502B Borrow Canalwhich traverses the WCA 3A/3B SMA feature. The impoundment pool will assist in reducing seepage from WCA 3B and the WCA 3A/3B SMA, thereby increasing groundwater recharge in the vicinity of the impoundment, and provide an additional source of water for meeting the municipal and agricultural water supply demands and for preventing saltwater intrusion into drinking water aquifers. Water will be released from the impoundment to the C-9 Canal to help maintain canal stages during the dry season, recharge south Broward County wellfields, and improve groundwater elevations in the C-9 Basin. Seepage from the impoundment will be collected and returned to the impoundment. The C-9 Impoundment includes approximately 247 acres to construct an adjacent 234-acre 1-foot deep wetland marsh area and approximately 136 acres required to construct a 105-acre 2-feet deep wetland marsh area, adjacent to the existing C-9 Canal. A stormwater treatment area (STA) is associated with both the C-11 and the C-9 impoundments when other CERP projects (including the Lake Belt Storage Area projects) are implemented, which will necessitate treatment of stored runoff prior to delivery to natural system areas. However, the BCWPA Project does not involve delivering stored water to natural system areas at this time; therefore, the

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

13

Print Date Thu 9 February 2012 U.S. Army Corps of Engineers Time 15:31:32
Eff. Date 2/6/2012 Project : BCWPA_PIR 050411
COE Standard Report Selections Project Notes Page iii

Date	Author	Note
11/5/2010	H Campbell	implementation of the STA associated with the C-11 and C-9 impoundments is not included for implementation as part of the BCWPA Project. Future CERP projects requiring water quality treatment will address conversion of the C-11 and C-9 impoundments to STAs.The recreation site at C-9 will consist of a parking area for visitors to theimpoundment along with a proposed information kiosk, shaded benches,footbridges, a canoe launch with a platform walkway, and other small amenitiesfor visitors.
11/5/2010	H Campbell	Project Feature Construction Sequence1. C-11 Impoundment 2. WCA 3A/3B Seepage Management Area3. C-9 Impoundment
11/5/2010	H Campbell	Feature Note - C-11 Project DescriptionThe C-11 Impoundment project includes a approximately 1,253 acres to construct an above-ground impoundment to 4.3 feet above grade Primary earthwork features include dam (D-511), a containment berm (L-511), a seepage collection canal (C-511), a mitigation canal (C-512) and a mitigation berm (L-512), on-site soil borrow and disposal areas, and miscellaneous demolition. The project also includes a 475 acre wetland mitigation area, recreational facilities for wildlife observation and fishing. Hydraulic control structures for water intake and discharge are listed below.Canals 1. C11 Seepage2. MitigationLevees1. Impoundment Levee2. Containment Dike3. Mitigation Berm Pumping Plant1. S-503 is a 1,500 cfs pumping station. Floodway Control-Diversion Structures1. S 503A - 200 csf 5'x6' Gated Culvert at Pump Station2. S-504 - 1000 cfs 8'x8' Gated Box Culvert.3. S 504BN - 250 csf 6'x8' Risers w/72" Dia RCP Outlet4. S 504BS - 250 csf 6'x8' Risers w/72" Dia RCP Outlet5. S 504BE - 250 csf 6'x8' Risers w/72" Dia RCP Outlet6. S 504BW - 250 csf 6'x8' Risers w/72" Dia RCP Outlet7. S 505A - 250 csf Fixed Weir-w/8'x8' Gate8. S 505B - 75 csf Fixed Weir-150' long9. S 505C - 250 csf Fixed Weir-154' long10. S 505D 10'x10' Ungated Culverts11. S 505E 12'x12' Ungated Culverts12. S 506A - 55 csf 48" Gated Culvert w/manhole (SAG13. S 506B - 75 csf 60" Culverts14. S 507A 48" Ungated Culvert 15. S 507B 48" Ungated Culvert16. S 507C 48" Ungated Culvert 17. S 507D 48" Ungated Culvert 18. S 507E 48" Ungated Culvert 19. S 507F 48" Ungated Culvert 20. S-508A 48" Ungated Culvert21. S-508B 72" Ungated Culvert22. S 508C 48" Ungated Culvert23. S 508D 48" Ungated CulvertProject Location: The project is located in western Broward County, adjacent to andeast of U.S. Highway 27. The northern boundary of this feature is approximately 3.5 miles south of the I-75/U.S.-27 interchange. The southern boundary of this component is the C-11 Canal. This component is approximately 2.3 miles in length from north to south, and is approximately 1.5 miles in width from east to west in the northern portion, and approximately 1.0 mile in width in the southern portion. Documents Used as the Basis for this Estimate: Plates G-3, G-11A thru G-11G and G-14 from the Final BCWPA PIR and Final EIS April 2007 report dated April 2007, Revised PIR Report and Plate G-15A the revised C-11 Typical Section.Volatile Cost Items: Two categories of volatile cost items are fuel (gasoline, on-road diesel and off-road diesel) and materials (e.g., fabrication materials for the pumping equipment, steel, concrete).Construction is scheduled to begin in February 8, 2016 and end June 8, 2018, lasting 28 months, with an April 9, 2017 midpoint of construction.Construction Windows: There are no known environmental windows at this time.Escalation N/A.1. Taxes: Sales tax is applied at 7.0%.2. FOOH: Applied at 8.0% of running costs for prime contractor3. HOOH: Applied at 5.0% of running costs for prime contractor.4. Profit: 7.35% Calculated per tables for the prime contractor.5. Bond: Applied at 2.0% of running costs for prime contractor.6. Price Level: May 20117. Productivity: 90%8. Overtime Usage: 10 hrs/day // 5 days/week.9. Contingency: 0.0%10. PED costs: 8.0%.11. S&A costs: 7.6%.Site Access: The project construction site is accessible via major highway/local roads/improved roadways.Fill Material: Fill material will be obtained from the canal excavations and the berm foundation excavations. No borrow excavation required.Granular Drainage Material: Granite drainage material will be obtained from out of state sources.Unusual Conditions (Soil, Water, and Weather): Florida has two weather seasons, the rainy season from June 1 to October 31 and the dry season from November 1 to May 31. Ground waters Elevation is 6.5 Fteet. Hard porous limestone bedrock is at a depth of about two feet to four feet.Unique Construction Techniques: It is anticipated that a prudent, well-equipped contractor can perform the construction.Equipment and Labor Availability and Distance Traveled: This estimate assumes equipment and labor availability of a prudent and well-equipped contractor, as indicated in Engineer Instructions 01D010, 1 Sep 1997 (Unified Facilities Criteria 3-700-02A, 01 March 2005). Due to the proximity of the project's to Boca Raton & Ft. Lauderdale, FL, it is assumed that the distance traveled is within a day's commute.Environmental Concerns During Construction: See note above on Environmental Windows.Acquisition Plan: Competitive Bid. Sub-contracting Plan: The prime contractor will be a heavy civil contractor and do the clearing & grubbing, emparkment placement, excavation and installion of the aggregate and weir surfacing. The structural concrete, mechanical, electrical, controls, and general construction work will be subcontracted.Construction Sequence: Single phase.Federal and Non-Federal cost sharing requirements: 50/50Databases used: MII English Cost Book 2008, MII Equipment Region 3r 2007 & Broward County 050311.Effective Dates for Labor, Equipment and Material Pricing: May 2011
11/5/2010	H Campbell	Feature Note - WCA 3A/3B Seepage Management Area Project DescriptionThe WCA 3A/3B SMA is an approximately 4,633-acre area bounded by WCAs 3A and 3B to the west and U.S. Highway 27 to the east. Major elements of this feature include levees, canals, and water control structures Primary earthwork features include dam (D-511), a containment berm (L-511), a seepage collection canal (C-511), a mitigation canal (C-512) and a mitigation berm (L-512), on-site soil borrow and disposal areas, and miscellaneous demolition. The project also includes a 475 acre wetland mitigation area, recreational facilities for wildlife observation and fishing. Hydraulic control structures for water intake and discharge are listed below.Canals 1. C-502 A Reach 1, 2, & 32. C-502 B Reach 1, 2, 3, 4 & 53. C-5034. C-502D Jones Park Levee Borrow Canal5. Holley Lakes Levee Borrow CanalLevees 1. L502 A Reach 1,2,& 32. L502 B Reach 1,2, 3, 4 & 53. L5034. FP&L Berm5. Jones Park Protection

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
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COE Standard Report Selections

Time 15:31:32

Project Notes Page iv

Date	Author	Note
11/5/2010	H Campbell	Levee6. Holly Lakes Protection Levee7. Bishop/Nixon Protection Levee Pumping Plants 1. S 514A Pump Plant 60 CFS2. S 514B Pump Plant 10 CFS Floodway Control-Diversion Structures2. S-502B Gated Culvert3. S-515 Gated Culvert - 600 csf4. S516A Triangular Concrete Weir5. S516B Triangular Concrete Weir6. FPL Maint Rd Cul. 1-4 & 7-9 - < 1 csf7. FPL Maint Rd Cul. 5 & 68. FPL Maint Rd Cul. 10-19Project Location: The project is located in western Broward County, with WCAs 3Aand 3B to the west and U.S. Highway 27 to the east.Documents Used as the Basis for this Estimate: Plates G-1 thru G-10, G-13 thru G-14 from the Final BCWPA PIR and Final EIS April 2007 report dated April 2007 and Revised PIR Report.Volatile Cost Items: Two categories of volatile cost items are fuel (gasoline, on-road diesel and off-road diesel) and materials (e.g., fabrication materials for the pumping equipment, steel, concrete).Construction is scheduled to begin in December 1, 2019 and end March 3, 2022, lasting 27 months, with an January 16, 2021 midpoint of construction. Construction Windows: There are no known environmental windows at this time.Escalation N/A.1. Taxes: Sales tax is applied at 7.0%.2. FOOH: Applied at 8.0% of running costs for prime contractor3. HOOH: Applied at 5.0% of running costs for prime contractor.4. Profit: 7.35% Calculated per tables for the prime contractor.5. Bond: Applied at 2.0% of running costs for prime contractor.6. Price Level: May 20117. Productivity: 90%8. Overtime Usage: 10 hrs/day // 5 days/week.9. Contingency: 0.0%10. PED costs: 8.0%.11. S&A costs: 7.6%.Site Access: The project construction site is accessible via major highway/local roads/improved roadways.Fill Material: Fill material will be obtained from the canal excavations and the berm foundation excavations. No borrow excavation required.Granular Drainage Material: Granite drainage material will be obtained from out of state sources.Unusual Conditions (Soil, Water, and Weather): Florida has two weather seasons, the rainy season from June 1 to October 31 and the dry season from November 1 to May 31. Ground waters Elevation is 6.5 Fteet. Hard porous limestone bedrock is at a depth of about two feet to four feet.Unique Construction Techniques: It is anticipated that a prudent, well-equipped contractor can perform the construction.Equipment and Labor Availability and Distance Traveled: This estimate assumes equipment and labor availability of a prudent and well-equipped contractor, as indicated in Engineer Instructions 01D010, 1 Sep 1997 (Unified Facilities Criteria 3-700-02A, 01 March 2005). Due to the proximity of the project's to Boca Raton & Ft. Lauderdale, FL, it is assumed that the distance traveled is within a day's commute.Environmental Concerns During Construction: See note above on Environmental Windows.Acquisition Plan: Competitive Bid. Sub-contracting Plan: The prime contractor will be a heavy civil contractor and do the clearing & grubbing, empankment placement, excavation and installion of the aggregate and weir surfacing. The structural concrete, mechanical, electrical, controls, and general construction work will be subcontracted.Construction Sequence: This project will be constructed with three concurrent segments using seperate crews for each segment. Segment 1 iincludes 502A Reachs 1 thru 3. Segment 2 iincludes 502B Reachs 1 thru 3, 502C, 502E & 502F. Segment 3 iincludes 3502B Reachs 4 thru 5, 503 and 502D. Federal and Non-Federal cost sharing requirements: 50/50Databases used: MII English Cost Book 2008, MII Equipment Region 3r 2007 & Broward County 050311.Effective Dates for Labor, Equipment and Material Pricing: May 2011
11/5/2010	H Campbell	Feature Note - C-9 Project DescriptionThe C-9 Impoundment project includes a approximately 1,804 acres to construct an above-ground impoundment with an effective interior storage area of 1,641 acres with water levels fluctuating up to 4.3 feet above grade. Primary earthwork features include dam (D-509), seepage collection canals (C-509, C-509 East & C-509W), mitigation canals (C-509A & C-509B), southern mitigation berm (L-509A) and northern mitigation berm (L-509B), on-site soil borrow and disposal areas, and miscellaneous demolition. The project also includes 339 acres of wetland mitigation area, recreational facilities for wildlife observation and fishing. Hydraulic control structures for water intake and discharge are listed below.Canals 1. Seepage2. North and South MitigationLevees 1. Impoundment Levee2. Mitigation Berm Pumping Plants 1. S 509 Pump Plant 1075 CFS2. S 512A Pump Plant 225 CFS Floodway Control-Diversion Strucures1. S510 2-Gated Spillway2. S510A Emergency Spillway C9 IM 2000csf3. S511 Gated Culvert 500csf4. S512B CIT Weir 150csf5. S512B Flap Gated Culvert 150csf6. S512C CIT Weir 150csf7. S512C Flap Gated Culvert 150csf8. S513A Gated Culvert 50csf9. S-513B Structure 25csfProject Location: The project is located in southwestern Broward County, adjacent to and east of U.S. Highway 27. The northern boundary of the project isapproximately 10.7 miles south of the I-75/US-27 Interchange. The southernboundary of this feature is the C-9 Canal. The impoundment is approximately1.4 miles in width from east to west and is approximately 1.3 miles in lengthfrom north to south.Documents Used as the Basis for this Estimate: Plates G-5, G-6, G-12 thru G-14 from the Final BCWPA PIR and Final EIS April 2007 report dated April 2007, Revised PIR Report and Plate G-15B the revised C-9 Typical Section.Volatile Cost Items: Two categories of volatile cost items are fuel (gasoline, on-road diesel and off-road diesel) and materials (e.g., fabrication materials for the pumping equipment, steel, concrete).Construction is scheduled to begin in October 1, 2023 and end June 5, 2026, lasting 32.2 months, with an February 1, 2025 midpoint of construction. Construction Windows: There are no known environmental windows at this time.Escalation N/A.1. Taxes: Sales tax is applied at 7.0%.2. FOOH: Applied at 8.0% of running costs for prime contractor3. HOOH: Applied at 5.0% of running costs for prime contractor.4. Profit: 7.35% Calculated per tables for the prime contractor.5. Bond: Applied at 2.0% of running costs for prime contractor.6. Price Level: May 20117. Productivity: 90%8. Overtime Usage: 10 hrs/day // 5 days/week.9. Contingency: 0.0%10. PED costs: 8.0%.11. S&A costs: 7.6%.Site Access: The project construction site is accessible via major highway/local roads/improved roadways.Fill Material: Fill material will be obtained from the canal excavations and the berm foundation excavations. No borrow excavation required.Granular Drainage Material: Granite drainage material will be obtained from out of state sources.Unusual Conditions (Soil, Water, and Weather): Florida has two weather seasons, the rainy season from June 1 to October 31 and the dry season from November 1 to May 31.

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date:Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR_050411
COE Standard Report Selections

Time 15:31:32

Project Notes Page v

Date	Author	Note
11/5/2010	H Campbell	Ground waters Elevation is 6.5 Fteet. Hard perous limestone bedrock is at a depth of about two feet to four feet.Unique Construction Techniques: It is anticipated that a prudent, well-equipped contractor can perform the construction.Equipment and Labor Availability and Distance Traveled: This estimate assumes equipment and labor availability of a prudent and well-equipped contractor, as indicated in Engineer Instructions 01D010, 1 Sep 1997 (Unified Facilities Criteria 3-700-02A, 01 March 2005). Due to the proximity of the project's to Boca Raton & Ft. Lauderdale, FL, it is assumed that the distance traveled is within a day's commute.Environmental Concerns During Construction: See note above on Environmental Windows.Acquisition Plan: Competitive Bid. Sub-contracting Plan: The prime contractor will be a heavy civil contractor and do the clearing & grubbing, empankment placement, excavation and installion of the aggregate and weir surfacing. The structural concrete, mechanical, electrical, controls, and general construction work will be subcontracted.Construction Sequence: Single phase.Federal and Non-Federal cost sharing requirements: 50/50Databases used: MII English Cost Book 2008, MII Equipment Region 3r 2007 & Broward County 050311.Effective Dates for Labor, Equipment and Material Pricing: May 2011
8/30/2011	D. Martin	Access Bridge has been change to reflect "Maintenance Bridge"Microwave Tower located in C-11Removed all Clear and grub down to 20% of original cost for clearing and grubbing in areas not specified for Clearing and grubbing. New number for Local in-State Material is $28.00/TN and Haul rate of $8.50/TN
1/3/2012	D. Martin	Gerald and Joe,Here is the basic design for the Canal along the north side of Krome Avenue. The velocity in the Canal will be below 1.5 ft/s for 300 cfs of flow.Extension Length5000feetAverage Ground Elevation4ft-NGVDBottom of Canal-3ft-NGVDDepth of Cut7feetCanal Bottom Width15feetLeft Side Slope 1 on =1Right Side Slope 1 on =1Ground Topwidth29feetVolume of Cut28,519cubic yardsThe levee height would match the existing levee in this portion of the SMA, which is top of levee at 6.50 ft-NGVD.
1/9/2012	D. Martin	Just to clarify the deletions for this change, L-502, C-502, L-503 Reach 1, C-503 Reach 1, S-514B, S-516B. I guess the new canal and levee will carry the designation C-502B Reach 5 and L-502B Reach 5, respectively. I also propose leaving the control structure S-516A in the plan for now. If down the road it is determined that S-516A should be removed then it can be deleted.
1/9/2012	D. Martin	We will be tying into L-33 Canal instead of the C-6 Canal, so some of the wording will need to be updating in the Appendix. I currently have the Appendix checked out to make these corrections.
1/31/2012	D. Martin	Leaving C503 reach 1 in place as originally designed and approved. No changes.Leaving L503 Reach 1 in place as originally designed and approved. No Changes.Also leaving S-516B as originally designed and approved.
2/9/2012	D. Martin	Costs increased in pumping areas due to the fact that there were no contractor markups originally in place.Also all labor and equipment labraries were updated.

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012 | U.S. Army Corps of Engineers | Time 15:31:32
Eff. Date 2/6/2012 | Project : BCWPA_PIR_050411 | Markup Properties Page vi
COE Standard Report Selections

Direct Cost Markups	**Category**	**Method**
Mob & De-Mob	MiscDirect	Running % on Selected Costs
EQCost		

Productivity rain days — Productivity — Productivity

Overtime - 10 Hrs / 5 Days — Overtime — Overtime

	Days/Week	*Hours/Shift*	*Shifts/Day*	*1st Shift*	*2nd Shift*	*3rd Shift*
Standard	*5.00*	*8.00*	*1.00*	*8.00*	*0.00*	*0.00*
Actual	*5.00*	*8.00*	*1.00*	*10.00*	*0.00*	*0.00*

Day	*OT Factor*	*Working*	*OT Percent*	*FCCM Percent*
Monday	*1.50*	*Yes*	*10.00*	*(20.00)*
Tuesday	*1.50*	*Yes*		
Wednesday	*1.50*	*Yes*		
Thursday	*1.50*	*Yes*		
Friday	*1.50*	*Yes*		
Saturday	*1.50*	*No*		
Sunday	*2.00*	*No*		

Overtime - Dewatering — Overtime — Overtime

	Days/Week	*Hours/Shift*	*Shifts/Day*	*1st Shift*	*2nd Shift*	*3rd Shift*
Standard	*5.00*	*8.00*	*3.00*	*8.00*	*8.00*	*8.00*
Actual	*7.00*	*8.00*	*3.00*	*8.00*	*8.00*	*8.00*

Day	*OT Factor*	*Working*	*OT Percent*	*FCCM Percent*
Monday	*1.50*	*Yes*	*21.43*	*(76.19)*
Tuesday	*1.50*	*Yes*		
Wednesday	*1.50*	*Yes*		
Thursday	*1.50*	*Yes*		
Friday	*1.50*	*Yes*		
Saturday	*1.50*	*Yes*		
Sunday	*2.00*	*Yes*		

Sales Tax	TaxAdj	Running % on Selected Costs
MatlCost		
200' Adder	MiscDirect	Running % on Selected Costs
LaborCost		
EQCost		
MatlCost		
SubBidCost		
ShipCost		
Other		
UserCost2		
UserCost3		
UserCost4		
UserCost5		

Contractor Markups	**Category**	**Method**

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012 U.S. Army Corps of Engineers Time 15:31:32
Eff. Date 2/6/2012 Project : BCWPA_PIR_050411
COE Standard Report Selections Markup Properties Page vii

JOOH - 3A/3B & C-9 (Small Tools)	JOOH		% of Labor	
JOOH - 3A/3B & C-9	JOOH		JOOH (Calculated)	
JOOH - C-11 (Small Tools)	Allowance		% of Labor	
JOOH - C-11	JOOH		JOOH (Calculated)	
JOOH - %	JOOH		Running %	
HOOH - %	HOOH		Running %	
Contractor's Risk	MiscContract		Direct %	
Profit - %	Profit		Running %	
Profit - Calculated	Profit		Profit Weighted Guidelines	
Guideline		*Value*	*Weight*	*Percentage*
Risk		*0.050*	*20*	*1.60*
Difficulty		*0.050*	*15*	*1.20*
Size		*0.030*	*15*	*0.45*
Period		*0.120*	*15*	*1.80*
Invest (Contractor's)		*0.060*	*5*	*0.30*
Assist (Assistance by)		*0.100*	*5*	*0.50*
SubContracting		*0.060*	*25*	*1.50*
Total			*100*	*7.35*
Bond - %	Bond		Running %	
Bond - Tables	Bond		Bond Table	
Class B, Tiered, 24 months, 1.00% Surcharge				
Contract Price		*Bond Rate*		
500,000		*15.84*		
2,000,000		*9.57*		
2,500,000		*7.59*		
2,500,000		*6.93*		
100,000,000,000		*6.34*		
Excise Tax	Excise		Running %	
JOOH - Sub	JOOH		Running %	
HOOH - Sub	HOOH		Running %	
Profit - Sub	Profit		Running %	
Bond - Sub	Bond		Running %	
Owner Markups	**Category**		**Method**	
Escalation	Escalation		Escalation	
StartDate	*StartIndex*	*EndDate*	*EndIndex*	*Escalation*
10/8/2010	*0.00*	*10/8/2010*	*0.00*	*0.00*
Contingency	Contingency		Running %	

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR_050411
COE Standard Report Selections

Time 15:31:32
Project Cost Summary Report Page 1

Description	Quantity	UOM	ContractCost	Escalation	Contingency	SIOH	ProjectCost
Project Cost Summary Report			**746,117,597**	**0**	**0**	**0**	**746,117,597**
01 BROWARD CO. WPA PIR C11 Impoundment	**1.00**	**LS**	**360,042,820**	**0**	**0**	**0**	**360,042,820**
CONSTRUCTION COST	**1.00**	**LS**	**137,662,221**	**0**	**0**	**0**	**137,662,221**
02 Relocations	**1.00**	**EA**	*256,278.39* **256,278**	**0**	**0**	**0**	*256,278.39* **256,278**
03 Reservoirs	**1.00**	**EA**	*9,483,485.11* **9,483,485**	**0**	**0**	**0**	*9,483,485.11* **9,483,485**
08 Roads, Railroads, and Bridges	**1.00**	**EA**	*4,919,022.11* **4,919,022**	**0**	**0**	**0**	*4,919,022.11* **4,919,022**
09 Channels and Canals	**1.00**	**EA**	*13,378,931.35* **13,378,931**	**0**	**0**	**0**	*13,378,931.35* **13,378,931**
11 Levees and Floodwalls	**1.00**	**EA**	*47,806,795.67* **47,806,796**	**0**	**0**	**0**	*47,806,795.67* **47,806,796**
13 Pumping Plant	**1.00**	**EA**	*44,256,994.54* **44,256,995**	**0**	**0**	**0**	*44,256,994.54* **44,256,995**
14 Recreation Facilities	**1.00**	**EA**	*1,884,011.61* **1,884,012**	**0**	**0**	**0**	*1,884,011.61* **1,884,012**
15 Floodway Control-Diversion Struc	**1.00**	**EA**	*14,829,709.13* **14,829,709**	**0**	**0**	**0**	*14,829,709.13* **14,829,709**
16 Cultural Resource Preservation	**1.00**	**EA**	*846,993.46* **846,993**	**0**	**0**	**0**	*846,993.46* **846,993**
NON CONSTRUCTION COST	**1.00**	**LS**	**222,380,599**	**0**	**0**	**0**	**222,380,599**
01 Lands and Damages	**1.00**	**EA**	*200,905,292.00* **200,905,292**	**0**	**0**	**0**	*200,905,292.00* **200,905,292**
30 Preconstruction Engineering & Design	**1.00**	**EA**	*11,012,977.71* **11,012,978**	**0**	**0**	**0**	*11,012,977.71* **11,012,978**
31 Construction Management	**1.00**	**EA**	*10,462,328.82* **10,462,329**	**0**	**0**	**0**	*10,462,328.82* **10,462,329**
02 BROWARD Co. WPA PIR 3A/3B	**1.00**	**LS**	**196,618,486**	**0**	**0**	**0**	**196,618,486**
CONSTRUCTION COST	**1.00**	**LS**	**57,246,995**	**0**	**0**	**0**	**57,246,995**
02 Relocations	**1.00**	**EA**	*10,923,323.31* **10,923,323**	**0**	**0**	**0**	*10,923,323.31* **10,923,323**

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR 050411
COE Standard Report Selections

Time 15:31:32
Project Cost Summary Report Page 2

Description	Quantity	UOM	ContractCost	Escalation	Contingency	SIOH	ProjectCost
03 Reservoirs	1.00	EA	*4,094,264.89* 4,094,265	0	0	0	*4,094,264.89* 4,094,265
08 Roads, Railroads, and Bridges	1.00	EA	*216,378.19* 216,378	0	0	0	*216,378.19* 216,378
09 Channels and Canals	1.00	EA	*22,559,906.43* 22,559,906	0	0	0	*22,559,906.43* 22,559,906
11 Levees and Floodwalls	1.00	EA	*9,200,020.51* 9,200,021	0	0	0	*9,200,020.51* 9,200,021
13 Pumping Plant	1.00	EA	*2,807,219.58* 2,807,220	0	0	0	*2,807,219.58* 2,807,220
14 Recreation Facilities	1.00	EA	*1,891,087.40* 1,891,087	0	0	0	*1,891,087.40* 1,891,087
15 Floodway Control-Diversion Struc	1.00	EA	*5,554,794.46* 5,554,794	0	0	0	*5,554,794.46* 5,554,794
NON CONSTRUCTION COST	1.00	LS	139,371,491	0	0	0	139,371,491
01 Lands and Damages	1.00	EA	*130,440,960.00* 130,440,960	0	0	0	*130,440,960.00* 130,440,960
30 Preconstruction Engineering & Design	1.00	EA	*4,579,759.58* 4,579,760	0	0	0	*4,579,759.58* 4,579,760
31 Construction Management	1.00	EA	*4,350,771.60* 4,350,772	0	0	0	*4,350,771.60* 4,350,772
03 BROWARD CO. WPA PIR C-9 Impoundment	1.00	LS	189,456,291	0	0	0	189,456,291
CONSTRUCTION COST	1.00	LS	134,301,618	0	0	0	134,301,618
03 Reservoirs	1.00	EA	*11,782,703.31* 11,782,703	0	0	0	*11,782,703.31* 11,782,703
09 Channels and Canals	1.00	EA	*8,319,409.81* 8,319,410	0	0	0	*8,319,409.81* 8,319,410
11 Levees and Floodwalls	1.00	EA	*62,470,064.73* 62,470,065	0	0	0	*62,470,064.73* 62,470,065
13 Pumping Plant	1.00	EA	*45,408,396.85* 45,408,397	0	0	0	*45,408,396.85* 45,408,397
14 Recreation Facilities	1.00	EA	*1,633,519.33* 1,633,519	0	0	0	*1,633,519.33* 1,633,519

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

20

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR 050411
COE Standard Report Selections

Time 15:31:32
Project Cost Summary Report Page 3

Description	Quantity	UOM	ContractCost	Escalation	Contingency	SIOH	ProjectCost
			4,687,523.90				*4,687,523.90*
15 Floodway Control-Diversion Struc	**1.00**	**EA**	**4,687,524**	**0**	**0**	**0**	**4,687,524**
NON CONSTRUCTION COST	**1.00**	**LS**	**55,154,673**	**0**	**0**	**0**	**55,154,673**
			34,203,621.00				*34,203,621.00*
01 Lands and Damages	**1.00**	**EA**	**34,203,621**	**0**	**0**	**0**	**34,203,621**
			10,744,129.43				*10,744,129.43*
30 Preconstruction Engineering & Design	**1.00**	**EA**	**10,744,129**	**0**	**0**	**0**	**10,744,129**
			10,206,922.96				*10,206,922.96*
31 Construction Management	**1.00**	**EA**	**10,206,923**	**0**	**0**	**0**	**10,206,923**

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR 050411
COE Standard Report Selections

Time 15:31:32
Contract Cost Summary Report Page 4

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost	C/O
Contract Cost Summary Report				677,081,045	0	677,081,045	69,036,552	746,117,597	
01 BROWARD CO. WPA PIR C11 Impoundment	1.00	LS	Prime Contractor - C-11	331,174,617	0	331,174,617	28,868,203	360,042,820	
CONSTRUCTION COST	1.00	LS	Prime Contractor - C-11	108,794,019	0	108,794,019	28,868,203	137,662,221	
02 Relocations	1.00	EA	Prime Contractor - C-11	202,536	0	202,536	53,742	256,278	
03 Reservoirs	1.00	EA	Prime Contractor - C-11	7,494,768	0	7,494,768	1,988,717	9,483,485	
0300 Reservoirs	1.00	EA	Prime Contractor - C-11	7,494,768	0	7,494,768	1,988,717	9,483,485	
08 Roads, Railroads, and Bridges	1.00	EA	Prime Contractor - C-11	3,887,488	0	3,887,488	1,031,534	4,919,022	
0801 Pavement Repair at Structures	1.00	EA	Prime Contractor - C-11	2,469,448	0	2,469,448	655,261	3,124,709	
0802 Vehicular Access Bridge - Maintenance	6,000.00	SF	Prime Contractor - C-11	1,418,040	0	1,418,040	376,273	1,794,313	
09 Channels and Canals	1.00	EA	Prime Contractor - C-11	10,573,327	0	10,573,327	2,805,604	13,378,931	
0902 Canals - C11 Impound - Deep	1.00	EA	Prime Contractor - C-11	8,390,535	0	8,390,535	2,226,406	10,616,941	
0902 Canals - C11 Impound - Shallow	1.00	EA	Prime Contractor - C-11	1,616,891	0	1,616,891	429,038	2,045,929	

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR 050411
COE Standard Report Selections

Time 15:31:32
Contract Cost Summary Report Page 5

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost	C/O
0902 Canals - Mitigation	1.00	EA	Prime Contractor - C-11	565,901	0	565,901	150,160	716,061	
11 Levees and Floodwalls	1.00	EA	Prime Contractor - C-11	37,781,560	0	37,781,560	10,025,236	47,806,796	
1101 Levees - C 11 Impoundment Levee	1.00	LS	Prime Contractor - C-11	34,547,705	0	34,547,705	9,167,141	43,714,846	
1101 Levees - Containment Dike	1.00	EA	Prime Contractor - C-11	1,859,640	0	1,859,640	493,450	2,353,090	
1101 Levees - Mitigation	1.00	EA	Prime Contractor - C-11	1,374,215	0	1,374,215	364,644	1,738,859	
13 Pumping Plant	1.00	EA	Prime Contractor - C-11	34,976,163	0	34,976,163	9,280,832	44,256,995	
1301 S 503 Pump Plant - 1500 CFS	1,500.00	CF	Prime Contractor - C-11	34,976,163	0	34,976,163	9,280,832	44,256,995	
14 Recreation Facilities	1.00	EA	Prime Contractor - C-11	1,488,928	0	1,488,928	395,083	1,884,012	
1400 Recreation Facilities	1.00	EA	Prime Contractor - C-11	1,488,928	0	1,488,928	395,083	1,884,012	
15 Floodway Control-Diversion Struc	1.00	EA	Prime Contractor - C-11	11,719,872	0	11,719,872	3,109,837	14,829,709	
1501 S 503A 5'x6' Gated Culvert at Pump Station	1.00	EA	Prime Contractor - C-11	1,321,301	0	1,321,301	350,604	1,671,904	
1502 S 504 8'x8' slide gate Box Culvert	2.00	EA	Prime Contractor - C-11	3,179,223	0	3,179,223	843,598	4,022,822	

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

23

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR_050411
COE Standard Report Selections

Time 15:31:32
Contract Cost Summary Report Page 6

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost	C/O
1505 S 504B S Emergency Spillway	1.00	EA	Prime Contractor - C-11	342,233	0	342,233	90,811	433,043	
1507 S 505A Fixed Weir-w/8'x8' Gate	1.00	EA	Prime Contractor - C-11	1,483,812	0	1,483,812	393,726	1,877,538	
1508 S 505B Fixed Weir-150' Long	1.00	EA	Prime Contractor - C-11	352,784	0	352,784	93,610	446,394	
1509 S 505C Fixed Weir-154' Long	1.00	EA	Prime Contractor - C-11	413,499	0	413,499	109,721	523,220	
1510 S 505D 10'x10' Ungated Culverts	65.00	LF	Prime Contractor - C-11	372,767	0	372,767	98,913	471,680	
1511 S 505E 12'x12' Ungated Culverts Bridge w/ Rails	6.00	EA	Prime Contractor - C-11	1,609,907	0	1,609,907	427,184	2,037,091	
1512 S 506A 48" Gated Culvert w/manhole (SAG)	1.00	EA	Prime Contractor - C-11	439,409	0	439,409	116,596	556,005	
1513 S 506B 60" Culverts	2.00	EA	Prime Contractor - C-11	748,168	0	748,168	198,524	946,692	
1514 S 507A 48" Ungated Culverts	1.00	LS	Prime Contractor - C-11	27,813	0	27,813	7,380	35,193	
1515 S 507B 48" Ungated Culverts	1.00	LS	Prime Contractor - C-11	27,813	0	27,813	7,380	35,193	
1516 S 507C 48" Ungated Culverts	1.00	LS	Prime Contractor - C-11	27,813	0	27,813	7,380	35,193	
1517 S 507D 48" Ungated Culverts	1.00	LS	Prime Contractor - C-11	27,813	0	27,813	7,380	35,193	

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR 050411
COE Standard Report Selections

Time 15:31:32
Contract Cost Summary Report Page 7

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost	C/O
1518 S 507E 48" Ungated Culverts	1.00	LS	Prime Contractor - C-11	27,813	0	27,813	7,380	35,193	
1519 S 507F 48" Ungated Culverts	1.00	LS	Prime Contractor - C-11	27,813	0	27,813	7,380	35,193	
1520 S-508A 48" Ungated Culvert	1.00	EA	Prime Contractor - C-11	63,351	0	63,351	16,810	80,161	
1521 S 508B 72" Ungated Culvert	1.00	EA	Prime Contractor - C-11	1,048,781	0	1,048,781	278,291	1,327,072	
1522 S 508C 48" Ungated Culvert	1.00	EA	Prime Contractor - C-11	86,915	0	86,915	23,063	109,977	
1523 S 508D 48" Ungated Culvert	1.00	EA	Prime Contractor - C-11	90,846	0	90,846	24,106	114,952	
16 Cultural Resource Preservation	1.00	EA	Prime Contractor - C-11	669,376	0	669,376	177,617	846,993	
1601 Human Remains Levee Modification	1.00	EA	Prime Contractor - C-11	669,376	0	669,376	177,617	846,993	
NON CONSTRUCTION COST	1.00	LS	Non-Construction Cost	222,380,599	0	222,380,599	0	222,380,599	
01 Lands and Damages	1.00	EA	01 Lands and Damages	200,905,292	0	200,905,292	0	200,905,292	
0101 LAND PURCHASED-ACTUAL ACQUISITION PRICE	1.00	EA	01 Lands and Damages	77,652,527	0	77,652,527	0	77,652,527	
0102 LAND PURCHASED-market value	1.00	EA	01 Lands and Damages	99,062,205	0	99,062,205	0	99,062,205	

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR_050411
COE Standard Report Selections

Time 15:31:32
Contract Cost Summary Report Page 8

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost	C/O
0103 LANDS NOT ACQUIRED-MARKET VALUE-(IREC)	1.00	EA	01 Lands and Damages	24,190,560	0	24,190,560	0	24,190,560	
30 Preconstruction Engineering & Design	1.00	EA	30 Planning Engineering & Design	11,012,978	0	11,012,978	0	11,012,978	
31 Construction Management	1.00	EA	31 Construction Management	10,462,329	0	10,462,329	0	10,462,329	
02 BROWARD Co. WPA PIR 3A/3B	1.00	LS	Prime Contractor - 3A/3B	184,613,610	0	184,613,610	12,004,876	196,618,486	
CONSTRUCTION COST	1.00	LS	Prime Contractor - 3A/3B	45,242,119	0	45,242,119	12,004,876	57,246,995	
02 Relocations	1.00	EA	Prime Contractor - 3A/3B	8,632,668	0	8,632,668	2,290,655	10,923,323	
03 Reservoirs	1.00	EA	Prime Contractor - 3A/3B	3,235,685	0	3,235,685	858,580	4,094,265	
0300 Reservoirs	1.00	EA	Prime Contractor - 3A/3B	3,235,685	0	3,235,685	858,580	4,094,265	
08 Roads, Railroads, and Bridges	1.00	EA	Prime Contractor - 3A/3B	171,003	0	171,003	45,375	216,378	
0801 Roads - B500 Bridge	1.00	EA	Prime Contractor - 3A/3B	171,003	0	171,003	45,375	216,378	
09 Channels and Canals	1.00	EA	Prime Contractor - 3A/3B	17,829,023	0	17,829,023	4,730,884	22,559,906	
0902 Canals - C-502 A Reach 1, 2, & 3	1.00	EA	Prime Contractor - 3A/3B	5,248,959	0	5,248,959	1,392,797	6,641,756	

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

(Revised May 2012))

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR_050411
COE Standard Report Selections

Time 15:31:32
Contract Cost Summary Report Page 9

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost	C/O
0902 Canals - C-502 B Reach 1, 2, & 3	1.00	EA	Prime Contractor - 3A/3B	9,226,239	0	9,226,239	2,448,158	11,674,397	
0902 Canals - C-502 B Reach 4 & 5	1.00	EA	Prime Contractor - 3A/3B	1,424,225	0	1,424,225	377,914	1,802,139	
0902 Canals - C-503 Reach 1	1.00	EA	Prime Contractor - 3A/3B	1,109,066	0	1,109,066	294,288	1,403,353	
0902 C-502C Holley Lakes Levee Borrow Canal	1.00	EA	Prime Contractor - 3A/3B	820,534	0	820,534	217,726	1,038,260	
11 Levees and Floodwalls	1.00	EA	Prime Contractor - 3A/3B	7,270,747	0	7,270,747	1,929,273	9,200,021	
1101 Levees - L502 B Reach 1,2,& 3	595,331.00	ECY	Prime Contractor - 3A/3B	2,522,866	0	2,522,866	669,436	3,192,302	
1101 Levees - L502 B Reach 4, & 5	58,151.00	ECY	Prime Contractor - 3A/3B	746,391	0	746,391	198,053	944,444	
1101 Levees - L503 - Reach 1	49,115.00	ECY	Prime Contractor - 3A/3B	640,433	0	640,433	169,937	810,370	
1101 Levees - L-502F FP&L Berm	80,292.00	ECY	Prime Contractor - 3A/3B	873,196	0	873,196	231,700	1,104,896	
1101 Levees - L502 A Reach 1,2,& 3	126,417.00	ECY	Prime Contractor - 3A/3B	1,761,211	0	1,761,211	467,333	2,228,544	
1101 Levees - L-502C Holly Lakes Protection Levee	31,379.00	ECY	Prime Contractor - 3A/3B	440,458	0	440,458	116,874	557,332	

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR 050411
COE Standard Report Selections

Time 15:31:32
Contract Cost Summary Report Page 10

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost	C/O
1101 Levees - L-502E Bishop/Nixon Protection Levee	20,750.00	ECY	Prime Contractor - 3A/3B	286,192	0	286,192	75,940	362,132	
13 Pumping Plant	1.00	EA	Prime Contractor - 3A/3B	2,218,537	0	2,218,537	588,683	2,807,220	
1300 Pumping Plant - S 514A Pump Plant 60 CFS	1.00	EA	Prime Contractor - 3A/3B	2,218,537	0	2,218,537	588,683	2,807,220	
14 Recreation Facilities	1.00	EA	Prime Contractor - 3A/3B	1,494,520	0	1,494,520	396,567	1,891,087	
1400 Recreation Facilities	1.00	EA	Prime Contractor - 3A/3B	1,494,520	0	1,494,520	396,567	1,891,087	
15 Floodway Control-Diversion Struc	1.00	EA	Prime Contractor - 3A/3B	4,389,937	0	4,389,937	1,164,858	5,554,794	
1500 S-502B Gated Culvert	1.00	EA	Prime Contractor - 3A/3B	3,167,400	0	3,167,400	840,461	4,007,861	
1500 S-515 Gated Culvert 600CFS	1.00	EA	Prime Contractor - 3A/3B	926,365	0	926,365	245,808	1,172,173	
1500 S-516A Triangular Concrete Weir	1.00	EA	Prime Contractor - 3A/3B	26,125	0	26,125	6,932	33,057	
1500 S-516B Triangular Concrete Weir	1.00	EA	Prime Contractor - 3A/3B	26,125	0	26,125	6,932	33,057	
1500 FPL Maint Rd Cul. 1-4 & 7-9 Ea [Design Capacity <1 cfs]	7.00	EA	Prime Contractor - 3A/3B	74,808	0	74,808	19,850	94,658	
1500 FPL Maint Rd Cul. 5 & 6 Ea	2.00	EA	Prime Contractor - 3A/3B	83,428	0	83,428	22,137	105,565	

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR_050411
COE Standard Report Selections

Time 15:31:32
Contract Cost Summary Report Page 11

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost	C/O
1500 FPL Maint Rd Cul. 10-19 Ea	10.00	EA	Prime Contractor - 3A/3B	85,686	0	85,686	22,736	108,422	
NON CONSTRUCTION COST	1.00	LS	Non-Construction Cost	139,371,491	0	139,371,491	0	139,371,491	
01 Lands and Damages	1.00	EA	01 Lands and Damages	130,440,960	0	130,440,960	0	130,440,960	
0101 Lands Already Purchased	1.00	EA	01 Lands and Damages	8,983,170	0	8,983,170	0	8,983,170	
0102 Lands To Be Purchased	1.00	EA	01 Lands and Damages	116,208,620	0	116,208,620	0	116,208,620	
0103 Land Not Aquired /Market Value/ IREC	1.00	EA	01 Lands and Damages	5,249,170	0	5,249,170	0	5,249,170	
30 Preconstruction Engineering & Design	1.00	EA	30 Planning Engineering & Design	4,579,760	0	4,579,760	0	4,579,760	
31 Construction Management	1.00	EA	31 Construction Management	4,350,772	0	4,350,772	0	4,350,772	
03 BROWARD CO. WPA PIR C-9 Impoundment	1.00	LS	Prime Contractor - C-9	161,292,818	0	161,292,818	28,163,473	189,456,291	
CONSTRUCTION COST	1.00	LS	Prime Contractor - C-9	106,138,144	0	106,138,144	28,163,473	134,301,618	
03 Reservoirs	1.00	EA	Prime Contractor - C-9	9,311,833	0	9,311,833	2,470,870	11,782,703	
0300 Reservoirs	1.00	EA	Prime Contractor - C-9	9,311,833	0	9,311,833	2,470,870	11,782,703	
09 Channels and Canals	1.00	EA	Prime Contractor - C-9	6,574,803	0	6,574,803	1,744,607	8,319,410	
0902 Canals - C-9 Impnd Canals	1.00	EA	Prime Contractor - C-9	6,118,224	0	6,118,224	1,623,455	7,741,679	

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR 050411
COE Standard Report Selections

Time 15:31:32
Contract Cost Summary Report Page 12

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost	C/O
0902 Canals - C-9 North and South Mitigation	1.00	EA	Prime Contractor - C-9	456,579	0	456,579	121,152	577,731	
11 Levees and Floodwalls	1.00	EA	Prime Contractor - C-9	49,369,895	0	49,369,895	13,100,170	62,470,065	
1101 Levees - C9 Impoundment Levee	2,454,683.00	ECY	Prime Contractor - C-9	48,183,168	0	48,183,168	12,785,275	60,968,443	
1101 Levees - C 9 Mitigation Berms	1.00	EA	Prime Contractor - C-9	1,186,727	0	1,186,727	314,895	1,501,621	
13 Pumping Plant	1.00	EA	Prime Contractor - C-9	35,886,113	0	35,886,113	9,522,284	45,408,397	
1300 Pumping Plant - S 509 Pump Plant 1075 CFS	1,075.00	CF	Prime Contractor - C-9	28,214,531	0	28,214,531	7,486,651	35,701,182	
1300 Pumping Plant - S 512A Pump Plant 225 CFS	225.00	CF	Prime Contractor - C-9	7,671,581	0	7,671,581	2,035,634	9,707,215	
14 Recreation Facilities	1.00	EA	Prime Contractor - C-9	1,290,965	0	1,290,965	342,554	1,633,519	
1400 Recreation Facilities	1.00	EA	Prime Contractor - C-9	1,290,965	0	1,290,965	342,554	1,633,519	
15 Floodway Control-Diversion Struc	1.00	EA	Prime Contractor - C-9	3,704,535	0	3,704,535	982,989	4,687,524	
1500 S-510 2-Gated Spillway	1.00	EA	Prime Contractor - C-9	1,470,621	0	1,470,621	390,225	1,860,846	
1500 S-510A Emergency Spillway C9 IM [Design Capacity 2,000]	1.00	EA	Prime Contractor - C-9	113,220	0	113,220	30,042	143,262	
1500 S-511 Gated Culvert 500 CFS	1.00	EA	Prime Contractor - C-9	832,704	0	832,704	220,956	1,053,660	
1500 S-512B CIT Weir [Design Capacity [Design Capacity 150 cfs]	1.00	EA	Prime Contractor - C-9	138,626	0	138,626	36,784	175,409	
1500 S-512B Flap Gated Culvert [Design Capacity 150 cfs]	1.00	EA	Prime Contractor - C-9	198,086	0	198,086	52,562	250,647	
1500 S-512C CIT Weir [Design Capacity 150 cfs]	1.00	EA	Prime Contractor - C-9	138,626	0	138,626	36,784	175,409	

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

30

Print Date Thu 9 February 2012
Eff. Date 2/6/2012

U.S. Army Corps of Engineers
Project : BCWPA_PIR_050411
COE Standard Report Selections

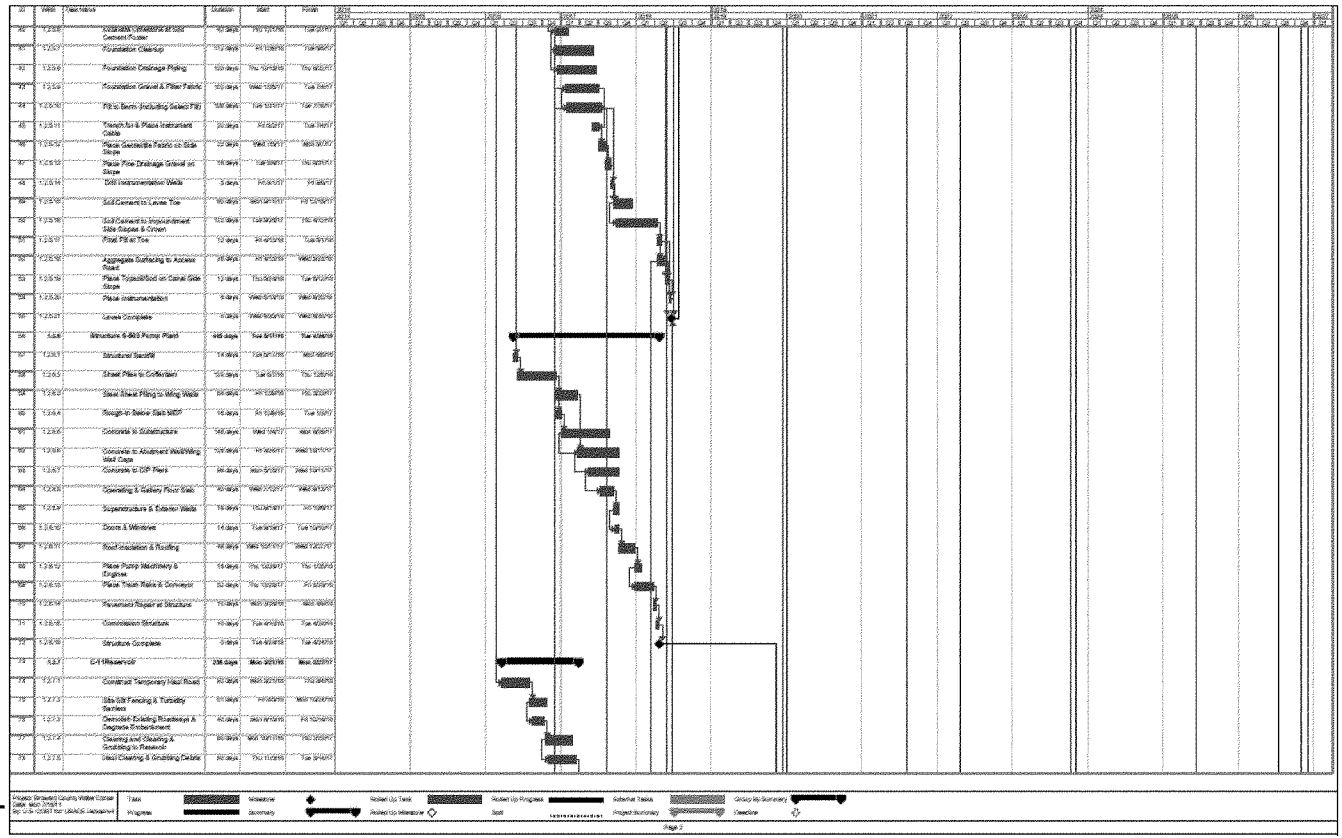
Time 15:31:32
Contract Cost Summary Report Page 13

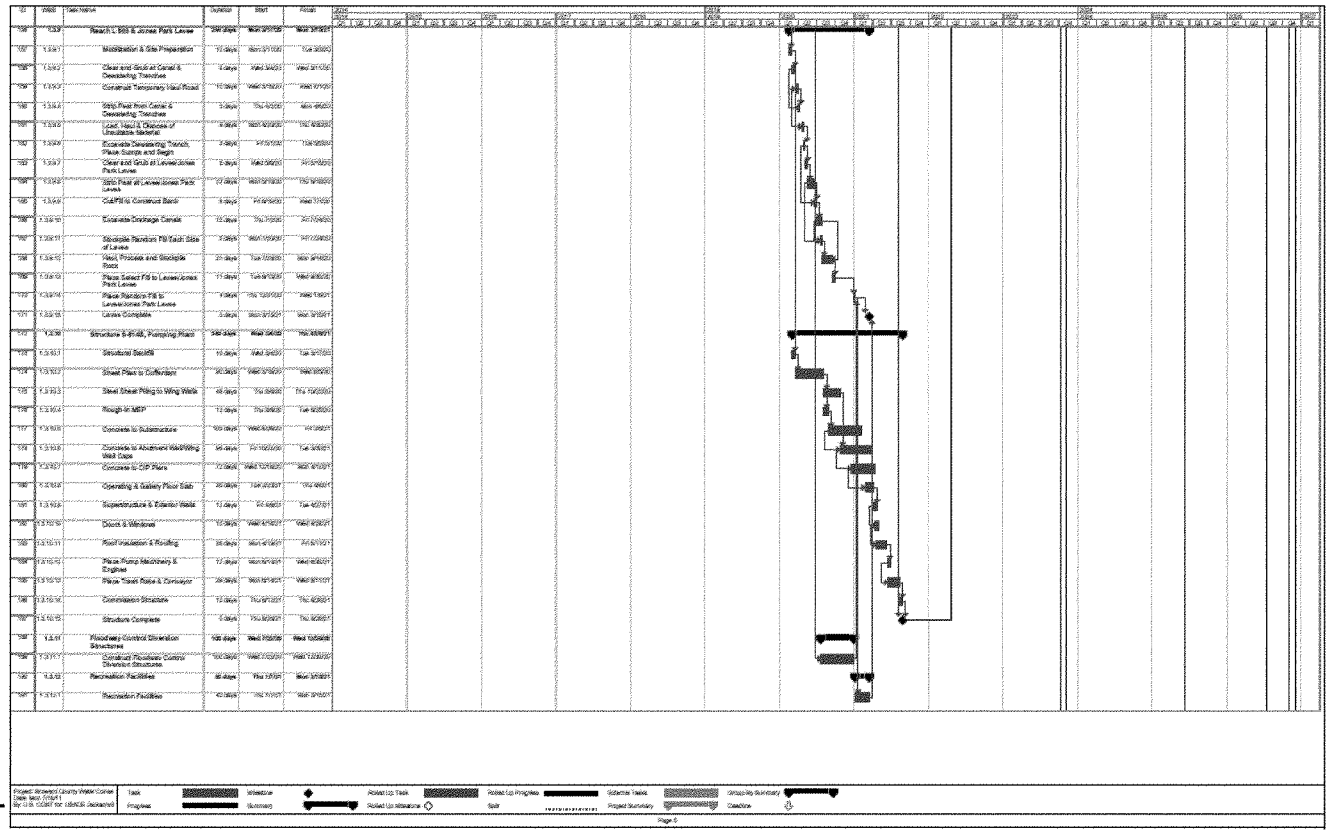
Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost	C/O
1500 S-512C Flap Gated Culvert [Design Capacity 150 cfs]	1.00	EA	Prime Contractor - C-9	198,086	0	198,086	52,562	250,647	
1500 S-513A Gated Culvert [Design Capacity 50 cfs]	1.00	EA	Prime Contractor - C-9	591,274	0	591,274	156,893	748,166	
1500 S-513B Structure [Design Capacity 25 cfs]	1.00	EA	Prime Contractor - C-9	23,295	0	23,295	6,181	29,476	
NON CONSTRUCTION COST	1.00	LS	Non-Construction Cost	55,154,673	0	55,154,673	0	55,154,673	
01 Lands and Damages	1.00	EA	01 Lands and Damages	34,203,621	0	34,203,621	0	34,203,621	
0101 Lands Already Purchased	1.00	EA	01 Lands and Damages	22,100,406	0	22,100,406	0	22,100,406	
0102 Lands To Be Purchased	1.00	EA	01 Lands and Damages	2,162,500	0	2,162,500	0	2,162,500	
0103 Land Not Aquired /Market Value/ IREC	1.00	EA	01 Lands and Damages	9,940,715	0	9,940,715	0	9,940,715	
30 Preconstruction Engineering & Design	1.00	EA	30 Planning Engineering & Design	10,744,129	0	10,744,129	0	10,744,129	
31 Construction Management	1.00	EA	31 Construction Management	10,206,923	0	10,206,923	0	10,206,923	

Labor ID: LFL2010 EQ ID: EP09R03 Currency in US dollars TRACES MII Version 4.1

B.3 SCHEDULE

32





34

ID	WBS	Task Name	Duration	Start	Finish
231	1.4.5.1	Construct Temporary Haul Road	60 days	Thu 5/1/08	Wed 7/23/08
232	1.4.5.2	Site Silt Fencing & Turbidity Barriers	10 days	Tue 7/29/08	Thu 11/27/08
233	1.4.5.3	Demolish Existing Roadways & Degrade Embankment	40 days	Mon 11/10/08	Thu 1/29/09
234	1.4.5.4	Clear & Grubbing & Hauling	200 days	Fri 1/30/09	Tue 12/8/09
235	1.4.5.5	Place Filter A/B/R Sand	24 days	Tue 12/8/09	Tue 1/26/10
236	1.4.7	Structure B-813 Pump Plant	148 days	Mon 3/28/08	Tue 10/7/08
237	1.4.7.1	Structural Backfill	4 days	Wed 3/26/08	Thu 3/28/08
238	1.4.7.2	Sheet Piles to Cofferdam	20 days	Fri 3/28/08	Wed 3/26/08
239	1.4.7.3	Steel Sheet Piling to Wing Walls	19 days	Thu 3/28/08	Mon 3/26/08
240	1.4.7.4	Rough-in MEP	4 days	Thu 3/28/08	Tue 3/26/08
241	1.4.7.5	Concrete to Substructure	37 days	Wed 4/23/08	Thu 5/15/08
242	1.4.7.6	Concrete to Abutment Wall/Wing Wall Caps	30 days	Thu 5/22/08	Thu 6/26/08
243	1.4.7.7	Concrete to CIP Piers	24 days	Wed 7/23/08	Wed 8/26/08
244	1.4.7.8	Operating & Gallery Floor Slab	10 days	Thu 8/28/08	Thu 9/4/08
245	1.4.7.9	Superstructure & Exterior Walls	4 days	Fri 9/5/08	Thu 9/18/08
246	1.4.7.10	Doors & Windows	4 days	Thu 9/18/08	Wed 9/24/08
247	1.4.7.11	Roof Insulation & Roofing	10 days	Thu 9/24/08	Fri 10/3/08
248	1.4.7.12	Place Pump Machinery & Engines	4 days	Tue 10/8/08	Fri 10/10/08
249	1.4.7.13	Place Trash Rake & Conveyor	10 days	Tue 10/8/08	Mon 10/20/08
250	1.4.7.14	Commission Structure	10 days	Tue 10/8/08	Tue 11/10/08
251	1.4.7.15	Structure Complete	0 days	Tue 11/11/08	Tue 11/11/08
252	1.4.8	Structure B-814 Pump Plant	608 days	Thu 3/28/08	Fri 10/3/09
253	1.4.8.1	Structural Backfill	7 days	Thu 3/28/08	Fri 3/28/08
254	1.4.8.2	Sheet Piles to Cofferdam	30 days	Mon 3/31/08	Tue 5/13/08
255	1.4.8.3	Steel Sheet Piling to Wing Walls	30 days	Wed 4/23/08	Fri 10/17/08
256	1.4.8.4	Rough-in MEP	5 days	Wed 4/23/08	Mon 5/26/08
257	1.4.8.5	Concrete to Substructure	44 days	Wed 4/11/08	Wed 6/4/08
258	1.4.8.6	Concrete to Abutment Wall/Wing Wall Caps	64 days	Mon 10/27/08	Mon 12/29/08
259	1.4.8.7	Concrete to CIP Piers	46 days	Fri 10/17/08	Fri 12/26/08
260	1.4.8.8	Operating & Gallery Floor Slab	20 days	Thu 12/18/08	Mon 1/12/09
261	1.4.8.9	Superstructure & Exterior Walls	5 days	Tue 1/13/09	Fri 1/23/09
262	1.4.8.10	Doors & Windows	7 days	Mon 1/26/09	Wed 2/4/09
263	1.4.8.11	Roof Insulation & Roofing	20 days	Thu 2/5/09	Thu 3/5/09
264	1.4.8.12	Place Pump Machinery & Engines	5 days	Mon 3/9/09	Wed 3/11/09
265	1.4.8.13	Place Trash Rake & Conveyor	20 days	Mon 3/9/09	Wed 4/8/09
266	1.4.8.14	Commission Structure	20 days	Thu 3/12/09	Thu 4/9/09
267	1.4.8.15	Structure Complete	0 days	Thu 10/3/09	Thu 10/3/09
268	1.4.9.96	Floodway Control Diversion Structures	608 days	Tue 10/28/08	Fri 10/30/09
269	1.4.9.1	Construct Floodway Control Diversion Structures	200 days	Tue 10/28/08	Fri 10/30/09

B.4 RISK AND UNCERTAINTY ANALYSIS

B.4.1 Risk analysis methods

The risk analysis process for this study followed the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Directory of Expertise for Civil Works (Cost Engineering DX). The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Oracle Crystal Ball software application. First, members of the PDT met to identify risk items, in both the construction cost estimate and the construction schedule, then the Construction Risk Register was completed. A separate Real Estate Risk Register was prepared by the Jacksonville District real estate division and provided for inclusion the risk analysis. After that, the Risk Model was customized using commercially available 'Crystal Ball' software. The most likely 'high', and 'low' values were assigned to estimate items using the software's 'Assumption' function and the triangular distribution. 'Forecasts' were then defined and the model was run.

After the model was run the results were extracted from the sensitivity chart, the forecast chart and the percentiles table for major items. The percentiles were then used to determine the contingency at the 80% confidence level.

The appropriate contingency was then applied to the MCACES/MII estimate for the Selected Plan, producing the 'After Risk Analysis' cost estimate contained herein. Upon completion of this estimate the Total Project Cost Summary was prepared.

B.4.2 Risk analysis results

Results of the risk analysis are shown below. First, the risk registers are presented, and then results are given for the construction costs, real estate cost and the schedule. For each major item studied, the results include 1)a sensitivity chart, 2)a forecast chart, 3)a percentile table including the most likely cost and contingencies and 4)an S-curve chart (only developed for Corps-constructed features). Finally, a table is shown providing contingencies.

B.4.2.1 Construction Risk Register

Table 1. Construction Risk Register

37

BROWARD COUNTY WATER PRESERVE AREAS
Risk Register (Excludes Real Estate)

RISK MATRIX USED BY PDT

Impact or Consequence of Occurrence

	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	Moderate	Moderate	Moderate
Likely	Low	Moderate	Moderate	Moderate	Moderate
Unlikely	Low	Low	Moderate	Moderate	Moderate
Very Unlikely	Low	Low	Low	Low	Moderate

RISK CATEGORY GUIDELINES USED BY PDT

Impact of Consequence of Occurrence	Cost	Schedule	Likelihood of Occurrence	
Negligible	<$100,000	<1 month	Very Likely	75-100%
Marginal	$100,000 - $1 million	1 - 3 months	Likely	50-75%
Significant	$1 million - $5 million	3 - 6 months	Unlikely	15-49%
Critical	$5 million - $10 million	6 - 12 months	Very Unlikely	0-15%
Crisis	>$10 million	>12 months		

Risk No.	Risk/Opportunity Event	PDT Event Concerns	PDT Discussions	Project Cost			Project Schedule			COMPLETED BY RISK ANALYST AFTER PDT DISCUSSIONS							
				Likelihood	Impact*	Risk Level*	Likelihood	Impact*	Risk Level*	Risk Analysis Notes	Cost Impact ($)	Variance Distribution (Cost)	Schedule Impact (mo)	Variance Distribution (Schedule)	Correlation to Others (Monte)	Affected Project Component	Project Implications
Contract Acquisition Risks																	
CA-1	Undefined Acquisition Strategy	The Acquisition Plan has not been finalized, therefore there is a potential for additional fleshing of the contracts.	Assumption is that project is subject to full and open competition, with minimal fleshing of contractor subs.	Unlikely	Significant	MODERATE	Unlikely	Marginal	LOW	Included in quantitative risk analysis for cost. Excluded from quantitative schedule risk analysis because the risk level is low.	$1,500,000	Triangle	N/A	N/A	N/A	All Construction Construction Management	Cost
Construction Risks																	
CON-1	Embankment Failure during Construction	Embankment failure during construction would require repair prior to continuing with construction.	Failure due to unsuitable material or improper compaction.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CON-2	3A/3B Connection Control/Diversion of Water	Control and diversion of water will be required for the construction 3A/3B connection.	Seepage management area 3A/3B components have not been developed past feasibility study level.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Included in quantitative risk analysis for both cost and schedule.	$700,000	Triangle	2	Triangle	N/A	3A/3B (Construction and Non Construction)	Cost Schedule
CON-3	Construction Contract Risk	Unanticipated subsurface conditions discovered during construction could cause changes in foundation design. Unforeseen contract modifications and claims.	This area is known to have lenses of soil, shale, limestone, etc.	Likely	Marginal	MODERATE	Unlikely	Marginal	LOW	Included in quantitative risk analysis for cost. Excluded from quantitative schedule risk analysis because the risk level is low.	$700,000	Triangle	N/A	N/A	N/A	All Construction Construction Management	Cost
CON-4	Mechanical Excavation of Rock	The City of Westin does not allow blasting. Risk of removal of rock by only mechanical excavation. This risk was eliminated from concern by adding mechanical excavation as the means for excavation for the project.	Rock fragmentation not allowed means larger equipment and longer duration to excavate rock by mechanical methods. After the initial review by Wallis Walls, they stated that if the most likely was mechanical then the base estimate should allow for that method of excavation which would eliminate this risk.	Very Unlikely	Critical	LOW	Very Unlikely	Significant	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CON-5	Site Access Restrictions	Unanticipated site access, lay down or work staging area restrictions impact productivity and cause schedule delays.	Access will be addressed in design. Site access is generally good for the project.	Very Unlikely	Significant	LOW	Very Unlikely	Significant	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CON-6	Site Work Hours	Public concerns result in actual work shifts and productivity differing from cost estimate and schedule assumptions.	One neighbor (a retiree) on eastern edge of project has indicated that it prefers no work from Noon Friday to Noon Monday. Anticipate being able to work on other areas of the project, but may become an issue is the project needs to make up for schedule delays.	Very Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Included in quantitative risk analysis for both cost and schedule.	$200,000	N/A	2	Triangle	N/A	Only affects C-11 1.5 mile of the perimeter work including pump station next to retreat.	Cost Schedule
Cost Estimate and Schedule Risks																	
EST-1	Onsite Borrow Areas	May be unable to identify suitable borrow areas for the subject project on site.	If unable to obtain sufficient quality or quantity of suitable soils on-site, project may have to purchase and/or transport soil from off-site. During latest workshop this was discussed in more detail and it is very unlikely at this point that there will not be sufficient borrow. Currently, it is anticipated that there will be surplus at the Cell 1 site.	Very Unlikely	Significant	LOW	Very Unlikely	Marginal	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EST-2	Availability of Aggregates	Non-calcareous aggregates not available from current sources, which will require us to obtain aggregates from more distant locations.	Local rock has cementation nature when used in filter drain applications.	Very Unlikely	Significant	LOW	Very Unlikely	Marginal	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EST-3	Volatile Craft Labor Costs	Craft labor costs may be affected by large contemporaneous regional projects and result in increased costs.	Not considered likely in current economy. Contractors are not putting overtime in their bids. Could be a future concern.	Very Unlikely	Significant	LOW	Very Unlikely	Marginal	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EST-4	Volatile Fuel Costs	Higher than anticipated future prices for gasoline and diesel may result in increased costs.	Future fuel costs very difficult to forecast. Contractors may hedge costs, resulting in higher bids.	Likely	Significant	MODERATE	Likely	Negligible	LOW	Included in quantitative risk analysis for cost. Excluded from quantitative schedule risk analysis because the risk level is low.	$2,500,000	Uniform	N/A	N/A	N/A	All Construction	Cost

08 July 2011

A-1

38

Risk No.	Risk/Opportunity Event	PDT Event Concerns	PDT Discussions	Project Cost			Project Schedule			COMPLETED BY RISK ANALYST AFTER PDT DISCUSSIONS							
				Likelihood	Impact	Risk Level	Likelihood	Impact	Risk Level	Risk Analysis Notes	Cost Impact ($)	Variance Distribution (Cost)	Schedule Impact (mo)	Variance Distribution (Schedule)	Correlation to Others (minimize)	Affected Project Component	Project Implications
External Risks																	
EXT-1	Blasting Waiver Negotiations	Local sponsor unsuccessful in reaching blasting waiver agreement without requiring concessions. The City of Weston does not allow blasting.	Local sponsor having talks with City of Weston on several issues including rock fragmentation. This is a political risk that the City may require a buffer or other concession in return for a blasting waiver. Impact would be redesign. **This was eliminated as a risk due to the fact that we have eliminated blasting from the estimate and now we are assuming mechanical excavation.**	Very Unlikely	Significant	LOW	Very Unlikely	Marginal	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EXT-2	Embankment Failure during Testing	Embankment failure during testing due to improper initial fill procedures.	Hurricane or other localized weather event dumps water on the impoundment during initial fill activities. **This was eliminated as a risk because SFWMD said this would not be a project cost if this event happened.**	Very Unlikely	Critical	LOW	Very Unlikely	Critical	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EXT-3	Political Support/Opposition	Delays due to political ramifications are possible and could critically delay or terminate the work.	Project is highly visible. Local political interest extremely high to see project constructed.	Very Unlikely	Critical	LOW	Very Unlikely	Critical	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EXT-4	Local Community Objections	There is a possibility of the surrounding communities posing objections to this project.	Southwest Ranches opposes groundwater rise.	Likely	Marginal	MODERATE	Likely	Significant	HIGH	Included in quantitative risk analysis for both cost and schedule.	$700,000	Triangle	4	Triangle	N/A	Total Project	Cost Schedule
EXT-5	Demonstration of Minimal Impact	The City of Weston requires project to demonstrate project assertions of minimal impact to their satisfaction.	The City of Weston has not agreed to fragmentation. **We have eliminated blasting from the estimate, therefore this risk element is no longer a risk.**	Very Unlikely	Significant	LOW	Very Unlikely	Significant	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Operations Risks																	
OPR-1	Wildlife Impact on Operations	Need to develop operating practices that will not prevent or limit wildlife nesting in project area.	Project site is a natural habitat for various species of threatened wildlife that spawn during spring months causing adjustments to operation cycles.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Included in quantitative risk analysis for both cost and schedule. Change in operations may result in design or construction scope changes.	$700,000	Triangle	2	Triangle	N/A	Total Project	Cost Schedule
OPR-2	Adaptive Management Features	There will possibly need to be in the field modifications to change the operation of the system.	The system was setup based on the model. Operation of feature could be adjusted due to in the field observations/data underestimating.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Included in quantitative risk analysis for both cost and schedule. Change in operations may result in design or construction scope changes.	$700,000	Triangle	2	Triangle	N/A	Total Project	Cost Schedule
Project and Program Management Risks																	
PRG-1	FDEP Interface	Substantial permitting delays may occur if there are significant environmental mitigation/ATRW issues, or political opposition.	Project is subject to FDEP (Florida Department of Environmental Protection) regulatory permitting procedures, policy, process, conditions--general and specific	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE	Included in quantitative risk analysis for both cost and schedule.	$1,500,000	Triangle	2	Triangle	N/A	PED Construction Start Date	Cost Schedule
PRG-2	Project Reviews and Funding	Concerns exist on obtaining appropriate schedule and funding for sufficient review and effort by specialized team members and contractors.	Project is subject to ATR (Agency Technical Review), IEPR (Independent External Peer Review), in-house staff and local sponsor review.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PRG-3	Sufficient Incremental Funding	Budget constraints could limit or delay funding creating potential sequencing delays and issues.	The environmental window constraints could prove problematic for project sequencing.	Very Likely	Significant	HIGH	Very Likely	Significant	HIGH	Included in quantitative risk analysis for both cost and schedule.	$4,500,000	Triangle	8	Triangle	N/A	Total Project	Cost Schedule
Regulatory and Environmental Risks																	
REG-1	Waiver for Truck Stop Stormwater	Possible waiver needed for runoff from the truck stop.	Current run-off is to C-11 area. No city sewer is nearby. Truck stop owner is not required to mitigate the stormwater run-off. If waiver cannot be obtained, may need separate water purification plant or tie into city sewer 1.5-miles away from project.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Included in quantitative risk analysis for both cost and schedule. Reflects impact of obtaining permit if waiver cannot be obtained.	$700,000	Triangle	2	Triangle	Inverse to REG-5	PED Construction Start Date	Cost Schedule
REG-2	Permit to Drain Mitigation Areas	Possible permit needed to drain existing mitigation areas north of the project.	Project is subject to FDEP (Florida Department of Environmental Protection) regulatory permitting procedures, policy, process, conditions--general and specific	Very Unlikely	Negligible	LOW	Very Unlikely	Negligible	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

08 July 2011 A-2

39

Risk No.	Risk/Opportunity Event	PDT Event Concerns	PDT Discussions	Project Cost			Project Schedule			COMPLETED BY RISK ANALYST AFTER PDT DISCUSSIONS							
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*	Risk Analysis Notes	Cost Impact ($)	Variance Distribution (Cost)	Schedule Impact (mo)	Variance Distribution (Schedule)	Correlation to Others (minimize)	Affected Project Component	Project Implications
REG-3	Historic/Cultural Sites	If the cultural resource / human remains site is larger than anticipated then additional costs may be seen, however the original risk element was mitigated within the project by including a protection feature in both the PIR and the estimate.	There is a cultural resource site within the seepage management area that may need relocating. If relocation not acceptable to tribe, boundary may need to be relocated or cantilever berm and pump system may have to installed to keep cultural resources dry.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
REG-4	EPA Emission Requirement Changes	EPA changes requirements for engine emission. May have to modify the engines to meet EPA new requirements.	After design but during construction, if EPA changes rules governing engine emissions, may require different engines or fan.	Very Likely	Marginal	MODERATE	Very Likely	Negligible	LOW	Included in quantitative risk analysis for cost. Excluded from quantitative schedule risk analysis because the risk level is low.	$200,000	Triangle	N/A	N/A	N/A	Pumping Plant (C-11, 3A/3B, C-9)	Cost
REG-5	Permit for Truck Stop Stormwater	A permit may be needed for runoff from the truck stop. It was determined through PDT discussions with South Florida that a permit would not be required. Therefore, this risk was eliminated.	Current run-off is to C-11 area. No city sewer is close. Truck stop owner is not required to mitigate the stormwater run-off. If permit cannot be obtained, may need separate water purification plant or tie into city sewer 1.5-miles away from project.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
REG-6	Burning Ordinance	Contractor's compliance with local burning ordinance.	No burning ordinance could require hauling debris to landfill. Burning is not allowed, estimate now includes hauling off-site.	Very Unlikely	Significant	LOW	Very Unlikely	Significant	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Technical (Design) Risks																	
TD-1	Site Surveys	The east boundary of the project overlaps the City of Weston property boundary.	Survey of the eastern boundary near the City of Weston could cause shift in project boundary and realignment of levee on east side of C-11 impoundment.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Included in quantitative risk analysis for both cost and schedule.	$100,000	Triangle	2	Triangle	N/A	C-11 (Construction and Non Construction)	Cost Schedule
TD-2	Trailer Park Protection	Trailer park may require protection berm, project boundary shift, or other protective features may increase	Within the seepage management area, there is land enclosed by a dirt mound and a portion of the trailer park. The original risk item had a likelihood of very likely, however a protection berm has now been added into the PIR and the estimate, therefore the only risk is the size if the berm increasing which is unlikely now.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TD-3	FPL Transmission Towers	Transmission line towers may require raising lower footers or construction of protection berm around lower base. Estimate currently covers 30% of the towers being raised, the concern is that this may increase.	FP&L has high power transmission towers through the seepage management area that may be affected by the increase in water level.	Likely	Significant	HIGH	Likely	Significant	HIGH	Included in quantitative risk analysis for both cost and schedule.	$3,500,000	Triangle	4	Triangle	N/A	3A/3B (Construction and Non Construction)	Cost Schedule
TD-4	Bishop-Nixon Site Protection	Berm around Bishop-Nixon site may require additional special consideration and mitigation.	Bishop-Nixon site has an existing berm that may need to be modified with erosion protection measures or replace gravity release with pumped release.	Likely	Significant	HIGH	Likely	Marginal	MODERATE	Included in quantitative risk analysis for both cost and schedule.	$3,500,000	Triangle	2	Triangle	N/A	Levees and Floodwalls (3A/3B)	Cost Schedule
Technical (Studies) Risks																	
TS-1	H&H Modeling	Additional H&H modeling could require re-design and/or additional project features in SMA 3A/3B and C-9. C-11 has already been modelled.	H&H modeling limited to preliminary study of project hydraulics and hydrology. In-depth modeling may show that cut-off wall, berm height adjustments are necessary to prevent undesired impact to adjacent property.	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE	Included in quantitative risk analysis for both cost and schedule.	$1,500,000	Triangle	2	Triangle	N/A	Total Project	Cost Schedule
TS-2	Geotechnical Studies	Additional geotechnical investigation for C-9, 1A and 3B sites could reveal undesired results.	Geotechnical investigations could reveal that some areas of soil can't be excavated or that the soil is unsuitable for construction requiring soil purchase. Current Geotechnical data has revealed good results indicating suitable soils, therefore the likelihood was changed to unlikelihood.	Very Unlikely	Marginal	LOW	Very Unlikely	Significant	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TS-3	Impacted Soil Studies	Soil studies may reveal unanticipated soil impacts as a result of past agricultural practices.	Low levels of selenium are anticipated. Higher levels of selenium, or other compounds, may be present at the site and result in additional scope. Soil Studies have been done that have shown levels of selenium higher than acceptable to the department of fish and wildlife. Costs for remediation have now been included in the estimate, therefore the risk has been eliminated.	Very Unlikely	Marginal	LOW	Very Unlikely	Significant	LOW	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

B.4.2.2 Real Estate Risk Register

Table 2. Real Estate Risk Register

41

Risk/Opportunity Scale

Risk or Opportunity scale will be based on Probability (likelihood) of occurrence and Impact (consequence) to the potential final cost of each Risk or Opportunity, or majority of the Risk Analysis over 100 utilized projects (Best of Practice BPC) (Particular attention to the Subjects, Needs Assessment Report).

Risk Level

Probability of Occurrence	Negligible	Marginal	Significant	Critical	Catastrophic
Very Likely	Low	Moderate	Critical	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

Impact or Consequence of Occurrence

Risk No.	Risk/Opportunity Event	PDT Concerns	PDT Discussions & Conclusions	Project Cost: Likelihood	Impact	Risk Level	Rough Order Impact ($)	Project Schedule: Likelihood	Impact	Risk Level	Rough Order Impact (Mos)	Variance Distribution	Correlation to Other(s)	Project Implications	Affected Project Components	Notes
	PROJECT & PROGRAM (RIM) RISKS IMPACTING REAL ESTATE															
RPM-1	Scope Definition Footprint	Project footprint and boundaries may not be clearly identified. Scope creep causes a change in the real estate needs	Additional land may be required as a result of future mitigation efforts. Hydrologic impacts may occur on lands outside of project footprint. Current modeling is not sufficient to show potential impacts to lands outside of project footprint. **COVERED IN RE-1 BELOW**	Very Likely	Significant		$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Cost impacts covered by Risk RE-1. Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RPM-2	Project Schedule	Project schedule may be accelerated and not provide adequate time for L&C acquisition	BPWMD, the non-Federal sponsor has acquired 98% of the lands required for the Project components. The lands remaining to be acquired should be acquired prior to project construction	Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RPM-3	Competing Priorities	District may have limited resources and competing high level priorities. This project may not receive adequate support and attention to complete the L&C requirements as required by current schedule	BPWMD, the non-Federal sponsor has acquired 98% of the lands required for the Project components. The lands remaining to be acquired should be acquired prior to project construction	Very Unlikely	Negligible	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RPM-4	Inexperienced/Inadequate Staffing	Available staff may be in short supply and/or lacks experience to efficiently support the project needs	BPWMD, the non-Federal sponsor has acquired 98% of the lands required for the Project components. The lands remaining to be acquired should be acquired prior to project construction	Very Unlikely	Negligible	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
	TECHNICAL DESIGN RISKS IMPACTING REAL ESTATE															
TD-1	Land Survey Issues	Project surveys and investigations may not result in a change to the real estate needs	No surveys are required until construction. Project lands are mostly owned by BPWMD non-Federal sponsor	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
TD-2	Base Map Data Inaccuracy	The base maps provided may not be sufficient, requiring additional study, surveys, or real investigations	Maps are accurate and all lands identified	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
TD-3	Borrow Pit Sources Identified	Borrow sources may not be completely identified and material quality in question to support the project needs	Additional fill material may have to be obtained from offsite. No additional lands required	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Negligible	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
TD-4	Project Access Identified	Project access points may be constrained or unclear	Access points have all been identified. No additional lands required	Very Unlikely	Negligible	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
TD-5	Locations for Plant/Equipment/Staging	Early stage of design may result in a lack of understanding related to location and storage needed to support the construction activities	Staging areas will be on project lands. No additional lands required	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
	REGULATORY / ENVIRONMENTAL IMPACTS ON REAL ESTATE															
RRE-1	Historic / Cultural Site Impacts	Cultural studies may be incomplete. There may be potential for undiscovered unknown cultural resources that could impact project boarder, staging and project boundaries.	Cultural studies have been completed. One special area been identified as having higher demand which is the subject of an EIS/R study under Tribes.	Unlikely	Marginal	LOW	$0	Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RRE-2	Endangered Species Impacts	Certain land parcels, jackrabbit and pygmy mice can compromise if certain endangered species are found to migrate into the project boundaries	Access and agreements not be compromised. No additional lands required.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RRE-3	Wetlands Present	Wetlands present on Project lands	Wetlands have been identified and mitigation will be carried out. No additional lands required.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RRE-4	Hazardous Waste Potential	Area may be contained potential regarding encounter of hazardous wastes due impact sources, agents, project boundaries.	No HTRW has been identified. Fractionated material levels may be required. No additional lands required.	Unlikely	Marginal	LOW	$0	Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RRE-5	Mitigation Requirements	Mitigation requirements have not been identified	Wetlands have been identified and mitigation will be carried out. No additional lands required.	Likely	Marginal	MODERATE	$9,835,000	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews

Risk No.	Risk/Opportunity Event	PDT Concerns	PDT Discussions & Conclusions	Project Cost: Likelihood	Project Cost: Impact	Project Cost: Risk Level	Project Cost: Rough Order Impact ($)	Project Schedule: Likelihood	Project Schedule: Impact	Project Schedule: Risk Level	Project Schedule: Rough Order Impact(Days)	Variance Distribution	Correlation or Driver(s)	Project Implications	Affected Project Components	Notes
	EXTERNAL RISKS IMPACTING REAL ESTATE															
EXT-1	Adequacy of Timely Funding	Budget constraints could lead to delay funding creating potential delays	SPWMD, the non-Federal sponsor has acquired 85% of the lands required for the Project components. The bank remaining to be acquired should be acquired prior to project construction.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
EXT-2	Local Community Support /Opposition	There is possibility of surrounding communities posing objections to project	Southwest Florida's expansive groundwater rich. City of Western approaches non-homeowner. No additional lands required.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
EXT-3	Political Factors Change (Local/State/Federal)	Delays due to political maneuvers are possible and could critically delay project	Project is highly visible. Local political interest is extremely high to see project completed	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
EXT-4	Late/Sketchy Scope Changes	New stakeholders could introduce refinements. Scope changes could change real estate needs	Additional lands may be required as a result of future modeling efforts. Hydrologic impacts may occur on lands outside of project footprint. Current modeling is not sufficient to show potential impacts to lands outside of project footprint. **COVERED IN RE-1 BELOW**	Very Likely	Significant	[illegible]	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Cost impacts covered by Risk RE-1. Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
EXT-5	Political Opposition /Lawsuits	State of Federal courts could create postponement of project	There is strong support for project, however there are always issues which could lead to court action	Unlikely	Marginal	LOW	$0	Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
	LANDS & DAMAGES - APPRAISAL AND NON-APPRAISAL REAL ESTATE RISKS															
RE-1	New Estate Study & Plan Changes	Additional lands may be required as a result of future modeling efforts. Hydrologic impacts may occur on lands outside of project footprint	Current modeling is not sufficient to show potential impacts to lands outside of project footprint.	Very Likely	Significant	[illegible]	$10,000,000	Likely	Marginal	MODERATE	0	Triangle	None	Cost Schedule	Real Estate	Included in quantitative risk analysis for both cost and schedule
RE-2	Acquisition Status	Additional lands may be required as a result of future modeling efforts. Hydrologic impacts may occur on lands outside of project footprint	Current modeling is not sufficient to show potential impacts to lands outside of project footprint. Lands likely to be impacted are covered by SFWMD **COVERED IN RE-1**	Very Likely	Significant	[illegible]	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Cost impacts covered by Risk RE-1. Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RE-3	Age of Appraisal	The Cactus Appraisal was completed in January 2010	Lands which were recently conveyed to have not changed from January 2010. Covered by the INCREMENTAL REAL ESTATE COSTS applied to the PROJECT	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RE-4	Potential Encumbrance Remnants	There may be potential for uncertainties/remnants of properties required for Project	SFWMD, the non-Federal sponsor has acquired 85% of the lands required for the Project components. The lands remaining to be acquired should be acquired prior to project construction. SFWMD is acquiring entire parcels as no potential for uneconomic remnants.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RE-5	Inability to Inspect Project Site	Access to properties have been open at times during study	All project lands have been open at at times, inspection of project land have been completed.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RE-6	Potential Development Pressures	Lands within project footprint could be developed prior to acquisition by SFWMD	SFWMD, the non-Federal sponsor has acquired 85% of the lands required for the Project components. The lands remaining to be acquired should be acquired prior to project construction. SFWMD is acquiring entire parcels as no potential for development costs	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RE-7	Potential Zoning Changes	Downzoning or future State courses could change zoning for project lands	Downzoned and Mixed Duty Lands have already been zoned properties acquired by SFWMD so that they cannot be downzoned	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RE-8	Potential for Condemnation	In C-11 impoundment there are only public lands to be acquired (118.54 acres). In C-43 impoundment 57 PMDU owners at least. In AKCA BASIN TMA, SFWMD has to acquire 76.02 acres from private owners. There is strong likelihood these 76.02 acres will have to be condemned	The potential for unresolved land costs associated with condemnation by SFWMD is met as the potential for successful condemnation process is covered by the INCREMENTAL REAL ESTATE COSTS applied to the PROJECT	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RE-9	Objections to NGVD Approvals	In C-11 impoundment there are only public lands to be acquired (118.54 acres). In AKCA BASIN TMA, SFWMD has to acquire 76.02 acres from private owners. There is strong likelihood these 76.02 acres will have to be condemned	The potential for SFWMD approved vacant lots/parcel with acquisition of the remaining lands by SFWMD is covered by the INCREMENTAL REAL ESTATE COSTS applied to the PROJECT	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews
RE-10	Ancillary Owner Rights	Property ownership for minerals rights might be in question	The potential for maintaining mineral interests associated with Project's sites is covered by the INCREMENTAL REAL ESTATE COSTS applied to the PROJECT	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews

43

Risk No.	Risk/Opportunity Event	PDT Concerns	PDT Uncertainties & Conclusions	Project Cost: Likelihood	Project Cost: Impact	Project Cost: Risk Level	Project Cost: Rough Order Impact ($)	Project Schedule: Likelihood	Project Schedule: Impact	Project Schedule: Risk Level	Project Schedule: Rough Order Impact (mo)	Variance Distribution	Correlation to Other(s)	Project Implications	Affected Project Components	Notes
RE-11	Other Agency Involvement	Considerable agreements for provision of lands might have to be negotiated with Broward County, Indian Tribes, FDOT, and the State of Florida. MOAs with USFWS, Indian Tribes and others may delay project	There are lands owned by the State and local entities which may have to be obtained by Supplemental Agreements which may require time to negotiate. Preliminary conversations only thus far initiated.	Likely	Marginal	MODERATE	$1,500,000	Very Unlikely	Marginal	LOW	0	Triangle	None	Cost	All Real Estate	Included in quantitative risk analysis for cost. Excluded from quantitative schedule risk analysis because the risk level is low.
RE-12	Preliminary Identified	There is concern that all utilities affecting project lands may not be identified.	Most utilities have been identified by simple investigations and review of SFWMD site evidence. However, there may be minor utility lines that have not been identified. More PPL owners may have to be added than identified.	Likely	Significant	[illegible]	$9,730,000	Very Unlikely	Marginal	LOW	0	Triangle	None	Cost	WCA 3A/3B FAM Relocations	Included in quantitative risk analysis for cost. Excluded from quantitative schedule risk analysis because the risk level is low.
RE-13	Relocations Behind Schedule	Negotiations of relocation agreements with owners of the utilities and PPL may take longer and may cost more than anticipated.	Not all the PPL utilities have been identified and there may be some that are not recorded or not licensed. Additionally, funding for the utility relocations which may be under submittal requires additional coordination.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.
RE-14	Inaccurate Records	Reliance on land ownership may be inaccurate.	SFWMD, the non-Federal sponsor has acquired 95% of the lands required for the Project components. The lands remaining to be acquired should be acquired prior to project construction.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.
RE-15	Unidentified Utility Impacts	There is concern that all utilities affecting project lands may not be identified.	Most utilities have been identified by simple investigations and review of SFWMD site evidence. However, there may be minor utility lines that have not been identified. More PPL owners may have to be added than identified.	Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.
RE-16	Trespassing/Loitering Issues Unresolved	Concern that lands may become occupied by trespassers.	SFWMD has strong enforcement program. County police and State agencies are cooperating to remove trespass.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.
RE-17	Overall Estimate as Most Likely	LEC estimates may be low. Historically, land value estimates have been underestimated.	The anticipated values of property are constantly changing and constituting the schedule of the ownership of property, which are constantly changing, it could have a positive or negative effect on the project. LEC Business count also be found. Historically speaking, they are usually underestimated. Covered by the INCREMENTAL REAL ESTATE COSTS applied to the PROJECT.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.
RE-18	Appraisal Underestimate Land Value	Values in Gross Appraisal may be lower than actual market.	Covered by the INCREMENTAL REAL ESTATE COSTS applied to the PROJECT.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.
RE-19	Appraisal Contingencies Identified	Values in Gross Appraisal may be lower than actual market.	Covered by the INCREMENTAL REAL ESTATE COSTS applied to the PROJECT.	Very Unlikely	Marginal	LOW	$0	Very Unlikely	Marginal	LOW	0	N/A	N/A	N/A	N/A	Low-level risks are excluded from quantitative risk analysis but included on the risk register to support risk monitoring and lessons learned reviews.
RE-20	Future Administrative costs may be greater than anticipated.	SFWMD and Federal Administrative costs have been calculated on historical data which may be low for the remainder of the lands to be acquired due to possible administrative costs associated with condemnation actions.	Provisions exists for condemnation purposes by SFWMD and Federal Courts may be more costly than anticipated. Excessive landowner attorney fees and costs may not be properly calculated.	Very Likely	Marginal	MODERATE	$1,500,000	Very Unlikely	Marginal	LOW	0	Triangle	None	Cost	All Real Estate	Included in quantitative risk analysis for cost. Excluded from quantitative schedule risk analysis because the risk level is low.
RE-21	Project Partnership Agreement	Unanticipated PPA rules may cause, resulting in project delays or changes to PDP Water Management.	PPA may take longer than anticipated to negotiate.	Unlikely	Marginal	LOW	$0	Likely	Marginal	MODERATE	3	Triangle	None	Cost	All Real Estate	Included in quantitative risk analysis for schedule. Excluded from quantitative cost risk analysis because the risk level is low.

Likelihood, Impact, and Risk Level are defined through a combination of the Project Delivery Team (PDT) and Cost Engineering and Schedule Analyst (Team).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and Design Deficiencies and data at the PDT.
2. Risk/Opportunity Likelihood: Very Unlikely, Unlikely, Marginal, Likely, Very Likely. Likelihood determination is based on the experience of the Project Delivery Team and Cost Engineering and Schedule Analyst (Team).
3. Risk/Opportunity Impact: Very Insignificant, Insignificant, Marginal, Significant, Critical. Impact determination is based on the experience of the Project Delivery Team and Cost Engineering and Schedule Analyst (Team).
4. Risk/Opportunity Level: Very Low, Low, Moderate, High, Very High. Risk/Opportunity Level is based on the Likelihood and Impact determinations.
5. Risk Level Determination: Low Impact and Low Likelihood = **Low**, Low Impact and Marginal Likelihood = **Low**, Marginal Impact and Low Likelihood = **Low**, Marginal Impact and Marginal Likelihood = **Moderate**, Significant Impact and Marginal Likelihood = **Moderate**, Significant Impact and Likelihood = **High**, Critical Impact and Likelihood = **High**, Critical Impact and Likely Likelihood = **Very High**.

6. Variance Distribution: Risk Variance is the difference between the risk value and the risk impact. Risk variance affects the shape of the probability distribution. Risk variance can be either triangular or normal distribution. A triangular distribution is used when the risk value is equal to the risk impact. A normal distribution is used when the risk value is not equal to the risk impact.
7. Correlation to Other(s): Correlation is the relationship between two variables. Correlation affects the overall probability distribution. Correlation can be either positive or negative. Correlation can be between two risks or between a risk and a cost or schedule activity.
8. Affected Project Components: Identifies the specific Project Components affected by the risk. Identifies the specific Project Components affected by the risk.
9. Project Implications: Identifies whether the risk impacts project cost, project schedule, or both. The PDT is responsible for conducting studies to reduce Project Cost and Project Schedule.
10. Risk/Opportunity Identification process was guided with Partial Workshop with the Cost Engineer, then analyzed through the Monte Carlo analysis software for Cost (Crystal Ball) and Schedule (Microsoft Project).

Risk Level Last Updated: TBD
This sheet last updated: 26 Sept 2012

B.4.2.3 Construction Costs Risk Model

BCWPA TOTAL COST	$746,117,597
C-11 Impoundment Total Cost	$360,042,820
C-11 CONSTRUCTION COST	$137,662,221
C-11 02 Relocations	$256,278
C-11 03 Reservoirs	$9,483,485
C-11 08 Roads, Railroads, and Bridges	$4,919,022
C-11 09 Channels and Canals	$13,378,931
C-11 11 Levees and Floodwalls	$47,806,796
C-11 13 Pumping Plant	$44,256,995
C-11 14 Recreation Facilities	$1,884,012
C-11 15 Floodway Control-Diversion Struc	$14,829,709
C-11 16 Cultural Resource Preservation	$846,993
C-11 NON CONSTRUCTION COST	$222,380,599
C-11 01 Lands and Damages	$200,905,292
C-11 30 Preconstruction Engineering & Design	$11,012,978
C-11 31 Construction Management	$10,462,329
3A/3B Seepage Areas Total Cost	$196,618,486
3A/3B CONSTRUCTION COST	$57,246,995
3A/3B 03 Relocations	$10,923,323
3A/3B 03 Reservoirs	$4,094,265
3A/3B 08 Roads, Railroads, and Bridges	$216,378
3A/3B 09 Channels and Canals	$22,559,906
3A/3B 11 Levees and Floodwalls	$9,200,021
3A/3B 13 Pumping Plant	$2,807,220
3A/3B 14 Recreation Facilities	$1,891,087
3A/3B 15 Floodway Control-Diversion Structure	$5,554,794
3A/3B NON CONSTRUCTION COST	$139,371,491
3A/3B 01 Lands and Damages	$130,440,960
3A/3B 30 Preconstruction Engineering & Design	$4,579,760
3A/3B 31 Construction Management	$4,350,772
C-9 Impoundment Total Cost	$189,456,291
C-9 CONSTRUCTION COST	$134,301,618
C-9 03 Reservoirs	$11,782,703
C-9 09 Channels and Canals	$8,319,410
C-9 11 Levees and Floodwalls	$62,470,065
C-9 13 Pumping Plant	$45,408,397
C-9 14 Recreation Facilities	$1,633,519
C-9 15 Floodway Control-Diversion Struc	$4,687,524
C-9 NON CONSTRUCTION COST	$55,154,673
C-9 01 Lands and Damages	$34,203,621
C-9 30 Preconstruction Engineering & Design	$10,744,129
C-9 31 Construction Management	$10,206,923

Table 3. Construction Costs Risk Model

** Note: This cost table does not include escalation and contingency

B.4.2.4 Construction Costs Results

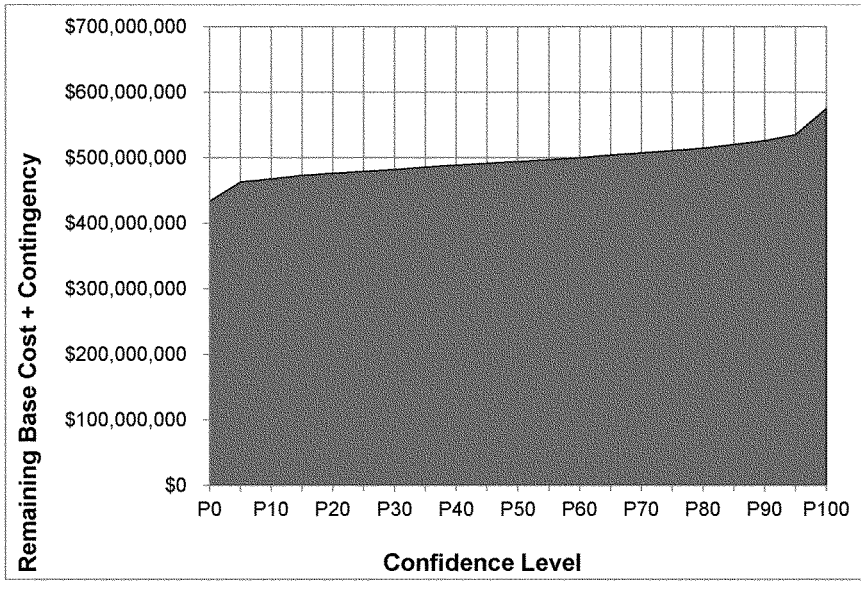


Figure 1. Project Risk Analysis Summary Graph

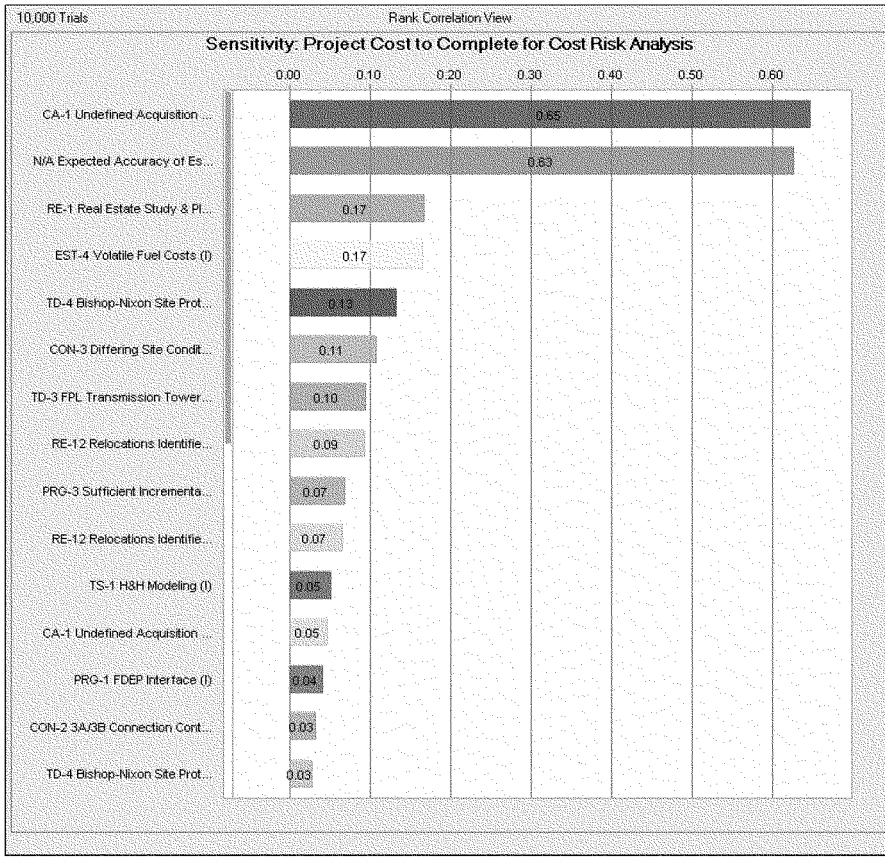


Figure 2. Cost Risk Sensitivity Chart

Table 4. Total Contingency Values

Confidence Level	Remaining Base Cost + Contingency	Contingency ($)	Contingency (%)
P0	$430,926,141	$10,977,972	3%
P05	$456,832,347	$36,884,178	9%
P10	$461,761,685	$41,813,516	10%
P15	$465,818,927	$45,870,758	11%
P20	$469,088,460	$49,140,291	12%
P25	$472,102,774	$52,154,605	12%
P30	$474,775,203	$54,827,034	13%
P35	$477,488,655	$57,540,486	14%
P40	$480,463,948	$60,515,779	14%
P45	$483,303,482	$63,355,313	15%
P50	$485,924,432	$65,976,263	16%
P55	$488,673,637	$68,725,468	16%
P60	$491,648,221	$71,700,052	17%
P65	$494,652,629	$74,704,460	18%
P70	$497,850,952	$77,902,783	19%
P75	$501,346,968	$81,398,799	19%
P80	$505,095,893	**$85,147,724**	**20%**
P85	$509,518,556	$89,570,387	21%
P90	$515,316,466	$95,368,297	23%
P95	$524,425,269	$104,477,100	25%
P100	$560,973,754	$141,025,585	34%

The P80 level is the contingency value most commonly reported for programming and management purposes within USACE. These results reflect contingencies based on both the cost and schedule risk analyses.

B.4.2.5 Schedule Risk Model

Table 5. Schedule Risk Model

WBS	Name	WBS_Predecessors	Start_Date	Finish_Date	Duration*	Risk Notes
1	Broward County Water Preserve Areas		4/17/14	12/23/26	152	
1.1	Real Estate, PED and S&A		4/17/14	12/23/26	2943	
1.1.1	C-11 Property Acquisition		4/17/14	2/5/16	468	*1/3 of Category 8*
1.1.2	C-3A and 3B Property Acquisition	1.1.1	9/29/16	11/29/19	720	*1/3 of Category 8*
1.1.3	C-9 Property Acquisition	1.1.2	5/3/22	9/29/23	324	*1/3 of Category 8*
1.1.4	C-11 PED	1.2.1	2/8/16	3/22/17	260	*1/3 of Category 4*
1.1.5	C-11 S&A During Construction	1.2.1	2/8/16	6/20/18	545	
1.1.6	C-11 S&A Contract Closeout	1.2.5.21	6/21/18	1/1/19	120	
1.1.7	C-11 Complete	1.1.6	1/1/19	1/1/19	0	
1.1.8	C-3A and 3B PED	1.3.1	12/3/19	1/27/21	260	*1/3 of Category 4*
1.1.9	C-3A & 3B S&A During Construction	1.3.1,1.3.10.15[FF]	12/3/2019	3/28/22	525	
1.1.10	C-3A & 3B S&A Contract Closeout	1.1.9	3/29/22	9/30/22	120	
1.1.11	C-3A & 3B Complete	1.1.10	9/30/22	9/30/22	0	
1.1.12	C-9 PED	1.4.1	10/3/23	1/30/25	300	*1/3 of Category 4*
1.1.13	C-9 S&A During Construction	1.4.1,1.4.5.22[FF]	10/3/23	6/12/26	611	
1.1.14	C-9 S&A Contract Closeout	1.1.13	6/15/26	12/23/26	120	
1.1.15	C-9 Complete	1.1.14	12/23/26	12/23/26	0	
1.2	C-11 Impoundment		2/8/16	6/20/18	545	
1.2.1	Notice to Proceed	1.1.1	2/8/16	2/8/16	0	*Category 5 (100%)*
1.2.2	Mobilization & Site Preparation	1.2.1	2/8/16	2/24/16	10	
1.2.3	Establish Wildlife Monitoring	1.2.2	2/25/16	3/2/16	5	
1.2.4	Canal Construction		3/3/16	6/1/17	291	
1.2.4.1	Clear and Grub at Canal & Dewatering Trenches	1.2.3	3/3/16	4/28/16	38	
1.2.4.2	Construct Temporary Haul Road and Bridge	1.2.4.1[SS+10 days]	3/21/16	8/4/16	92	
1.2.4.3	Strip Peat from Canal & Dewatering Trenches	1.2.4.1[SS+10 days]	3/21/16	4/19/16	21	
1.2.4.4	Load, Haul & Dispose of Unsuitable Material	1.2.4.2[SS+28 days],1.2.4.3[SS+20 days]	4/29/2016	6/1/16	21	
1.2.4.5	Excavate Dewatering Trench, Place Sumps and Begin Pumping	1.2.4.4	6/2/16	12/2/16	120	
1.2.4.6	Clear and Grub at Levee & Containment Dike	1.2.4.5[FF]	9/19/2016	12/2/16	50	
1.2.4.7	Strip Peat at Levee	1.2.4.6[FF]	11/11/2016	12/2/16	14	
1.2.4.8	Cut/Fill to Construct Bank	1.2.4.5	12/6/16	12/16/16	8	
1.2.4.9	Excavate Drainage Canals	1.2.4.8,1.2.4.5	12/19/2016	5/26/17	100	
1.2.4.10	Crush Excavated Rock	1.2.4.9[SS+4 days]	12/23/16	6/1/17	100	
1.2.4.11	Construct Containment Dike	1.2.4.10[FF]	4/5/2017	6/1/17	38	

WBS	Name	WBS_Predecessors	Start_Date	Finish_Date	Duration*	Risk Notes
1.2.5	**Levee**		**4/29/16**	**6/20/18**	**492**	
1.2.5.1	Clearing & Grubbing	1.2.4.1	4/29/16	5/16/16	10	
1.2.5.2	Establish Dewatering Trenches	1.2.5.1	5/17/16	8/8/16	56	
1.2.5.3	Strip & Stockpile Topsoil	1.2.5.2[SS+10 days],1.2.5.4,1.2.4.7[SS]	11/11/2016	11/25/16	9	
1.2.5.4	Excavate & Haul Peat & Muck	1.2.5.2[SS+5 days],1.2.4.2[SS+10 days]	5/24/2016	6/7/16	10	
1.2.5.5	Excavate & Haul Suitable Material	1.2.5.3[SS+2 days]	11/16/16	12/23/16	25	
1.2.5.6	Excavate Limestone at Soil Cement Footer	1.2.5.5[SS+10 days]	12/1/16	2/7/17	42	
1.2.5.7	Foundation Cleanup	1.2.5.6[SS+5 days]	12/9/16	6/6/17	112	
1.2.5.8	Foundation Drainage Piping	1.2.5.7[SS+3 days]	12/15/16	6/22/17	120	
1.2.5.9	Foundation Gravel & Filter Fabric	1.2.5.8[SS+24 days]	1/25/17	7/4/17	102	
1.2.5.10	Fill to Berm (Including Select Fill)	1.2.5.9[SS+4 days],1.2.4.9[SS],1.2.7.6[FF]	1/31/2017	7/18/2017	108	
1.2.5.11	Trench for & Place Instrument Cable	1.2.5.9[FF]	6/2/2017	7/4/17	20	
1.2.5.12	Place Geotextile Fabric on Side Slope	1.2.5.11	7/5/17	8/7/17	22	
1.2.5.13	Place Fine Drainage Gravel on Slope	1.2.5.12	8/8/17	8/31/17	16	
1.2.5.14	Drill Instrumentation Wells	1.2.5.13	9/1/17	9/8/17	5	
1.2.5.15	Soil Cement to Levee Toe	1.2.5.14,1.2.5.10	9/11/2017	12/15/2017	60	
1.2.5.16	Soil Cement to Impoundment Side Slopes & Crown	1.2.5.15[SS+10 days]	9/26/2017	4/12/2018	122	
1.2.5.17	Final Fill at Toe	1.2.5.16	4/13/2018	5/1/2018	12	
1.2.5.18	Aggregate Surfacing to Access Road	1.2.5.16	4/13/2018	5/23/2018	26	
1.2.5.19	Place Topsoil/Sod on Canal Side Slope	1.2.5.18,1.2.4.11,1.2.5.17	5/24/2018	6/12/2018	12	
1.2.5.20	Place Instrumentation	1.2.5.19,1.2.5.17	6/13/2018	6/20/2018	6	
1.2.5.21	Levee Complete	1.2.5.20,1.2.9.1,1.1.4,1.1.5	6/20/2018	6/20/2018	0	
1.2.6	**Structure S-503 Pump Plant**		**5/17/16**	**4/24/18**	**445**	
1.2.6.1	Structural Backfill	1.2.5.1	5/17/16	6/6/2016	14	
1.2.6.2	Sheet Piles to Cofferdam	1.2.6.1	6/7/2016	12/8/2016	120	
1.2.6.3	Steel Sheet Piling to Wing Walls	1.2.6.2	12/9/2016	3/23/2017	64	
1.2.6.4	Rough-in Below Slab MEP	1.2.6.2	12/9/2016	1/3/2017	16	
1.2.6.5	Concrete to Substructure	1.2.6.4	1/4/2017	8/28/2017	148	
1.2.6.6	Concrete to Abutment Wall/Wing Wall Caps	1.2.6.3,1.2.6.5[SS+24 days]	3/24/2017	10/11/2017	128	
1.2.6.7	Concrete to CIP Piers	1.2.6.6[SS+32 days]	5/15/2017	10/11/2017	96	
1.2.6.8	Operating & Gallery Floor Slab	1.2.6.7[SS+38 days]	7/12/2017	9/13/2017	40	
1.2.6.9	Superstructure & Exterior Walls	1.2.6.8	9/14/2017	10/6/2017	16	
1.2.6.10	Doors & Windows	1.2.6.9[SS+3 days]	9/19/2017	10/10/2017	14	
1.2.6.11	Roof Insulation & Roofing	1.2.6.10	10/11/2017	12/27/2017	48	
1.2.6.12	Place Pump Machinery & Engines	1.2.6.11	12/28/2017	1/25/2018	16	
1.2.6.13	Place Trash Rake & Conveyor	1.2.6.12[SS]	12/28/2017	3/23/2018	52	
1.2.6.14	Pavement Repair at Structure	1.2.6.13	3/26/2018	4/9/2018	10	
1.2.6.15	Commission Structure	1.2.6.14	4/10/2018	4/24/2018	10	*Category 3 (100%); Category 6 (100%); 1/3 of Ca*
1.2.6.16	Structure Complete	1.2.6.15	4/24/2018	4/24/2018	0	

52

WBS	Name	WBS_Predecessors	Start_Date	Finish_Date	Duration*	Risk Notes
1.2.7	**C-11Reservoir**		**3/21/16**	**3/27/17**	**238**	
1.2.7.1	Construct Temporary Haul Road	1.2.4.2[SS]	3/21/2016	8/4/2016	92	
1.2.7.2	Site Silt Fencing & Turbidity Barriers	1.2.7.1	8/5/2016	10/24/2016	51	
1.2.7.3	Demolish Existing Roadways & Degrade Embankment	1.2.7.2[SS+6 days]	8/15/2016	10/14/2016	40	
1.2.7.4	Clearing and Clearing & Grubbing to Resevoir	1.2.7.3	10/17/2016	2/23/2017	80	
1.2.7.5	Haul Clearing & Grubbing Debris	1.2.7.4[SS+12 days]	11/3/2016	3/14/2017	80	
1.2.7.6	Wetland Scrape	1.2.7.5	3/15/2017	3/27/2017	8	
1.2.8	**Floodway Control Diversion Structures**		**1/4/17**	**5/1/18**	**300**	
1.2.8.1	Construct Floodway Control Diversion Structures	1.2.5.8[SS],1.2.5.17[FF]	1/4/2017	5/1/18	300	
1.2.9	**Recreation Facilities**		**4/13/18**	**6/14/18**	**40**	
1.2.9.1	Recreation Facilities	1.2.5.18[SS]	4/13/2018	6/14/2018	40	
1.3	**WCA 3A and 3B**		**11/29/19**	**3/28/22**	**526**	
1.3.1	NTP for WCA 3a&3B	1.2.6.16,1.1.2	11/29/2019	11/29/2019	0	
1.3.2	Mobilization & Site Preparation	1.3.1	12/3/19	12/17/19	10	
1.3.3	Establish Wildlife Monitoring	1.3.2	12/18/19	12/24/19	5	
1.3.4	**Reservoir**		**12/3/19**	**12/4/20**	**230**	
1.3.4.1	Relocate Existing 500kV Transmission Line	1.3.1	12/3/2019	4/9/2020	80	
1.3.4.2	Site Silt Fencing & Turbidity Barriers	1.3.3	12/26/19	6/24/20	114	
1.3.4.3	Demolish Existing Roadways & Degrade Embankment	1.3.4.2[SS+10 days]	1/13/2020	3/17/2020	40	
1.3.4.4	Clearing and Clearing & Grubbing to Resevoir	1.3.4.3,1.3.4.1	4/10/2020	8/28/2020	90	
1.3.4.5	Haul Clearing & Grubbing Debris	1.3.4.4[SS+12 days]	4/29/2020	9/18/2020	90	
1.3.4.6	Wetland Scrape	1.3.4.5[SS+10 days],1.3.5.10[SS+45 days]	7/14/2020	12/4/2020	90	
1.3.5	**Reaches L502A 1, 2 and 3**		**12/26/19**	**10/8/20**	**180**	
1.3.5.1	Mobilization & Site Preparation	1.3.3	12/26/19	1/9/20	10	
1.3.5.2	Clear and Grub at Canal & Dewatering Trenches	1.3.5.1	1/13/2020	2/6/2020	16	
1.3.5.3	Construct Temporary Haul Road	1.3.5.2[SS+10 days]	1/30/2020	4/1/2020	40	
1.3.5.4	Strip Peat from Canal & Dewatering Trenches	1.3.5.2[SS+10 days]	1/30/2020	4/10/2020	46	
1.3.5.5	Load, Haul & Dispose of Unsuitable Material	1.3.5.4[SS+20 days],1.3.5.3[SS+28 days]	3/16/2020	4/10/2020	18	
1.3.5.6	Excavate Dewatering Trench, Place Sumps and Begin Pumping	1.3.5.5	4/13/2020	4/27/2020	10	
1.3.5.7	Clear and Grub at Levee	1.3.5.6	4/28/2020	5/25/2020	18	
1.3.5.8	Strip Peat at Levee	1.3.5.7	5/26/2020	6/24/2020	20	
1.3.5.9	Cut/Fill to Construct Bank	1.3.5.6[SS+6 days]	4/22/2020	5/1/2020	8	
1.3.5.10	Excavate Drainage Canals	1.3.5.9	5/4/2020	10/8/2020	100	
1.3.5.11	Stockpile Random Fill Each Side of Levee/FPL Berm	1.3.5.10[SS+10 days],1.3.5.8[SS+2 days]	5/29/2020	6/24/2020	18	
1.3.5.12	Haul Rock to Crusher/Excess to Disposal	1.3.5.10[FF],1.3.5.5	5/4/2020	10/8/2020	100	
1.3.5.13	Place Select Fill	1.3.5.12[SS+50 days],1.3.5.11	7/22/2020	8/31/2020	26	
1.3.5.14	Place Random Fill at Levee	1.3.5.13[SS+16 days]	8/14/2020	9/4/2020	14	

WBS	Name	WBS_Predecessors	Start_Date	Finish_Date	Duration*	Risk Notes
1.3.6	**Structure S-514A, Pumping Plant**		**1/13/20**	**8/31/21**	**373**	
1.3.6.1	Structural Backfill	1.3.5.1	1/13/2020	1/31/2020	12	
1.3.6.2	Sheet Piles to Cofferdam	1.3.6.1	2/3/2020	7/10/2020	102	
1.3.6.3	Steel Sheet Piling to Wing Walls	1.3.6.2	7/13/2020	10/1/2020	52	
1.3.6.4	Rough-in MEP	1.3.6.2	7/13/2020	7/30/2020	12	
1.3.6.5	Concrete to Substructure	1.3.6.4	7/31/2020	1/19/2021	104	
1.3.6.6	Concrete to Abutment Wall/Wing Wall Caps	1.3.6.5[SS+24 days],1.3.6.3	10/2/2020	3/30/2021	108	
1.3.6.7	Concrete to CIP Piers	1.3.6.6[SS+32 days]	11/25/2020	4/5/2021	80	
1.3.6.8	Operating & Gallery Floor Slab	1.3.6.7[SS+40 days]	2/2/2021	3/26/2021	34	
1.3.6.9	Superstructure & Exterior Walls	1.3.6.8	3/29/2021	4/14/2021	12	
1.3.6.10	Doors & Windows	1.3.6.9[SS+3 days]	4/1/2021	4/20/2021	12	
1.3.6.11	Roof Insulation & Roofing	1.3.6.10[SS+2 days]	4/5/2021	6/9/2021	42	
1.3.6.12	Place Pump Machinery & Engines	1.3.6.11	6/10/2021	6/28/2021	12	
1.3.6.13	Place Trash Rake & Conveyor	1.3.6.12[SS]	6/10/2021	8/16/2021	44	
1.3.6.14	Commission Structure	1.3.6.13	8/18/2021	8/31/2021	10	
1.3.6.15	Structure Complete	1.3.6.14	8/31/2021	8/31/2021	0	
1.3.7	**Reaches L502B 1, 2 and 3 Holly Lakes, Bishop/Nixon & FPL Berms**		**1/13/20**	**3/28/22**	**500**	
1.3.7.1	Mobilization & Site Preparation	1.3.5.1	1/13/2020	1/29/2020	10	
1.3.7.2	Clear and Grub at Canal & Dewatering Trenches	1.3.7.1	1/30/2020	3/19/2020	32	
1.3.7.3	Construct Temporary Haul Road	1.3.7.2[SS+10 days]	2/17/2020	5/11/2020	54	
1.3.7.4	Strip Peat from Canal & Dewatering Trenches	1.3.7.2[SS+15 days]	2/25/2020	5/15/2020	53	
1.3.7.5	Load, Haul & Dispose of Unsuitable Material	1.3.7.4[SS+10 days],1.3.7.3[SS+20 days]	3/18/2020	5/13/2020	36	
1.3.7.6	Excavate Dewatering Trench, Place Sumps and Begin Pumping	1.3.7.5	5/14/2020	5/27/2020	10	
1.3.7.7	Clear and Grub at Levee & Berms	1.3.7.6	5/29/2020	9/10/2020	66	
1.3.7.8	Strip Peat at Levee/ Berms	1.3.7.7	9/11/2020	11/27/2020	48	
1.3.7.9	Cut/Fill to Construct Bank	1.3.7.6[SS+6 days]	5/22/2020	6/4/2020	8	
1.3.7.10	Excavate Drainage Canals	1.3.7.9	6/5/2020	6/22/2021	238	
1.3.7.11	Stockpile Random Fill Each Side of Levee & at FPL Berm	1.3.7.8[SS+2 days],1.3.7.10[SS+10 days]	9/15/2020	3/11/2021	108	
1.3.7.12	Haul, Process and Stockpile Rock	1.3.7.10[FF]	5/20/2020	6/22/2021	248	
1.3.7.13	Place Select Fill	1.3.7.12,1.3.7.11[FF]	6/23/2021	11/30/2021	100	
1.3.7.14	Place Random Fill at Levee/ Berms	1.3.7.13	12/1/2021	3/28/2022	72	*Category 2 (100%); 1/3 of Category 1*
1.3.8	**Reaches L502B 4 and 5**		**1/30/20**	**10/26/20**	**170**	
1.3.8.1	Mobilization & Site Preparation	1.3.7.1	1/30/2020	2/13/2020	10	
1.3.8.2	Clear and Grub at Canal & Dewatering Trenches	1.3.8.1	2/17/2020	2/25/2020	6	
1.3.8.3	Construct Temporary Haul Road	1.3.8.2[SS+10 days]	3/4/2020	3/19/2020	12	
1.3.8.4	Strip Peat from Canal & Dewatering Trenches	1.3.8.2[SS+15 days],1.3.8.3	3/23/2020	3/26/2020	4	
1.3.8.5	Load, Haul & Dispose of Unsuitable Material	1.3.8.3[SS+20 days],1.3.8.4[SS+10 days]	4/6/2020	4/20/2020	9	
1.3.8.6	Excavate Dewatering Trench, Place Sumps and Begin Pumping	1.3.8.5	4/21/2020	4/28/2020	6	
1.3.8.7	Clear and Grub at Levee	1.3.8.6	4/29/2020	5/6/2020	6	
1.3.8.8	Strip Peat at Levee	1.3.8.7	5/11/2020	6/11/2020	22	

WBS	Name	WBS_Predecessors	Start_Date	Finish_Date	Duration*	Risk Notes
1.3.8.9	Cut/Fill to Construct Bank	1.3.8.6[SS+6 days],1.3.8.8	6/12/2020	6/23/2020	8	
1.3.8.10	Excavate Drainage Canals	1.3.8.9	6/24/2020	7/22/2020	18	
1.3.8.11	Stockpile Random Fill Each Side of Levee	1.3.8.8[SS+2 days],1.3.8.10[SS+10 days]	7/10/2020	7/16/2020	4	
1.3.8.12	Haul, Process and Stockpile Rock	1.3.8.10[FF],1.3.8.11	7/17/2020	9/30/2020	48	
1.3.8.13	Place Select Fill	1.3.8.12	10/1/2020	10/20/2020	11	
1.3.8.14	Place Random Fill	1.3.8.13	10/21/2020	10/26/2020	4	
1.3.9	**Reach L 503 & Jones Park Levee**		**2/17/20**	**3/15/21**	**244**	
1.3.9.1	Mobilization & Site Preparation	1.3.8.1	2/17/2020	3/3/2020	10	
1.3.9.2	Clear and Grub at Canal & Dewatering Trenches	1.3.9.1	3/4/2020	3/11/2020	6	
1.3.9.3	Construct Temporary Haul Road	1.3.9.2[SS+10 days]	3/18/2020	4/1/2020	10	
1.3.9.4	Strip Peat from Canal & Dewatering Trenches	1.3.9.2[SS+15 days],1.3.9.3	4/2/2020	4/6/2020	3	
1.3.9.5	Load, Haul & Dispose of Unsuitable Material	1.3.9.3[SS+20 days],1.3.9.4[SS+10 days]	4/20/2020	4/30/2020	9	
1.3.9.6	Excavate Dewatering Trench, Place Sumps and Begin Pumping	1.3.9.5	5/1/2020	5/5/2020	3	
1.3.9.7	Clear and Grub at Levee/Jones Park Levee	1.3.9.6	5/6/2020	5/15/2020	6	
1.3.9.8	Strip Peat at Levee/Jones Park Levee	1.3.9.7	5/18/2020	6/18/2020	22	
1.3.9.9	Cut/Fill to Construct Bank	1.3.9.6[SS+6 days],1.3.9.8	6/19/2020	7/1/2020	8	
1.3.9.10	Excavate Drainage Canals	1.3.9.9	7/2/2020	7/24/2020	15	
1.3.9.11	Stockpile Random Fill Each Side of Levee	1.3.9.8[SS+2 days],1.3.9.10[SS+10 days]	7/20/2020	7/24/2020	5	
1.3.9.12	Haul, Process and Stockpile Rock	1.3.9.10[FF],1.3.9.11	7/28/2020	9/14/2020	31	
1.3.9.13	Place Select Fill to Levee/Jones Park Levee	1.3.9.12	9/15/2020	9/30/2020	11	
1.3.9.14	Place Random Fill to Levee/Jones Park Levee	1.3.9.13,1.3.11.1	12/31/2020	1/6/2021	4	
1.3.9.15	Levee Complete	1.3.9.14,1.3.12.1	3/15/2021	3/15/2021	0	*Category 7 (100%)*
1.3.10	**Structure S-514B, Pumping Plant**		**3/4/20**	**8/26/21**	**340**	
1.3.10.1	Structural Backfill	1.3.9.1	3/4/2020	3/17/2020	10	
1.3.10.2	Sheet Piles to Cofferdam	1.3.10.1	3/18/2020	8/5/2020	90	
1.3.10.3	Steel Sheet Piling to Wing Walls	1.3.10.2	8/6/2020	10/22/2020	48	
1.3.10.4	Rough-in MEP	1.3.10.2	8/6/2020	8/25/2020	12	
1.3.10.5	Concrete to Substructure	1.3.10.4	8/26/2020	2/5/2021	100	
1.3.10.6	Concrete to Abutment Wall/Wing Wall Caps	1.3.10.3,1.3.10.5[SS+24 days]	10/23/2020	3/30/2021	96	
1.3.10.7	Concrete to CIP Piers	1.3.10.6[SS+32 days]	12/16/2020	4/12/2021	72	
1.3.10.8	Operating & Gallery Floor Slab	1.3.10.7[SS+40 days]	2/23/2021	4/8/2021	30	
1.3.10.9	Superstructure & Exterior Walls	1.3.10.8	4/9/2021	4/27/2021	12	
1.3.10.10	Doors & Windows	1.3.10.9[SS+3 days]	4/14/2021	4/28/2021	10	
1.3.10.11	Roof Insulation & Roofing	1.3.10.10[SS+2 days]	4/19/2021	6/11/2021	36	
1.3.10.12	Place Pump Machinery & Engines	1.3.10.11	6/14/2021	6/30/2021	12	
1.3.10.13	Place Trash Rake & Conveyor	1.3.10.12[SS]	6/14/2021	8/11/2021	39	
1.3.10.14	Commission Structure	1.3.10.13	8/12/2021	8/26/2021	10	
1.3.10.15	Structure Complete	1.3.10.14,1.1.8	8/26/2021	8/26/2021	0	

WBS	Name	WBS_Predecessors	Start_Date	Finish_Date	Duration*	Risk Notes
1.3.11	**Floodway Control Diversion Structures**		**7/22/20**	**12/30/20**	**100**	
1.3.11.1	Construct Floodway Control Diversion Structures	1.3.5.13[SS]	7/22/2020	12/30/2020	100	
1.3.12	**Recreation Facilities**		**1/7/21**	**3/15/21**	**40**	
1.3.12.1	Recreation Facilities	1.3.9.14	1/7/2021	3/15/2021	40	
1.4	**C-9 Impoundment**		**10/3/23**	**6/12/26**	**611**	
1.4.1	NTP for C-9	1.1.3	10/3/23	10/3/23	0	
1.4.2	Mobilization & Site Preparation	1.4.1	10/3/23	10/17/23	10	
1.4.3	Establish Wildlife Monitoring	1.4.2	10/18/23	10/25/23	5	
1.4.4	**Canal Construction**		**10/26/23**	**2/24/26**	**526**	
1.4.4.1	Clear and Grub at Canal & Dewatering Trenches	1.4.3	10/26/2023	1/5/2024	44	
1.4.4.2	Construct Temporary Haul Road	1.4.4.1[SS+10 days]	11/14/2023	4/10/2024	92	
1.4.4.3	Strip Unsuitable Soil from Canal & Dewatering Trenches	1.4.4.1[SS+10 days]	11/14/2023	12/20/2023	24	
1.4.4.4	Load, Haul & Stockpile Suitable Material	1.4.4.2[SS+28 days],1.4.4.3[SS+20 days]	12/28/2023	1/29/2024	18	
1.4.4.5	Excavate Dewatering Trench, Place Sumps and Begin Pumping	1.4.4.4	1/30/2024	2/16/2024	12	
1.4.4.6	Clear and Grub at Levee	1.4.4.5	2/19/2024	3/18/2024	18	
1.4.4.7	Strip Peat at Levee	1.4.4.6	3/19/2024	4/8/2024	14	
1.4.4.8	Cut/Fill to Construct Bank	1.4.4.5[SS+6 days]	2/7/2024	2/20/2024	8	
1.4.4.9	Excavate Drainage Canals	1.4.4.8	2/22/2024	2/24/2026	456	
1.4.4.10	Load & Haul Surplus Material	1.4.4.9[SS+10 days]	3/8/2024	8/9/2024	100	
1.4.5	**Levee**		**3/8/24**	**6/12/26**	**516**	
1.4.5.1	Clearing & Grubbing	1.4.4.10[SS],1.4.4.1	3/8/2024	7/10/2024	80	
1.4.5.2	Temporary Haul Road	1.4.5.1[SS+10 days],1.4.4.2[SS+10 days]	3/25/2024	6/12/2024	52	
1.4.5.3	Establish Dewatering Trenches	1.4.5.2	6/13/2024	6/24/2024	8	
1.4.5.4	Strip & Stockpile Topsoil	1.4.5.3[SS+10 days],1.4.5.5,1.4.4.7	8/22/2024	8/30/2024	7	
1.4.5.5	Excavate & Haul Peat & Muck	1.4.5.3	6/25/2024	8/21/2024	37	
1.4.5.6	Excavate & Haul Suitable Material	1.4.5.4[SS+2 days]	8/26/2024	10/24/2024	38	
1.4.5.7	Excavate Limestone at Soil Cement Footer	1.4.5.6[SS+10 days]	9/11/2024	12/13/2024	58	
1.4.5.8	Foundation Cleanup	1.4.5.7[SS+10 days]	9/26/2024	2/5/2025	80	
1.4.5.9	Foundation Drainage Piping	1.4.5.8[SS+20 days]	10/29/2024	5/13/2025	120	
1.4.5.10	Foundation Gravel & Filter Fabric	1.4.5.9[SS+20 days]	12/3/2024	5/21/2025	106	
1.4.5.11	Fill to Berm (Including Select Fill, Chimney & Blanket)	1.4.5.10[SS+10 days],1.4.7.15[FF],1.4.8.15[FF]	12/18/2024	8/22/2025	156	
1.4.5.12	Trench for & Place Instrument Cable	1.4.5.10[FF]	4/28/2025	5/21/2025	16	
1.4.5.13	Place Geotextile Fabric on Side Slope	1.4.5.12[SS],1.4.5.11[FF]	7/22/2025	8/22/2025	22	
1.4.5.14	Place Fine Drainage Gravel on Slope	1.4.5.13[SS+4 days]	7/29/2025	8/26/2025	20	
1.4.5.15	Drill Instrumentation Wells	1.4.5.14	8/27/2025	9/2/2025	4	
1.4.5.16	Soil Cement to Levee Toe	1.4.5.15	9/3/2025	12/4/2025	57	
1.4.5.17	Soil Cement to Impoundment Side Slopes & Crown	1.4.5.16[SS+10 days],1.4.5.11[SS+120 days],1.4.6.5[FF],1.	9/19/2025	3/27/2026	116	

WBS	Name	WBS_Predecessors	Start_Date	Finish_Date	Duration*	Risk Notes
1.4.5.18	Final Fill at Toe	1.4.5.17	3/30/2026	4/10/2026	9	
1.4.5.19	Aggregate Surfacing to Access Road & Ramp	1.4.5.14,1.4.5.18	4/13/2026	4/23/2026	8	
1.4.5.20	Place Sod on Canal Side Slope	1.4.5.19	4/24/2026	5/25/2026	20	
1.4.5.21	Place Instrumentation	1.4.5.18,1.4.5.20	5/26/2026	6/1/2026	4	
1.4.5.22	Levee Complete	1.4.5.21,1.4.9.1	6/12/2026	6/12/2026	0	
1.4.6	**C-9 Reservoir**		**6/13/24**	**12/9/25**	**338**	
1.4.6.1	Construct Temporary Haul Road	1.4.5.2	6/13/2024	11/4/2024	92	
1.4.6.2	Site Silt Fencing & Turbidity Barriers	1.4.6.1	11/5/2024	11/21/2024	10	
1.4.6.3	Demolish Existing Roadways & Degrade Embankment	1.4.6.2[SS+6 days]	11/18/2024	1/23/2025	40	
1.4.6.4	Clear & Clearing & Hauling	1.4.6.3	1/24/2025	12/9/2025	200	
1.4.6.5	Place Fill at ASR Sites	1.4.6.4[FF]	10/14/2025	12/9/2025	34	
1.4.7	**Structure S-512 Pump Plant**		**3/25/24**	**11/12/24**	**149**	
1.4.7.1	Structural Backfill	1.4.5.1[SS+10 days]	3/25/2024	3/28/2024	4	
1.4.7.2	Sheet Piles to Cofferdam	1.4.7.1	3/29/2024	5/15/2024	30	
1.4.7.3	Steel Sheet Piling to Wing Walls	1.4.7.2	5/16/2024	6/10/2024	16	
1.4.7.4	Rough-in MEP	1.4.7.2	5/16/2024	5/21/2024	4	
1.4.7.5	Concrete to Substructure	1.4.7.4	5/22/2024	7/18/2024	37	
1.4.7.6	Concrete to Abutment Wall/Wing Wall Caps	1.4.7.5[SS+24 days],1.4.7.3	6/27/2024	8/15/2024	32	
1.4.7.7	Concrete to CIP Piers	1.4.7.6[SS+16 days]	7/24/2024	8/28/2024	24	
1.4.7.8	Operating & Gallery Floor Slab	1.4.7.7[SS+19 days]	8/22/2024	9/5/2024	10	
1.4.7.9	Superstructure & Exterior Walls	1.4.7.8	9/6/2024	9/12/2024	4	
1.4.7.10	Doors & Windows	1.4.7.9[SS+3 days]	9/12/2024	9/18/2024	4	
1.4.7.11	Roof Insulation & Roofing	1.4.7.10	9/19/2024	10/4/2024	12	
1.4.7.12	Place Pump Machinery & Engines	1.4.7.11	10/8/2024	10/11/2024	4	
1.4.7.13	Place Trash Rake & Conveyor	1.4.7.12[SS]	10/8/2024	10/28/2024	13	
1.4.7.14	Commission Structure	1.4.7.13	10/29/2024	11/12/2024	10	
1.4.7.15	Structure Complete	1.4.7.14	11/12/2024	11/12/2024	0	
1.4.8	**Structure S-509 Pump Plant**		**5/16/24**	**2/27/26**	**405**	
1.4.8.1	Structural Backfill	1.4.7.2	5/16/2024	5/24/2024	7	
1.4.8.2	Sheet Piles to Cofferdam	1.4.8.1	5/27/2024	8/27/2024	60	
1.4.8.3	Steel Sheet Piling to Wing Walls	1.4.8.2	8/28/2024	10/17/2024	32	
1.4.8.4	Rough-in MEP	1.4.8.2	8/28/2024	9/9/2024	8	
1.4.8.5	Concrete to Substructure	1.4.8.4	9/11/2024	1/8/2025	74	
1.4.8.6	Concrete to Abutment Wall/Wing Wall Caps	1.4.8.3,1.4.8.5[SS+24 days]	10/21/2024	2/3/2025	64	
1.4.8.7	Concrete to CIP Piers	1.4.8.6[SS+32 days]	12/12/2024	2/28/2025	48	

WBS	Name	WBS_Predecessors	Start_Date	Finish_Date	Duration*	Risk Notes
1.4.8.8	Operating & Gallery Floor Slab	1.4.8.7[SS+38 days]	2/13/2025	3/17/2025	20	
1.4.8.9	Superstructure & Exterior Walls	1.4.8.8	3/18/2025	3/28/2025	8	
1.4.8.10	Doors & Windows	1.4.8.9[SS+3 days]	3/24/2025	4/2/2025	7	
1.4.8.11	Roof Insulation & Roofing	1.4.8.10	4/3/2025	5/8/2025	24	
1.4.8.12	Place Pump Machinery & Engines	1.4.8.11	5/12/2025	5/21/2025	8	
1.4.8.13	Place Trash Rake & Conveyor	1.4.8.12[SS]	5/12/2025	6/18/2025	26	
1.4.8.14	Commission Structure	1.4.8.13	6/19/2025	7/3/2025	10	
1.4.8.15	Structure Complete	1.4.8.14,1.1.12	7/3/2025	7/3/2025	0	
1.4.8.16	**Floodway Control Diversion Structures**		**10/29/24**	**2/27/26**	**300**	
1.4.8.16.1	Construct Floodway Control Diversion Structures	1.4.5.9[SS]	10/29/2024	2/27/2026	300	
1.4.9	**Recreation Facilities**		**4/13/26**	**6/12/26**	**40**	
1.4.9.1	Recreation Facilities	1.4.5.19[SS]	4/13/2026	6/12/2026	40	*1/3 of Category I*
1.5	**Project Finish**		**12/23/26**	**12/23/26**	**0**	
1.5.1	Water Preserve Areas Complete	1.1.7,1.1.15,1.1.11	12/23/2026	12/23/2026	0	

58

B.4.2.6 **Schedule Results**

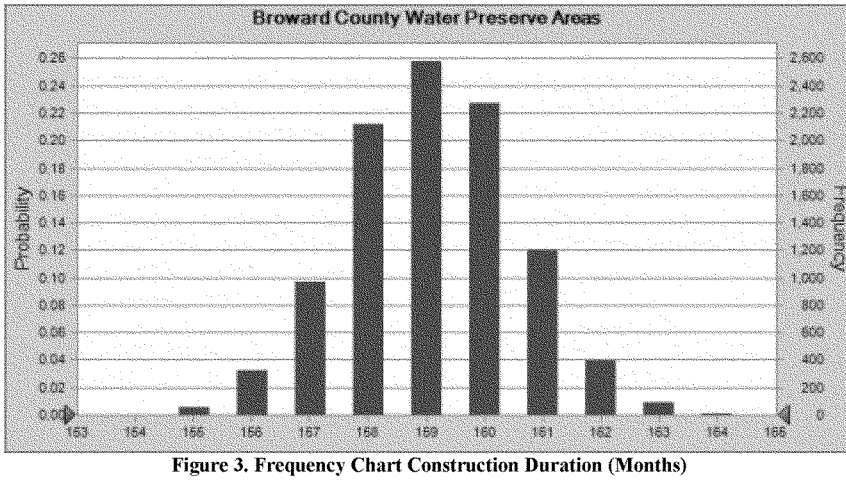


Figure 3. Frequency Chart Construction Duration (Months)

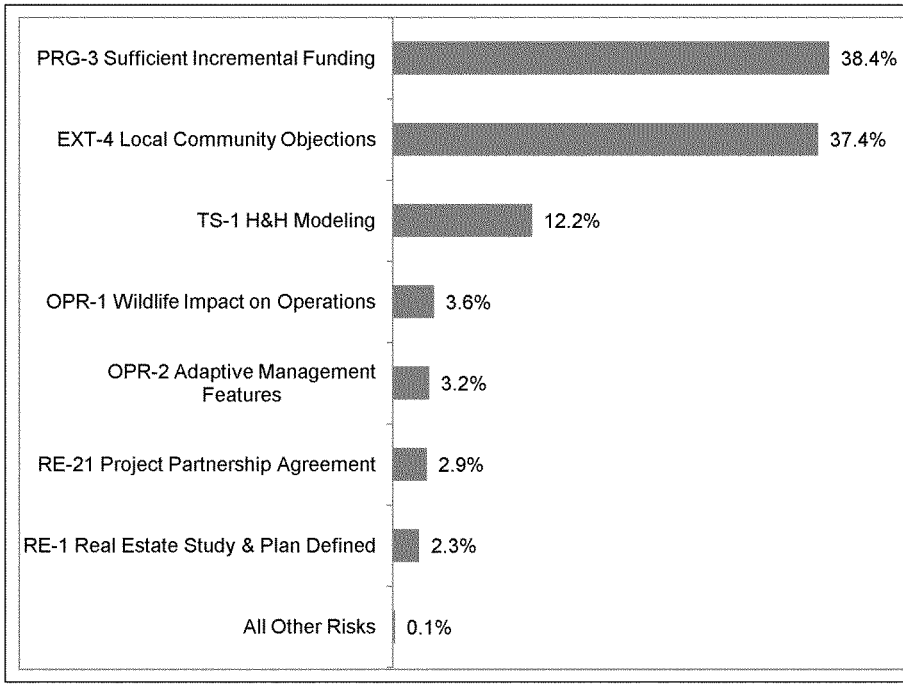


Figure 4. Sensitivity Chart Construction Duration

Table 6. Forecast Values/Construction Duration

Confidence Level	Duration + Contingency (months)	Contingency (months)	Contingency (%)
P0	154	2.0	1.3%
P05	157	5.0	3.3%
P10	157	5.0	3.3%
P15	158	6.0	3.9%
P20	158	6.0	3.9%
P25	158	6.0	3.9%
P30	158	6.0	3.9%
P35	159	7.0	4.6%
P40	159	7.0	4.6%
P45	159	7.0	4.6%
P50	159	7.0	4.6%
P55	159	7.0	4.6%
P60	159	7.0	4.6%
P65	160	8.0	5.3%
P70	160	8.0	5.3%
P75	160	8.0	5.3%
P80	160	8.0	5.3%
P85	161	9.0	5.9%
P90	161	9.0	5.9%
P95	161	9.0	5.9%
P100	164	12.0	7.9%

B.5 TOTAL PROJECT COST SUMMARY

The Total Project Cost Summary (TPCS) addresses inflation through project completion (accomplished by escalation to mid-point of construction per ER 1110-2-1302, Appendix C, Page C-2). It is based on the scope of the TSP and the project schedule. The TPCS includes Federal and non-Federal costs for lands and damages, all construction features, PED, and S&A, along with the appropriate contingencies and escalation associated with each of these activities. The TPCS is formatted according to the WBS and uses Civil Works Construction Cost Indexing System factors for escalation (EM 1110-2-1304) of construction costs and Office of Management and Budget (EC 11-2-18X, 31 March 2011) factors for escalation of PED and S&A costs.

Table 6. is the Total Project Cost Summary prepared using the MCACES/MII cost estimate on the TSP with contingencies set by the risk analysis (and the exceptions as described above) and the official project schedule.

Table 7. Total Project Cost Summay

****** TOTAL PROJECT COST SUMMARY ******

Printed:2/6/2012
Page 1 of 4

PROJECT: Broward County Water Preserve Areas
LOCATION: Broward County, FL

DISTRICT: Jacksonville
POC: CHIEF, COST ENGINEERING, Tracy Leeser, P.E

PREPARED: 2/6/2012

This Estimate reflects the scope and schedule in report; Broward County WPA, Integrated Project Implementation Report and Environmental Impact Statement April 2007

						Program Year (Budget EC): 2013 Effective Price Level Date: 1 OCT 12								
				ESTIMATED COST			PROJECT FIRST COST			TOTAL PROJECT COST (FULLY FUNDED)				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Spent Thru: ($K)	L	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
02	RELOCATIONS	$11,180	$9,439	84.4%	$20,618	1.2%	$11,315	$9,553	$20,868			$12,813	$10,829	$23,642
03	RESERVOIRS	$25,360	$4,744	18.7%	$30,104	1.2%	$25,667	$4,801	$30,469			$29,726	$5,559	$35,285
08	ROADS, RAILROADS & BRIDGES	$5,135	$946	18.4%	$6,081	1.2%	$5,198	$957	$6,154			$5,554	$1,023	$6,576
09	CHANNELS & CANALS	$44,258	$8,668	19.6%	$52,926	1.2%	$44,794	$8,773	$53,567			$51,005	$9,993	$60,998
11	LEVEES & FLOODWALLS	$119,477	$24,135	20.2%	$143,612	1.2%	$120,924	$24,428	$145,351			$141,063	$28,493	$169,556
13	PUMPING PLANT	$92,473	$17,005	18.4%	$109,477	1.2%	$93,592	$17,210	$110,802			$108,603	$19,969	$128,572
14	RECREATION FACILITIES	$5,409	$1,037	18.4%	$6,446	1.2%	$5,474	$1,050	$6,524			$6,401	$1,227	$7,628
15	FLOODWAY CONTROL & DIVERSION STR	$25,072	$4,728	19.2%	$29,800	1.2%	$25,376	$4,785	$30,161			$28,647	$5,405	$34,052
18	CULTURAL RESOURCE PRESERVATION	$847	$155	18.3%	$1,002	1.2%	$857	$157	$1,014			$926	$169	$1,095
	CONSTRUCTION ESTIMATE TOTALS:	$329,211	$70,856	21.5%	**$400,067**	1.2%	$333,197	$71,714	$404,911			$384,737	$82,666	**$467,404**
01	LANDS AND DAMAGES	$365,560	$15,083	4.1%	$380,633	1.2%	$369,976	$15,265	$385,242			$409,030	$17,071	$426,100
30	PLANNING, ENGINEERING & DESIGN	$26,337	$4,009	15.2%	$30,346	2.2%	$26,915	$4,097	$31,011	$26,050		$30,143	$4,588	$60,781
31	CONSTRUCTION MANAGEMENT	$25,020	$4,592	18.4%	$29,612	2.2%	$25,569	$4,692	$30,261			$35,182	$6,456	$41,638
	PROJECT COST TOTALS:	$746,118	$94,540	12.7%	$840,657	1.3%	$755,656	$95,769	**$851,425**	$26,050		$859,093	$110,781	$995,923

_____ CHIEF, COST ENGINEERING, Tracy Leeser, P.E

_____ PROJECT MANAGER, xxx

_____ CHIEF, REAL ESTATE, xxx

_____ CHIEF, PLANNING,xxx

_____ CHIEF, ENGINEERING, xxx

_____ CHIEF, OPERATIONS, xxx

_____ CHIEF, CONSTRUCTION, xxx

_____ CHIEF, CONTRACTING,xxx

_____ CHIEF, PM-PB, xxxx

_____ CHIEF, DPM, xxx

ESTIMATED FEDERAL COST: **$497,962**
ESTIMATED NON-FEDERAL COST: **$497,962**

ESTIMATED TOTAL PROJECT COST: $995,923

****** TOTAL PROJECT COST SUMMARY ******

Printed:2/6/2012
Page 2 of 4

****** CONTRACT COST SUMMARY ******

PROJECT: Broward County Water Preserve Areas
LOCATION: Broward County, FL
This Estimate reflects the scope and schedule in report; Broward County WPA, Integrated Project Implementation Report and Environmental Impact Statement April 2007

DISTRICT: Jacksonville
POC: CHIEF, COST ENGINEERING, Tracy Leeser, P.E
PREPARED: 2/6/2012

Estimate Prepared: 13-Sep-11
Effective Price Level: 1-Oct-11

Program Year (Budget EC): 2013
Effective Price Level Date: 1 OCT 12

FULLY FUNDED PROJECT ESTIMATE

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	CONTRACT #1 - C-11													
02	RELOCATIONS	$256	$47	18.3%	$303	1.2%	$259	$47	$307	2016Q4	6.5%	$276	$51	$327
03	RESERVOIRS	$9,483	$1,735	18.3%	$11,219	1.2%	$9,598	$1,756	$11,355	2016Q4	6.5%	$10,222	$1,870	$12,092
08	ROADS, RAILROADS & BRIDGES	$4,919	$900	18.3%	$5,819	1.2%	$4,979	$911	$5,890	2016Q4	6.5%	$5,302	$970	$6,272
09	CHANNELS & CANALS	$13,379	$2,448	18.3%	$15,827	1.2%	$13,541	$2,478	$16,019	2017Q1	7.0%	$14,489	$2,651	$17,140
11	LEVEES & FLOODWALLS	$47,807	$9,579	20.0%	$57,386	1.2%	$48,386	$9,695	$58,081	2016Q4	6.5%	$51,529	$10,325	$61,854
13	PUMPING PLANT	$44,257	$8,110	18.3%	$52,367	1.2%	$44,793	$8,208	$53,001	2017Q3	8.0%	$48,362	$8,862	$57,224
14	RECREATION FACILITIES	$1,884	$345	18.3%	$2,229	1.2%	$1,907	$349	$2,256	2018Q3	9.9%	$2,096	$383	$2,479
15	FLOODWAY CONTROL & DIVERSION STR	$14,830	$2,714	18.3%	$17,543	1.2%	$15,009	$2,746	$17,756	2017Q4	8.5%	$16,278	$2,979	$19,257
18	CULTURAL RESOURCE PRESERVATION	$847	$155	18.3%	$1,002	1.2%	$857	$157	$1,014	2017Q3	8.0%	$926	$169	$1,095
	CONSTRUCTION ESTIMATE TOTALS:	$137,662	$26,033	18.9%	**$163,695**		$139,329	$26,348	$165,677			$149,480	$28,261	$177,740
01	LANDS AND DAMAGES													
	Lands Already Purchased:	$176,715			$176,715	1.2%	$178,855		$178,855	2016Q4	6.5%	$190,474		$190,474
	Lands To Be Purchased	$24,191	$9,265	38.3%	$33,456	1.2%	$24,483	$9,377	$33,861	2016Q4	6.5%	$26,074	$9,986	$36,060
30	PLANNING, ENGINEERING & DESIGN													
	Project Management													
	Planning & Environmental Compliance:													
8.0%	Engineering & Design	$11,013	$1,619	14.7%	$12,632	2.2%	$11,254	$1,654	$12,909	2014Q1	4.0%	$11,705	$1,721	$13,426
	Engineering Tech Review ITR & VE													
	Contracting & Reprographics:													
	Planning During Construction:													
	Project Operations:													
31	CONSTRUCTION MANAGEMENT													
7.6%	Construction Management (Inc. EDC):	$10,462	$1,873	17.9%	$12,335	2.2%	$10,691	$1,914	$12,605	2017Q4	20.4%	$12,868	$2,303	$15,172
	Project Operation:													
	Project Management													
	CONTRACT COST TOTALS:	$360,042	$38,789		$398,832		$364,613	$39,293	$403,906			$390,601	$42,271	**$432,872**

****** TOTAL PROJECT COST SUMMARY ******

Printed:2/6/2012
Page 4 of 4

PROJECT: Broward County Water Preserve Areas
LOCATION: Broward County, FL.
This Estimate reflects the scope and schedule in report; Broward County WPA, Integrated Project Implementation Report and Environmental Impact Statement April 2007

DISTRICT: Jacksonville PREPARED: 2/6/2012
POC: CHIEF, COST ENGINEERING, Tracy Leeser, P.E

Estimate Prepared: 13-Sep-11
Effective Price Level: 1 OCT 12

Program Year (Budget EC): 2013
Effective Price Level Date: 1 OCT 12

FULLY FUNDED PROJECT ESTIMATE

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	CONTRACT #3 - C-9:													
02	RELOCATIONS													
03	RESERVOIRS	$11,783	$2,156	18.3%	$13,938.9	1.2%	$11,925	$2,182	$14,108	2025Q2	24.0%	$14,784	$2,706	$17,490
08	ROADS, RAILROADS & BRIDGES													
09	CHANNELS & CANALS	$8,319	$1,522	18.3%	$9,841.9	1.2%	$8,420	$1,541	$9,961	2025Q1	23.4%	$10,392	$1,902	$12,293
11	LEVEES & FLOODWALLS	$62,470	$12,494	20.0%	$74,964.1	1.2%	$63,226	$12,645	$75,872	2025Q3	24.5%	$78,737	$15,747	$94,485
13	PUMPING PLANT	$45,408	$8,310	18.3%	$53,718.1	1.2%	$45,958	$8,410	$54,368	2025Q2	24.0%	$56,976	$10,427	$67,402
14	RECREATION FACILITIES	$1,634	$299	18.3%	$1,932.5	1.2%	$1,653	$303	$1,956	2026Q3	26.6%	$2,096	$384	$2,479
15	FLOODWAY CONTROL & DIVERSION STR	$4,688	$858	18.3%	$5,545.3	1.2%	$4,744	$868	$5,612	2025Q3	24.6%	$5,908	$1,081	$6,989
18	CULTURAL RESOURCE PRESERVATION													
	CONSTRUCTION ESTIMATE TOTALS:	$134,302	$25,639	19.1%	**$159,940.8**		$135,928	$25,950	$161,877			$168,893	$32,246	$201,139
01	LANDS AND DAMAGES													
01	LANDS AND DAMAGES	$24,263			$24,262.9	1.2%	$24,557		$24,557	2025Q1	23.4%	$30,306		$30,306
01	LANDS AND DAMAGES	$9,941	$3,807	38.3%	$13,748.0	1.2%	$10,061	$3,853	$13,914	2025Q2	24.0%	$12,473	$4,777	$17,250
30	PLANNING, ENGINEERING & DESIGN													
	Project Management													
	Planning & Environmental Compliance													
8.0%	Engineering & Design	$10,744	$1,579	14.7%	$12,323.4	2.2%	$10,980	$1,614	$12,594	2017Q4	20.4%	$13,215	$1,943	$15,158
	Engineering Tech Review ITR & VE													
	Contracting & Reprographics													
	Planning During Construction													
	Project Operations													
31	CONSTRUCTION MANAGEMENT													
7.6%	Construction Management (Inc. EDC)	$10,207	$1,827	17.9%	$12,034.1	2.2%	$10,431	$1,867	$12,298	2025Q3	55.5%	$16,221	$2,904	$19,124
	Project Operation:													
	Project Management													
	CONTRACT COST TOTALS:	$189,456	$32,853		$222,309.1		$191,956	$33,284	$225,240			$241,109	$41,869	**$282,978**

****** TOTAL PROJECT COST SUMMARY ******

Printed:2/6/2012
Page 3 of 4

****** CONTRACT COST SUMMARY ******

PROJECT: Broward County Water Preserve Areas
LOCATION: Broward County, FL
This Estimate reflects the scope and schedule in report; Broward County WPA, Integrated Project Implementation Report and Environmental Impact Statement April 2007

DISTRICT: Jacksonville
POC: CHIEF, COST ENGINEERING, Tracy Leeser, P.E
PREPARED: 2/6/2012

Estimate Prepared: 13-Sep-11
Effective Price Level: 1 OCT 12

Program Year (Budget EC): 2013
Effective Price Level Date: 1 OCT 12

FULLY FUNDED PROJECT ESTIMATE

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	CONTRACT #2 - WCA 3A/3B Seepage Management Area													
02	RELOCATIONS	$10,923	$9,392	86.0%	$20,315	1.2%	$11,056	$9,506	$20,561	2020Q2	13.4%	$12,536	$10,779	$23,315
03	RESERVOIRS	$4,094	$853	20.8%	$4,947	1.2%	$4,144	$863	$5,007	2020Q3	13.9%	$4,720	$983	$5,703
08	ROADS, RAILROADS & BRIDGES	$216	$45	20.8%	$261	1.2%	$219	$46	$265	2021Q1	14.9%	$252	$52	$304
09	CHANNELS & CANALS	$22,560	$4,698	20.8%	$27,257	1.2%	$22,833	$4,754	$27,588	2020Q4	14.4%	$26,125	$5,440	$31,565
11	LEVEES & FLOODWALLS	$9,200	$2,062	22.4%	$11,262	1.2%	$9,311	$2,087	$11,398	2021Q3	16.0%	$10,797	$2,420	$13,217
13	PUMPING PLANT	$2,807	$585	20.8%	$3,392	1.2%	$2,841	$592	$3,433	2021Q1	14.9%	$3,265	$680	$3,945
14	RECREATION FACILITIES	$1,891	$394	20.8%	$2,285	1.2%	$1,914	$399	$2,313	2021Q2	15.4%	$2,209	$460	$2,669
15	FLOODWAY CONTROL & DIVERSION STR	$5,555	$1,157	20.8%	$6,711	1.2%	$5,622	$1,171	$6,793	2021Q1	14.9%	$6,461	$1,345	$7,806
18	CULTURAL RESOURCE PRESERVATION													
	CONSTRUCTION ESTIMATE TOTALS:	$57,247	$19,185	33.5%	**$76,432**		$57,940	$19,417	$77,357			$66,365	$22,160	$88,524
01	LANDS AND DAMAGES													
	Lands Already Purchased	$125,192			$125,192	1.2%	$126,708		$126,708	2020Q2	13.4%	$143,678		$143,678
	Lands To Be Purchased	$5,249	$2,010	38.3%	$7,260	1.2%	$5,313	$2,035	$7,348	2020Q2	13.4%	$6,024	$2,307	$8,332
30	PLANNING, ENGINEERING & DESIGN													
	Project Management													
	Planning & Environmental Compliance													
8.0%	Engineering & Design	$4,580	$811	17.7%	$5,391	2.2%	$4,680	$828	$5,509	2015Q4	11.6%	$5,223	$924	$6,147
	Engineering Tech Review ITR & VE													
	Contracting & Reprographics													
	Planning During Construction													
	Project Operations													
31	CONSTRUCTION MANAGEMENT													
7.6%	Construction Management (Inc. EDC)	$4,351	$892	20.5%	$5,243	2.2%	$4,446	$912	$5,358	2021Q3	37.0%	$6,093	$1,249	$7,342
	Project Operation													
	Project Management													
	CONTRACT COST TOTALS:	$196,619	$22,898		$219,517		$199,087	$23,192	$222,279			$227,383	$26,640	**$254,023**

APPENDIX C

ENVIRONMENTAL INFORMATION

TABLE OF CONTENTS

C.0 ENVIRONMENTAL INFORMATION C-1
C.1 PERFORMANCE MEASURES C-1
C.2 BENEFIT ANALYSIS C-16
C.3 PROJECT BACKGROUND C-16
C.4 MODEL APPLICATION C-26
C.4.1 Area of Impact C-28
C.4.1.1 Performance Measure Distribution C-29
C.4.1.2 Indicator Region Delineation C-30
C.4.1.2.1 Reduction in Cattail Vegetation Expansion Rate C-31
C.4.1.3 Performance Measure Background C-32
C.4.1.3.1 Detrimental Effects of Cattail C-33
C.4.1.3.2 Cattail Expansion at the Expense of Native Sawgrass C-33
C.4.1.3.3 Cattail Liberates Excessive Phosphorus into the Soil and Water Column as it Decomposes C-34
C.4.1.3.4 Sawgrass Produces more Dissolved Oxygen (DO) to the Water Column than Cattail C-34
C.4.1.3.5 Cattail Expansion Encourages Fragmentation of Sawgrass Habitat C-34
C.4.1.4 Model description and Application C-35
C.4.1.5 Description of Input Data C-35
C.4.1.6 Lands Currently Dominated By Cattail C-35
C.4.1.7 LANDS PRIMED FOR CONVERSION TO CATTAIL C-38
C.4.2 Description of Output Data C-43
C.4.2.1 S-9 Flow and Phosphorus Loading Calculations C-43
C.4.2.2 A-Series Flow Calculations C-43
C.4.2.3 F-Series Flow Calculations C-43
C.4.2.4 Phosphorus Loading Calculations C-44
C.4.2.5 Cattail Reduction Index C-46
C.4.2.6 Future Cattail Acre Expansion C-47
C.4.2.7 Protected Sawgrass Acreage C-48
C.5 HABITAT UNITS C-50
C.5.1 Habitat Suitability Index C-50
C.5.1.1 Average Annual Habitat Units C-50
C.6 MODEL NAME: EVERGLADE SNAIL KITE HABITAT QUALITY C-52
C.6.1 Performance Measure Background C-52
C.6.2 Model Description and Depiction C-55
C.6.3 Contribution to Planning Effort C-56
C.6.4 Methodology C-56
C.6.4.1 Apple Snail Reproduction PM C-56
C.6.4.2 Snail Kite Foraging Habitat Vegetation Structure PM C-57
C.6.5 Indicator Regions C-57
C.6.6 EVALUATION C-58
C.6.6.1 Apple Snail C-58
C.6.6.2 Snail Kite Foraging Vegetation Structure C-60
C.6.6.3 Combined Performance Measure Score C-62
C.6.7 Habitat Units C-64

C.6.7.1 Average Annual Habitat Units C-66
C.6.8 Ridge and Slough C-66
C.6.8.1 Performance Measure Background C-66
C.6.8.2 Model Description and Depiction C-67
C.6.8.3 Contribution to Planning Effort C-67
C.6.8.4 Description of Input Data C-67
C.6.8.5 Description of Output Data C-71
C.6.8.6 Statement on the capabilities and limitations of the model C-76
C.6.8.7 Technical Quality C-77
C.6.8.8 Assumptions C-77
C.7 SUMMARY OF BROWARD COUNTY WPA PROJECT BENEFITS C-78
C.8 NEXT ADDED INCREMENT – BENEFITS EVALUATION AND ASSESSMENT METHOD (BEAM) C-79
C.8.1 Introduction C-79
C.8.2 CERP System Wide Performance Measures C-80
C.8.3 Benefits Evaluation and Assessment Method (BEAM) C-82
C.8.3.1 Greater Everglades C-83
C.8.3.2 Southern Estuaries C-84
C.8.3.3 Index Performance Measure (PM) Hydrological Output C-85
C.8.3.4 Aggregating Index Scores C-89
C.8.3.5 Scaling Index Scores to Habitat Units C-89
C.8.3.6 Index Performance Measure (PM) Hydrological Output C-89
C.8.3.7 SE-9A Snake Creek Wet Season Flows C-89
C.8.3.8 SE-9B Snake Creek Dry Season Flows C-91
C.8.3.9 Aggregating Index Scores C-93
C.8.3.10 Biscayne Bay-Snake Creek C-93
C.8.3.11 Scaling Index Scores to Habitat Units C-94
C.8.3.11.1 Biscayne Bay C-94
C.8.4 Results of BEAM C-94
C.8.5 Conclusions and Recommendations C-94
C.9 EVERGLADES RIDGE AND SLOUGH CONCEPTUAL ECOLOGICAL MODEL C-108
C.9.1 Model Lead C-108
C.9.2 Introduction C-108
C.9.3 External Drivers and Ecological Stressors C-108
C.9.3.1 Urban and Agricultural Expansion C-111
C.9.3.2 Influences from Industrial and Agricultural Practices C-111
C.9.3.3 Water Management Practices C-112
C.9.3.4 Cultural Influences on Species Composition C-113
C.9.4 Ecological Attributes C-113
C.9.4.1 Peat Soils C-113
C.9.4.2 Periphyton C-114
C.9.4.3 Marsh Plant Communities C-114
C.9.4.4 Tree Islands C-115
C.9.4.5 Marsh Fishes, Invertebrates, and Herps C-115
C.9.4.6 Alligators C-116

C.9.4.7 Wading Birds C-116
C.9.5 Ecological Effects: Critical Linkages Between Stressors And Attributes/Working Hypotheses C-117
C.9.5.1 Reduced Water Storage Capacity C-117
C.9.5.1.1 Wet Season C-117
C.9.5.1.2 Dry Season C-118
C.9.5.2 Compartmentalization C-118
C.9.5.2.1 Effects of Levees C-118
C.9.5.2.2 Effects of Canals C-119
C.9.5.3 Exotic (Nonnative) Species C-119
C.9.5.4 Reduced Habitat Extent C-119
C.9.5.5 Degraded Water and Soil Quality C-120
C.9.5.6 Critical Ecological Linkages C-120
C.9.6 Research Questions C-121
C.9.7 Hydrologic Performance Measures C-122
C.9.7.1 Hydropatterns C-122
C.9.8 Ecological Performance Measures C-123
C.9.8.1 Peat Soils C-123
C.9.8.2 Periphyton C-123
C.9.8.3 Marsh Plant Communities C-123
C.9.8.4 Tree Islands C-124
C.9.8.5 Marsh Fishes and Invertebrates and Herps C-124
C.9.8.6 Alligator C-124
C.9.8.7 Wading Birds C-125
C.9.9 Model C-125
C.9.10 Literature Cited C-128
C.10 WATER QUALITY PLAN FORMULATION AND EVALUATION METHODOLOGY FOR THE WPA COMPONENTS C-135
C.10.1 Background and Introduction C-135
C.10.2 Description of Components Analyzed C-137
C.10.2.1 General Description C-137
C.10.2.2 Description of Components Water Quality Criteria (Source and Outflow Waters) C-138
C.10.2.3 Description and Screening Components for Water Quality C-139
C.10.3 The C-11 Impoundment Water Quality Data C-140
C.10.4 The North New River Water Quality Data C-141
C.10.5 The C-9 Impoundment Water Quality Data C-142
C.10.6 WPA ALTERNATIVE ANALYSIS SCHEME C-143
C.10.6.1 General Analysis C-143
C.10.6.1.1 Quantitative Analysis C-143
C.10.6.1.2 Qualitative Analysis: Inherent Capacity Of Wetlands To Improve Or Maintain Water Quality C-144
C.10.6.2 Description of Evaluation Matrix and Performance Measures C-145
C.10.6.2.1 Quantitative Matrix Analysis C-145
C.10.6.2.2 Qualitative Matrix Analysis C-147
C.11 WATER QUALITY EVALUATION METHOD C-147

C.11.1.1 Quantitative Matrix Analysis C-147
C.11.1.2 Results of the Matrix Analysis C-148
C.11.1.2.1 Results of Quantitative Analysis C-149
C.11.1.2.1.1 General Results C-149
C.11.1.2.2 Results for Components with Major Regional Water Quality Impact C-149
C.11.1.2.2.1 C-9 and C-11 Impoundments C-150
C.11.1.3 Results of Qualitative Analysis C-151
C.11.1.4 Final Matrix C-152
C.11.2 General Model Information for WPA Alternatives Analysis C-152
C.11.2.1 Dr. William Walker's Models C-152
C.11.2.1.1 Model Assumptions C-153
C.11.2.2 The EUTROMOD Model C-154
C.11.2.3 The DO Regression Model C-155
C.11.2.3.1 Residence Time Estimations C-156
C.11.2.3.2 Load Computations C-156
C.11.2.4 Functional Assessment Model C-157
C.11.2.4.1 General Description C-157
C.11.2.4.2 Inherent Capacity of Wetlands To Improve Or Maintain Water Quality C-157
C.11.2.4.3 Inherent Capacity Analysis Summary C-158
C.11.3 Inherent Capacity Rating Calculations For WPA Components C-160
C.11.4 The Comprehensive Evaluation Matrix C-163
C.11.5 WPA Feasibility Study Hydrologic Evaluation C-166
C.11.6 References C-170
C.12 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE (HTRW) C-171
C.13 MITIGATION MEASURES TO OFFSET IMPACTS TO DEPARTMENT OF THE ARMY ESTABLISHED MITIGATION AREA C-172
C.13.1 Avoidance C-173
C.13.2 Creation of A Northern Buffer Marsh C-173
C.13.3 Enhancement of the FDOT Mitigation Area C-174
C.13.4 Wetland Enhancement and Restoration within WCA 3A/3B SMA C-174
C.13.5 Conclusions of Replacement Mitigation Plan C-182
C.13.6 UMAM Score Sheets C-183
C.14 ATTACHMENT A - BCWPA ENVIRONMENTAL BENEFITS MODEL LIST OF ACRONYMS C-220
C.14.1 Broward County Water Preserve Areas Environmental Benefits Model Appendix C List of Acronyms C-220
C.14.2 Glossary of Terms C-222
C.15 ATTACHMENT B - BCWPA ENVIRONMENTAL BENEFITS MODEL APPENDIX C REFERENCES C-225
C.16 ATTACHMENT C - RECOVER EVERGLADES SNAIL KITE INFORMATION C-230
C.17 ATTACHMENT D - BCWPA ENVIRONMENTAL BENEFITS MODEL ATR CERTIFICATION C-242

C.18 ATTACHMENT E - PROTOCOL FOR ASSESSMENT, REMEDIATION AND POST-REMEDIATION MONITORING FOR ENVIRONMENTAL CONTAMINANTS ON EVERGLADES RESTORATION PROJECTS.....C-244

C.19 SUMMARY OF ENVIRONMENTAL CONDITIONS, 2005 SFWMD MEMORANDUM.....C-251

C.20 LIST OF ENVIRONMENTAL AUDIT AND ECOLOGICAL ASSESSMENT DOCUMENTS PREPARED FOR PROJECT LANDS.....C-259

LIST OF FIGURES

Figure C-1: BCWPA Study Area.....C-16
Figure C-2: BCWPA Project Plan.....C-17
Figure C-3: Without Project Conditions Flows (Rain Event).....C-19
Figure C-4: Without Project Conditions Flows (Seepage/Dry Event).....C-21
Figure C-5: With Project Conditions Flows (Rain Event).....C-23
Figure C-6: With Project Conditions Flows (Seepage/Dry Event).....C-25
Figure C-7: Comparison of Linear, Step, and Sinusoidal Functions.....C-28
Figure C-8: Broward County Water Preserve Areas Performance Measure Spatial Distribution.....C-29
Figure C-9: Project Indicator Regions.....C-31
Figure C-10: Water Conservation Area 3 Vegetation Map.....C-37
Figure C-11: Soil Phosphorus Level Maps Comparison.....C-38
Figure C-12: Transect Sites in WCA-2A.....C-41
Figure C-13: Ecological Changes Along the WCA-2A Gradient.....C-42
Figure C-14: Sub Index Scores for Phosphorus Loading.....C-47
Figure C-15: Depiction of Representative Acreage of Cattail Expansion for Each Project Alternative.....C-49
Figure C-16: Average Annual Habitat Unit Lift for Sawgrass Marsh.....C-52
Figure C-17: Snail Kite Life Cycle Diagrams.....C-53
Figure C-18: Juvenile and Mature Apple Snails.....C-54
Figure C-19: Critical Snail Kite Habitat.....C-55
Figure C-20: Expanded Indicator Regions Map for the BCWPA Project.....C-58
Figure C-21: Combined Quality Scores for Snail Kite Performance Measure.....C-63
Figure C-22: Comparison Between Project Conditions of Habitat Quality Across Indicator Regions.....C-64
Figure C-23: The Boundary of the Ridge and Slough Performance Measure.....C-69
Figure C-24: Greater Everglades Indicator Regions and Expanded Indicator Regions to be Used with CERP System-Wide Performance Measures.....C-69
Figure C-25: Habitat Suitability Indices by Indicator Region.....C-72
Figure C-26: Average Annual Habitat Unit Lift for Ridge and Slough Ecosystem.....C-76
Figure C-27: Greater Everglades-Integrated Hydrology and Water Quality Conceptual Ecological Model.....C-83
Figure C-28: Biscayne Bay- Nearshore Community Conceptual Ecological Model.....C-84

Figure C-29: Greater Everglades Indicator Regions to be used with CERP System-Wide Performance Measures C-96
Figure C-30: Expanded Greater Everglades Indicator Region Map C-101
Figure C-31: The Boundary of the Ridge and Slough Conceptual Ecological Model C-110
Figure C-32: Key to the Symbols used in the Following Diagram C-126
Figure C-33: Everglades Ridge and Slough Conceptual Ecological Model Diagram C-127
Figure C-34: Map of the C-11 Impoundment Related Water Quality Site C-141
Figure C-35: Map of the North New River Water Quality Site C-142
Figure C-36: Map of the C-9 Water Quality Sampling Sites C-143
Figure C-37: Existing and Proposed Wetland Mitigation Within the C-11 Impoundment C-179
Figure C-38: Existing and Proposed Wetland Mitigation Within C-9 Impoundment C-180
Figure C-39: Proposed Wetland Mitigation Within WCA 3A/3B SMA C-181

LIST OF TABLES

Table C-1: Seepage Retained by WCA 3A and 3B Levee Seepage Management Areas C-2
Table C-2: Extreme High and Low Water Levels in WCA 3A and 3B C-3
Table C-3: Average Annual Total Phosphorus (TP) Load Reduction C-5
Table C-4: Inundation Pattern C-6
Table C-5: Restoration of Stage Variability C-8
Table C-6: Snail Kite – Foraging Habitat Vegetation Structure C-9
Table C-7: Apple Snail Reproduction C-11
Table C-8: Restore Number and Acres of Functional Tree Islands C-13
Table C-9: Cattail Expansion Rate Reduction C-14
Table C-10: Historical Expansion of Cattail in WCA 2A Based on Observed Trends C-39
Table C-11: Summary of Three Cattail Expansion Estimates used to Determine the Primed Area C-42
Table C-12: Total Phosphorus Loads Calculated for BCWPA Project (PM 1. Cattail Reduction - TP Loading Reduction) C-45
Table C-13: Potential Future Spread of Cattail With Spread Reduction For Each Alternative C-49
Table C-14: Sawgrass Marsh Habitat Quality Units for the Various Project Alternatives for the BCWPA Project C-51
Table C-15: Alternative Average Annual Habitat Units for Sawgrass Marsh Habitat Quality C-51
Table C-16: Suitability Index Scores Applied to the Apple Snail Reproduction PM C-58
Table C-17: Sub-Index Scores for The Apple Snail Reproduction PM Under Various Alternatives Evaluated for The BCWPA Project C-60
Table C-18: Sub-Index Scores Applied to The Snail Kite Foraging Vegetation Structure PM C-61
Table C-19: Sub-Index Scores and Number of Dryouts for The Snail Kite Foraging Vegetation Structure PM C-62
Table C-20: Combined Quality Scores for The Apple Snail Reproduction Performance Measure and The Snail Kite Foraging Vegetation Structure PM C-63
Table C-21: Snail Kite Habitat Quality Units (HUs) Calculated for The BCWPA C-65
Table C-22: Performance Measure 2. Snail Kite Annual Average Habitat Unit Lift C-66

Table C-23: PM 3 Indicator Region Total Acreage C-70
Table C-24: Overall Habitat Suitability Indices for Ridge and Slough Performance Measure C-71
Table C-25: Inundation Duration Percentage by Indicator Region for Each Condition C-71
Table C-26: Ridge and Slough Habitat Units C-73
Table C-27: Results of Proportioning Method Used to Derive Alternative Plan A1 Total Habitat Units C-75
Table C-28: Summary of Average Annual Habitat Unit Lift for Ridge and Slough Ecosystem C-76
Table C-29: Summary of Broward County WPA Benefits C-79
Table C-30: Qualitative and Quantitative Description of PM Index Values for GE-1 ..... C-86
Table C-31: Qualitative and Quantitative Description of PM Index Values for GE-2 ..... C-87
Table C-32: Qualitative and Quantitative Description of PM Index Values for GE-3 ..... C-88
Table C-33: Description of Quality Index Scores for SE-9A C-91
Table C-34: Description of Quality Index Scores for SE-9B C-93
Table C-35: Expanded Indicator Regions C-102
Table C-36: WPA Components' Water Quality Information C-139
Table C-37: Average of TP and DO Concentrations for the C-9 Impoundment C-142
Table C-38: Matrix with Performance Measures and Associated Performance Rating C-145
Table C-39: Capacity to Remove, Degrade, Settle Out, or Provide Long-Term Storage of Specific Pollutants for a Given Alternative C-147
Table C-40: Water Quality Information for TP and Dissolved Oxygen and Benefits Provided by WPA Features C-149
Table C-41: Flows to WCA 3A through S-9 ..... C-150
Table C-42: Loads to WCA 3A through S-9 ..... C-150
Table C-43: Load Reduction of WPA and D13R Scenarios Versus Existing Condition (%). C-150
Table C-44: Water Quality Rank Scores for WPA Alternatives Including the Effects of Hydrology, TP Reduction, DO Increase and Load Reduction through the WPA C-151
Table C-45: Results of the Qualitative Matrix Analysis C-151
Table C-46: Pre-Selection of Plan Water Preserve Area Feasibility Study 8/21/00 ..... C-152
Table C-47: EUTROMOD Model Variables and Equations C-155
Table C-48: Cumulative Water Quality Rating Scores for Each Alternative C-159
Table C-49: Characteristics of WPA Components C-160
Table C-50:Plant Communities Expected for Each Alternative, Based upon Site Hydropatterns Predicted by Sub-Regional Groundwater Model Output C-160
Table C-51: Functional Assessment Ratings for Capacity for Denitrification C-161
Table C-52: Functional Assessment Ratings for Capacity for Long-Term Chemical Binding of Phosphorus C-161
Table C-53: Functional Assessment Ratings for Capacity for Long-Term Chemical Binding of Micronutrients C-161
Table C-54: Functional Assessment Ratings for Capacity for Long-Term Storage of Nutrients by the Plant Community C-161
Table C-55: Functional Assessment Ratings for Capacity for Long-Term Chemical Binding of Heavy Metals C-161
Table C-56: Functional Assessment Ratings for Capacity for Settling Out of Suspended Solids C-162

Table C-C-57: Functional Assessment Ratings for Capacity for Removal or Degradation of Pathogenic Organisms C-162
Table C-58: Functional Assessment Ratings for Capacity to Degrade Pesticides C-162
Table C-59: Functional Assessment Ratings for Capacity for Nitrogen Removal or Long Term Storage C-162
Table C-60: Functional Assessment Ratings for Capacity for Long Term Storage of Phosphorus C-162
Table C-61: Functional Assessment Ratings for Capacity for Long Term Storage of Micronutrients C-163
Table C-62: C-11 Impoundment C-164
Table C-63: C-9 Impoundment C-166
Table C-64: UMAM Evaluation for Impacts to Established and Proposed Wetland Mitigation Areas C-176

C ENVIRONMENTAL INFORMATION

C.1 PERFORMANCE MEASURES

Performance measures were developed to evaluate each alternative in the final array against one another. Performance measures include both hydrological and ecological criteria to evaluate system responses in Water Conservation Area 3 (WCA 3). The hydrologic performance measures were applied to certain ecological attributes in order to predict responses in the natural system. In addition, certain ecological performance measures were developed for specific species of plants, animals or communities or both. The following planning models were used to develop environmental benefits and help to determine a final array of alternatives for the BCWPA PIR:

- PM 1: Cattail Expansion Rate Reduction
- PM 2: Snail Kite – Foraging Habitat Vegetation Structure
- PM 3: Ridge and Slough Habitat Quality

Table C-1 through ***Table C-9*** are summary documentation sheets for each performance measure that was initially considered to develop environmental benefits to screen the BCWPA array of alternatives. Even though most of the PMs were not used, and some were slightly modified, the entire suite is included as a reference of the environmental benefits thought process.

TABLE C-1: SEEPAGE RETAINED BY WCA 3A AND 3B LEVEE SEEPAGE MANAGEMENT AREAS

Evaluation Performance Measure
Broward WPA PM: Seepage Retained by WCA 3A and 3B Levee Seepage Management Areas
Justification
Water levels in Water Conservation Area 3A and 3B (WCA 3) are regulated to produce maximum benefits among the various interests-flood control, water supply, fish and wildlife, and preservation of salt water intrusion. To produce these benefits, the water level in WCA 3 is adjusted as the year progresses, either by a release of water from Water Conservation Area 3, an intake of water from Lake Okeechobee, or by a combination of water releases and intake. The particular action taken to release, intake, or retain water is dependent upon the water elevation in a given month. Water levels in eastern WCA 3, along the L-37 and L-33 levees are controlled higher (from 8 to 11 feet NGVD) than developed areas to the east (from 3 to 5 feet NGVD). The water level difference between WCA 3 and the developed areas to the east causes levee and groundwater seepage of water from WCA 3 to the east. Reduction of the water level difference between the two areas will reduce the quantity of seepage to the east. Reduction of seepage water from the marsh helps to meet hydrologic targets in the WCA 3.
CERP Evaluation Target
Reduce the volume of seepage to zero across the L-33 and L-37 Levees to the east.
Evaluation Protocol
A transect along the L-37 and L-33 levee will be used to quantify the amount of groundwater flow/seepage that crosses that transect given the various simulations (with and without project conditions) and alternatives (restudy, water preserve area selected plan, etc). The sub-regional Mod- Flow ground water model for Broward County (developed for the Water Preserve Area Feasibility Study) will be used to obtain the seepage quantities for the selected simulations. The volume of groundwater, expressed in average acre–feet per year, will be the net total groundwater flow across the transect moving eastward. The difference between the simulations with and without project conditions will determine how much seepage is retained in the natural system.
Source and History of Evaluation Protocol
Restrepo J.I., Giddings J. Garces D., and Restrepo N. March 2001.A Three–Dimensional Finite Difference Groundwater Flow Model of the Surficial Aquifer System, Broward County, Florida, Florida Atlantic University. Boca Raton, Florida. South Florida Water Management District
Contact
Jeff Needle, SFWMD, jneedle@sfwmd.gov

TABLE C-2: EXTREME HIGH AND LOW WATER LEVELS IN WCA 3A AND 3B

Evaluation Performance Measure
Broward WPA PM: Extreme High and Low Water Levels in WCA 3A and 3B
Justification
The predrainage Everglades was a single, hydrologically integrated system, with water depth and distribution determined by the seasonal and annual interplay of fairly high-contrast weather patterns, vegetation and the underlying topography. The spatial extent of the shallow, flowing Ridge and Slough system allowed large quantities of water to be stored for extended periods of time, resulting in a system that was much wetter (but not necessarily deeper) than the current system. The depth, distribution, and duration of surface flooding in the three central Everglades landscape types (ridge and slough, the adjacent marl prairie and rocky glades, and Big Cypress wetlands) largely determined the vegetation patterns, as well as the distribution, abundance, seasonal movements and reproductive dynamics of all of the aquatic and many of the terrestrial animals in the Everglades. In the ridge and slough environment, the C&SF Project made it possible to stack water in the water conservation areas and provide it to urban and agriculture areas in the dry season. The result in this landscape type has been excessive depths during wet seasons and wet years whenever the spatial extent of remaining natural wetlands (and of man-made water storage areas) exceeds its water storage capacity. Tree islands are flooded, shallow feeding habitat for wading birds is lost, periphyton communities are stressed, alligator nests are flooded and feeding conditions reduced, and the species composition and size classes of fishes are altered. Efficient drainage has caused stress in the receiving estuaries in wet seasons and wet years and a reduction of the total amount of water stored in the system. During the dry seasons and dry years that follow, the frequencies and durations of dryouts are exaggerated. The result is increased rates of organic soil loss, spread of woody vegetation, reduced survival of aquatic species, altered periphyton communities, reduced alligator nesting and sawgrass expansion into slough communities.
CERP Evaluation Target
The target is a range for the total duration of extreme high and low water events in weeks and the number of extreme high and low water events or an envelope of occurrences that meet the NSM version 3.5 output for cells included in the ridge and slough.
Evaluation Protocol
The NSM results will help determine appropriate targets or a range for the target number and duration of extreme high and low events, which can also be described as envelopes for each landscape type in the ridge and slough indicator region (IR 14-22). The average depth for a given week is calculated for each grid cell and these values are averaged over the cells within the indicator region to obtain an average depth for the indicator region for that week. The average weekly water depth is compared to the high and low water level criteria. The duration and number of extreme high or low events is then calculated for the period of record. 1) Period of record (POR) = 1965-2000 simulation period a) Non-Leap Years -> last eight days of calendar year used for weekly average b) Leap Years -> last nine days of calendar year used for weekly average 2) The average depth for a given week in a given year is calculated for each grid cell within an indicator region and these values are averaged over the cells within the indicator region to obtain an average depth for the indicator region for that week. 3) Average duration of high or low event (weeks per event) is the average number of weeks that water levels rise above or fall below the extreme high or low criteria for the period of record: average duration of high or low event = sum [duration of each extreme event in weeks] / (number of extreme events) 4) Total duration of extreme events as a percent of POR = 100 x sum [duration of each extreme event in weeks] / (number of years in POR x 52) Extreme high and low water levels are defined using thresholds carried over from the Restudy (USACE and SFWMD, 1999). They are as follows: • Ridge and Slough types: high = +2.5 feet; low = -1.0 feet (below ground) A table titled "Extreme High and Low Water Levels for Indicator Regions" will be produced. The table will

include the number of extreme low and high events, the average duration (weeks/events) of events over the period of record, and the total duration of the each type of event as a percentage of the period of record for indicator regions listed. Results for each alternative compared and the NSM target envelope will be displayed.

Source and History of Evaluation Protocol

Everglades Ridge and Slough, Marl Prairie and Rocky Glades, and Big Cypress CEMs stressor
Alternative Evaluation Team performance measure C&SF Restudy (USACE and SFWMD, 1999)

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Contact

This PM was based on: DECOMP PM 1.3a Restoration of Stage: High and Low Extremes & RET GE-E3 Extreme High and Low Water Levels in the Greater Everglades Wetlands
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TABLE C-3: AVERAGE ANNUAL TOTAL PHOSPHORUS (TP) LOAD REDUCTION

(Used in PM 1: Reduction in Cattail Vegetation Expansion Rate)

Evaluation Performance Measure
Broward WPA PM: Average Annual Total Phosphorus (TP) Load Reduction
Justification
Elevated mass loading of organic and inorganic forms of TP (in excess of atmospheric deposition) in surface waters throughout the Everglades, including WCA-3, is a critical short/medium-term measure of water quality and is significantly correlated to soil eutrophication and community successional changes, such as cattail expansion in the Everglades wetlands. TP loading is variable in space depending on the size of the receiving basin, volume of water flow, and TP concentration of the water. Historical monitoring data from S-9 reveal a positive correlation between phosphorus concentration and daily flow. Concentrations range from <20 ppb at low flows to >100 ppb at high flows (Walker, 1997). The S-9 pump station on the C-11 canal in western Broward County discharges approximately 215,000 acre-feet of runoff from the C-11 West Basin on an average annual basis. Total phosphorus concentration is 16 ppb based on annual average, with peak storm events reaching 34 ppb on a flow proportional basis (USACE and SFWMD, 2001). A goal of the Broward WPA Project is to divert stormwater from the C-11 West drainage basin away from the Everglades system, thereby reducing the high TP concentration inflows at the S-9 pump station. As a result, phosphorus-induced impacts such as cattail expansion in WCA-3 can be reduced and the natural Everglades flora and fauna will be restored.
CERP Evaluation Target
The evaluation target for this performance measure is zero for flow rate (i.e., no inflows through the S-9 pump) and zero for TP load.
Evaluation Protocol
TP load reduction is based on calculations of volume of water coming into WCA-3 through the S-9 pump station. To evaluate the reduction in TP loads, the scenarios of the future with the project and future without the project will be compared to the target.
Source and History of Evaluation Protocol
Everglades Ridge and Slough Conceptual Ecological Model USACE and SFWMD. 2001. Draft Water Preserve Areas Integrated Feasibility Report, Supplemental Environmental Impact Statement. October 2001. Walker, William W. 1997. Draft Water Quality Aspects of the Proposed East-Coast Buffer Strip: Evaluation of the C11-West Basin, prepared for U.S. Department of the Interior, Everglades National Park. January 31, 1997.
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TABLE C-4: INUNDATION PATTERN

(Used in PM 3: Ridge and Slough Habitat Quality)

Evaluation Performance Measure
Broward WPA PM: Inundation Pattern
Justification
Water management practices that compartmentalized the Everglades to prevent flooding of and provide water supply to urban and agricultural areas also fragmented the landscape, exaggerated hydroperiods and depths, and reduced flows through natural sloughs. The result has been substantially altered plant community structures, reduced abundance and diversity of animals, and the spread of exotic vegetation. Altered inundation patterns are one of the most critical stressors on the ecology of the Everglades. In the predrainage system, the inundation pattern supported an expansive system of freshwater marshes including longer hydroperiod sawgrass "ridges" interspersed with open-water "sloughs". Conceptual ecological models for the ridge and slough system (Ogden, 2003; Davis, 2003; Duever, 2003) detail the fundamental role inundation patterns play in the formation and maintenance of the soils, vegetation patterns, animal use, and water quality characteristics of these landscape types. The draft Total System Conceptual Ecological Model, Version 2.1 (Ogden et al., 2003) states that the ecological consequences of operationally altered hydropatterns are numerous and widespread, including flooding of alligator nests (Mazzotti and Brandt, 1994) and apple snail egg clusters (Bennetts et. al., 1994), the adverse effects of water depth reversals on wading bird nesting and foraging (Bancroft et al., 1994), and flooding of tree islands (Brandt et al., 2000).
CERP Evaluation Target
The target is the range of weeks of inundation and the number of inundation events or an envelope for the duration and number of inundation events that meet the NSM version 3.5 output for cells in the model categorized by landscape type.
Evaluation Protocol
The NSM will be used to determine appropriate hydrologic ranges ("envelopes") for the ridge and slough landscape type (IR 14-22). The average depth for a given week in a given year is calculated for each grid cell and these values are averaged over the cells within the indicator region to obtain an average depth for the indicator region for that week. The duration of inundation is then calculated as the number of sequential weeks in the period of record during which water depths averaged above ground (>0). Dry events are calculated as the number of weeks water levels are below ground (<0). However, minor flood events where water rises above ground slightly, less than 0.2 feet, do not initiate an inundation event until it continues to rise above 0.2 feet. These minor flood events impair the establishment of populations of aquatic organisms. Specifically, these calculations are as follows: 1) Period of record (POR) = 1965-2000 simulation period a) Non-Leap Years -> last eight days of calendar year used for weekly average b) Leap Years -> last nine days of calendar year used for weekly average 2) An inundation event (IE) is calculated as a discrete segment of time from the point at which water levels rise above ground surface, providing they exceed 0.2 feet, until the time they fall below ground. 3) Average inundation duration (weeks per event) is the average number of sequential weeks in an IE for the period of record: average inundation duration = sum [duration of each IE in weeks] / (number of IE) 4) Percent of period inundated = 100 x sum [duration of each IE in weeks] / (no. of yrs in POR x 52) A table titled "Inundation Pattern Summary" will be produced. This table will include percent of period of record inundated. Indicator regions should be grouped by landscape type on the table. Results for each alternative compared and the target envelope, which may be NSM or the existing condition, will be displayed.
Source and History of Evaluation Protocol
Everglades Ridge and Slough, Marl Prairie and Rocky Glades, and Big Cypress CEMs stressor Alternative Evaluation Team Performance Measure, C&SF Restudy (USACE and SFWMD, 1999) Bancroft et al., 1994; Bennetts et al., 1994; Brandt et al., 2000; Davis, 2003; Duever, 2003; Mazzotti and Brandt, 1994; Ogden, 2003

Contact

This PM was based on: GE-E2 Inundation Pattern in the Greater Everglades Wetlands & DECOMP PM 1.4 a Discontinuous Hydroperiod
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TABLE C-5: RESTORATION OF STAGE VARIABILITY

Evaluation Performance Measure
Broward WPA PM: Restoration of Stage Variability
Justification
The large spatial extent of the predrainage Everglades landscape was interconnected and internally unconstrained. Annual high and low surface water depths varied in response to seasonal and inter-annual weather patterns including, at times, dramatic storms. The effects of climatic variation on water depths were tempered by the large, unconstrained spatial extent of wetlands. In the post drainage, compartmentalized system, floodwater can be stacked in wetlands, increasing depths. Excess water can be shunted to the coast by canals, impacting estuaries and reducing the water available to avoid future droughts. In today's system, some parts of the greater Everglades exhibit a pattern of excessive depths, others exhibit more exaggerated drydowns and some areas experience both. Excessive amplitude is evident within and between years. This performance measure quantifies the seasonal amplitude and inter-annual variability of water levels in the Indicator Regions of the greater Everglades landscape and compares them to the pattern of variation found in the natural system. Replicating the historic range of seasonal peak high and low water levels as much as possible is needed to provide the pulses that organize productivity in this ecosystem without causing undue stress to native organisms. The effect of returning the annual amplitude and interannual variation in water depths to its classic pre-drainage pattern protects tree islands in the ridge and slough system from flooding and supports organic soil deposition in peat systems.
CERP Evaluation Target
The target for WCA 3A and WCA 3B is the NSM. The goal is to have zero percent difference from target seasonal variation for each indicator region. Seasonal variation closest to target values is considered more likely to support native vegetation, aquatic fauna and to support the freshwater head driving flows toward Florida Bay.
Evaluation Protocol
This performance measure uses the difference between the maximum mean weekly stage and the minimum mean weekly stage to quantify seasonal variation in stage. For each indicator region listed below, mean stages for each week are calculated for the period of record for each alternative, base condition and NSM. The seasonal variation (the difference between highest maximum stage and lowest minimum stage for each mean model year) is calculated for each alternative and base condition and compared to the seasonal variation predicted by the NSM. The SFWMM and the NSM are used to evaluate these measures in indicator regions within the ridge and slough (IR 14-22) This performance measure replaces the "Mean Depth During Flooding and "Average Maximum Depth Below Ground During Dry Events". In addition, this is a measure of seasonal variability, so in the water conservation areas it will replace the Alternative Evaluation Team seasonal performance measure that used mean October maximum and May minimum water depths. This performance measure uses weekly average water depths above and below ground to compare seasonal fluctuations and year-to-year variation in water levels compared to NSM and base values. Tables for each indicator region include the following: 1) Mean maximum stages for each indicator region for each alternative/base condition and NSM and the percent difference from target. 2) Mean minimum stages for each indicator region for each alternative/base condition and NSM and the percent difference from target. 3) Seasonal variation in stage (the difference between the 1) and 2) and the percent difference from target for each indicator region for each condition.
Source and History of Evaluation Protocol
Everglades Ridge & Slough, Marl Prairie & Rocky Glades, and Big Cypress CEMs stressor Alternative Evaluation Team performance measures USACE and SFWMD, 1999
Contact
Based on: DECOMP PM 1.3b Restoration of Stage: Variability & GE-E4 Seasonal Amplitude and Interannual Variability of Water Levels in the Greater Everglades Wetlands Yvette Alger, FWC, yvette.alger@MyFWC.com

TABLE C-6: SNAIL KITE – FORAGING HABITAT VEGETATION STRUCTURE

(Used in PM 2: Everglades Snail Kite Habitat Quality)

Evaluation Performance Measure
Broward County WPA PM: Snail Kite – Foraging Habitat Vegetation Structure
Justification
The snail kite (*Rostrhamus sociabilis*) is an endangered raptor whose distribution in the United States is restricted to the South Florida Ecosystem, including watersheds of the Everglades, Lake Okeechobee, Caloosahatchee River, Kissimmee River, and Upper St. Johns River. Because snail kites feed almost exclusively on one species of aquatic snail (the apple snail, *Pomacea paludosa*), their survival depends directly on the hydrologic functioning of these watersheds (Bennetts et al. 1998). Apple snails are more common in wet prairies that include emergent vegetation such as *Rhynchospora* spp. and *Eleocharis* sp. than in adjacent sloughs with sparse, floating and submerged vegetation such as *Utricularia* spp. and *Nymphaea* sp. (Darby 2003). Emergent vegetation allows the snails to easily access the water surface for respiration, where they are visible and accessible to foraging snail kites. Based on Bennetts et al. (1998) and Bennetts pers. comm. (2003), optimal snail kite foraging habitat supporting emergent wet prairie vegetation is maintained in areas where water levels fall below ground surface between 1 in 3 and 1 in 5 years (156-260 weeks average flood duration). Marginal habitat is maintained in slightly drier and slightly wetter areas with 1 in 2 to 1 in 3 year drydowns (104-156 weeks average flood duration) and 1 in 5 to 1 in 6 drydowns (260-312 weeks average flood duration). These hydroperiod classes correspond with the hydrologic requirements of emergent marsh vegetation reported in the scientific literature as reviewed in two recent publications (Wetzel 2001 and SFWMD 1995). C&SF project operations have disrupted natural hydrologic patterns, reducing hydroperiods in some areas, and increasing them in others (Weaver et al. 1993). The Broward County WPA project should help to reverse these trends and support increasing areas of snail kite foraging habitat by improving groundwater elevations (hydroperiod and hydropattern) and providing seepage control for WCA-3 and the wetlands to the east of the WCA (the 3A/3B Seepage Management Area).
CERP Evaluation Target
The evaluation target for this performance measure is 156 to 260 weeks inundation duration.
Evaluation Protocol
This performance measure uses SFWMM 2x2 output to evaluate the average duration of flooding events over the 31-year period of record. Evaluations will be based on the second column (Avg Flood Duration (Wks/Event)) in the existing Inundation Duration Summary for Indicator Regions table. Indicator regions with average flood durations from 157 to 260 weeks will be considered optimal, indicators regions with average flood durations from 104 to 156 week or 261 to 312 weeks will be considered marginal. This performance measure is applied to the following Indicator Regions: 14-22.
Source and History of Evaluation Protocol
This performance measure was used in evaluations of the Modified Water Deliveries Canals and Levees alternatives and in evaluation of the ISOP and IOP. Bennetts, R.E., W.M. Kitchens, and D.L. DeAngelis. 1998. Recovery of the Snail Kite in Florida: Beyond a reductionist paradigm. Transactions North American Wildlife and Natural Resources Conference. Darby, P.C. 2003. Direct and Indirect Effects of Hydrology on Florida Apple Snails. Presentation given to the South Florida Ecosystem Working Group's Avian Ecology Workshop. March 17-18, 2003, Key Largo, FL. South Florida Water Management District. 1995. Technical Support for Development of Wetland Drawdown Criteria for Florida's West Coast: Part 1, Results of Literature Review, Modeling Studies and Expert Opinion. Draft Technical Publication, West Palm Beach, FL. Weaver, J. And B. Brown (chairs). 1993. Federal Objectives for the South Florida Restoration. Report of the Science Sub-Group of the South Florida Management and Coordination Working Group. 87 pp. Wetzel, P.R. 2001. Plant Community Parameter Estimates and Documentation for the Across Trophic Level System Simulation (ATLSS). Data report prepared for the ATLSS project team.

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TABLE C-7: APPLE SNAIL REPRODUCTION

(Used in PM 2: Everglades Snail Kite Habitat Quality)

Evaluation Performance Measure
Broward WPA PM: Apple Snail Reproduction
Justification
The snail kite (*Rostrhamus sociabilis*) is an endangered raptor whose distribution in the United States is restricted to the South Florida Ecosystem, including watersheds of the Everglades, Lake Okeechobee, Kissimmee River, and Upper St. Johns River. Because snail kites feed almost exclusively on one species of aquatic snail (the apple snail, *Pomacea paludosa*), their survival depends directly on the hydrologic functioning of these watersheds (Bennetts et al. 1998). Apple snail populations, and therefore, snail kite habitat suitability, are particularly affected by severe and untimely drydowns (Darby et al. 1997). Apple snails require water levels above ground surface in order to produce egg clusters, and newly hatched snails are less able to survive dry periods that are adult-sized snails (Darby 1997 and 2003). Darby (1997 and 2003) has documented a peak in apple snail egg cluster production in March – April and has suggested that dryouts below ground level prior to or during this peak can substantially reduce apple snail populations through reduced egg cluster production and reduced hatchling survival. The Everglades watershed has experienced, and continues to experience, substantial degradation including increased number and severity of drydowns in many areas (Weaver et al. 1993). CERP implementation should help to reverse these trends and support increasing abundance of apple snails and snail kites. The Endangered Species Act requires the USACE to evaluate the effects of CERP on listed species.
CERP Evaluation Target
Reduced number of years in which water levels fall below ground surface consistent with NSM patterns.
Evaluation Protocol
This performance measure uses SFWMM 2x2 output to evaluate the number of years in which water levels fall below ground surface prior to May 1. Predicted water levels for April 30 of each year of the 36-year record will be averaged across each indicator region and compared to the average ground surface for each indicator region. A table will list each indicator region and the number of years in which water levels were below ground surface on April 30 – prior to May 1 for NSM, the base cases, and the evaluated alternative(s). The goal is to reduce the number of drydowns before May 1 to match the NSM frequency. Fewer drydowns before May 1 than predicted by NSM are desirable when this does not conflict with other performance measures. This performance measure is applied to the following Indicator Regions: 14-22.
Source and History of Evaluation Protocol
This performance measure was used in evaluations of the Modified Water Deliveries Canals and Levees alternatives and in evaluation of the ISOP and IOP. Bennetts, R.E., W.M. Kitchens, and D.L. DeAngelis. 1998. Recovery of the Snail Kite in Florida: Beyond a reductionist paradigm. Transactions North American Wildlife and Natural Resources Conference. Darby, P.C. 2003. Direct and Indirect Effects of Hydrology on Florida Apple Snails. Presentation given to the South Florida Ecosystem Working Group's Avian Ecology Workshop. March 17-18, 2003, Key Largo, FL. Darby, P.C., PL. Valentine Darby, R.F. Bennetts, J.D. Croop, H.F. Percival, and W.M. Kitchens. 1997. Ecological studies of apple snails (Pomacea paludosa, Say). Final Report prepared for South Florida Water Management District and St. Johns River Water Management District. Contract # E-6609, Florida Cooperative Fish and Wildlife Research Unit, Gainesville, Florida. Weaver, J. And B. Brown (chairs). 1993. Federal Objectives for the South Florida Restoration. Report of the Science Sub-Group of the South Florida Management and Coordination Working Group. 87 pp.
Contact
This PM was based on: DECOMP PM 6.1(e) Snail Kite – Apple snail reproduction (DRAFT)

Updated: 4/30/03
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TABLE C-8: RESTORE NUMBER AND ACRES OF FUNCTIONAL TREE ISLANDS

Evaluation Performance Measure
Broward WPA PM: Restore Number and Acres of Functional Tree Islands
Justification
Tree islands are a unique and important component of the Everglades landscape. They are biodiversity hotspots where numerous birds, mammals and reptiles forage, mate and nest. Large numbers of tree islands north of Tamiami Trail have been replaced by marsh vegetation due to both fire and prolonged ponding. The Water Resources Development Act (WRDA) of 2000 calls for no further destruction of tree islands, and the Everglades Forever Act of 1994 calls for hydrologic restoration and no further "imbalance." Tree islands in certain regions of the Everglades have experienced altered hydroperiod due to water management including those is WCA-3A and WCA-3B. Everglades' restoration efforts will result in dramatic changes in the depth patterns in the Central Everglades, as well as the ridge and slough landscapes that encompass a large number of tree islands. Water depth and duration has been identified as a key factor for tree island health. The Broward WPA project should help to mitigate for the loss of functional tree islands by reducing the duration of flooding in WCA-3A and WCA-3B, as well as putting more water in the same area during the drought season.
CERP Evaluation Target
The target is the acres and number of trees islands within WCA 3A and WCA 3B predicted for NSM. This target is based on achieving a water depth range and duration that is most beneficial for tree island health.
Evaluation Protocol
The Everglades Landscape Vegetation Model (ELVM) has been used to investigate whether an observed trend in tree island loss is reversible and if tree islands can be used as performance measures or ecological indicators for CERP (Wu et al. 2002). The ELVM is a tool to understand the spatial and temporal interactions among vegetation, water depth, hydroperiod, fire, and nutrients. Simulations of the ELVM indicated that tree island water depths greater than 30 cm and hydroperiods longer than 150 days have decreased tree island survival rates in WCA-3A. According to the model, about 60% (confirm for 3A) of tree islands lost in WCA-3A in the last few decades can be recovered by restoring the NSM hydrological regimes. The ELVM uses SFWMM outputs to simulate the responses of tree islands both temporally and spatially. When combined with NSM the ELVM will evaluate the following: 1) Acres of lost tree islands that can be restored; 2) Acres of tree islands that will continue to be lost; 3) The location of tree islands that can be restored; Required input data sets also include revisions of topography based on USGS/USACE Lidar data, and 2x2 water depth output from NSM and SFWMM.
Source and History of Evaluation Protocol
Yegang Wu, Ken Rutchey, Weihe Guan, Les Vilchek and Fred H. Sklar. 2003. "Spatial Simulations of Tree Islands for Everglades Restoration". In. Tree Islands of the Everglades". Edited by Fred H. Sklar and Arnold van der Valk. P469-498. Yegang Wu, Weihe Guan, Fred H. Sklar, Frank Chang. 2001. "Modeling spatial and temporal dynamics of the Everglades with GIS: Development of a GIS interface for the Everglades Landscape Vegetation Model". In. Integrating GIS and Environmental Modeling (GIS/EM4): Problems, Prospects and Research Needs. Lorraine Heisler, Yegang Wu, Fred Sklar, Tim Towles, Michelle Irizarry, Ken Tarboton. 2002. "Hydrologic Suitability Indices for Everglades Tree Islands".
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TABLE C-9: CATTAIL EXPANSION RATE REDUCTION

(Used in PM 1: Reduction in Cattail Vegetation Expansion Rate)

Evaluation Performance Measure
Broward WPA PM: Cattail Expansion Rate Reduction
Justification
Changes in hydrology and phosphorus inflows over the last 30 years have resulted in a conversion of ridge and slough vegetation to vast expanses of cattail marsh (Newman et al. 1996). Consequently, large areas of WCA-3 have been invaded by cattail (Rutchey and Vilchek, 1999), which tends to fill in the deep water sloughs needed as refuge by aquatic organisms during the dry season. Conversion to cattail can also change the biodiversity, soil structure, and the basic biogeochemical processes needed to sustain the oligotrophic nutrient regimes and the organic structure of both ridges and sloughs (Sklar et al. 2001, 2002, 2003). The Broward WPA Project is expected to reduce the rate of cattail expansion by retaining clean water within the system and reducing the need for high TP inflows. While expansion may not be halted, reducing the rate at which the cattail is advancing can be targeted as a goal. Therefore several targets, one affecting the other in succession, are identified. First is a reduction in TP water concentrations which reduces TP loading of the soil. The Broward WPA will help to reduce TP concentration and loads in WCA-3 because less stormwater, thus less TP will enter into the system through the S-9 pumping structure. This also benefits downstream areas reducing the TP concentration and loads there as well. Both of these events aid in reducing cattail expansion, which is following the anthropogenically, elevated soil TP front.
CERP Evaluation Target
The CERP evaluation target for this performance measure is to reduce the rate of cattail expansion in WCA 3 to zero.
Evaluation Protocol
The Sawgrass & Cattail Module (SAWCAT) was developed to evaluate the effects of TP loadings/concentration and flow/volume of water and its relation with soil TP on sawgrass growth and cattail expansion (Wu et al. 1997, Newman et al. 1996). To determine the expansion rate, historical vegetation maps and soil maps are utilized to simulate the area of cattail coverage and soil TP concentrations, respectively (Rutchey and Vilchek, 1999, Rutchey et al. manuscript). Cattail maps through time are utilized to show changes in acres and location of cattail and to validate the simulation results. Based on these metrics an expansion rate of cattail spread can be calculated for an area. The SAWCAT module can be utilized as a performance measure to evaluate the environmental benefits of changing TP loadings/concentration and flow/volumes and cattail expansion under various alternatives. Cattail expansion is most dependent on species competition in the landscape. The model also simulates that the interaction between water depth and TP favors cattails out-competing sawgrass in the Everglades. SAWCAT can also be used to predict the long-term impacts of both increases and decreases of TP on cattail expansion. The simulation of the effects of TP on cattail expansion can be expressed as a Logistic function. The threshold for accelerated cattail expansion is estimated at about 650 mg/kg of soil TP (Wu et al. 1997). Evaluation can be based upon change of TP loading (volume and concentration) calculation to compare the impact of different TP loading on cattail expansion; or based on the assumption of 10 ppb surface water flowing into the system to compare the different hydrological alternatives on cattail expansion.
Source and History of Evaluation Protocol
Newman, S. Grace and Koebel. 1996. The effects of nutrients and hydroperiod on mixtures of Typha. Ecol. Apps 6:774. Rutchey, K. and L. Vilchek. 1999. Air photo interpretation and satellite imagery analysis techniques for mapping cattail. Photogr. Eng. and Remote Sensing. Sklar, F. et al. 2001, 2002, 2003. Everglades Consolidated Report. South Florida Water Management District Wu, Y., F. Sklar, and K. Rutchey. 1997. Analysis and simulations of fragmentation patterns in the Everglades. Ecological Applications 7(1):268-276.

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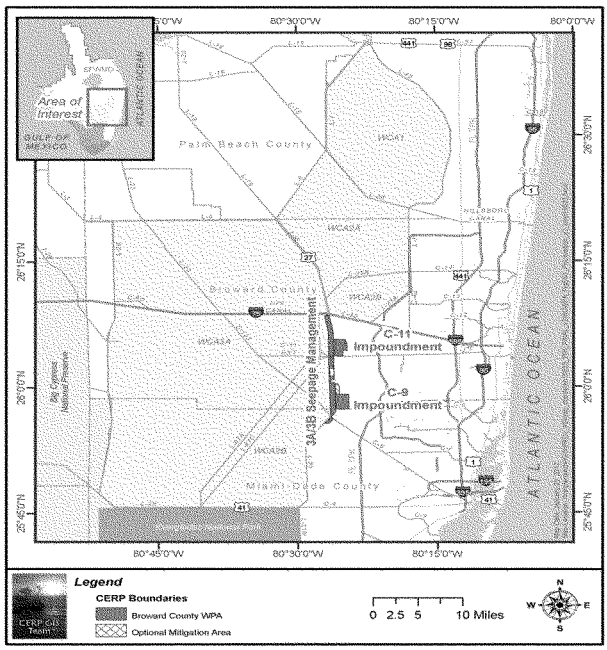
C.2 BENEFIT ANALYSIS

C.3 PROJECT BACKGROUND

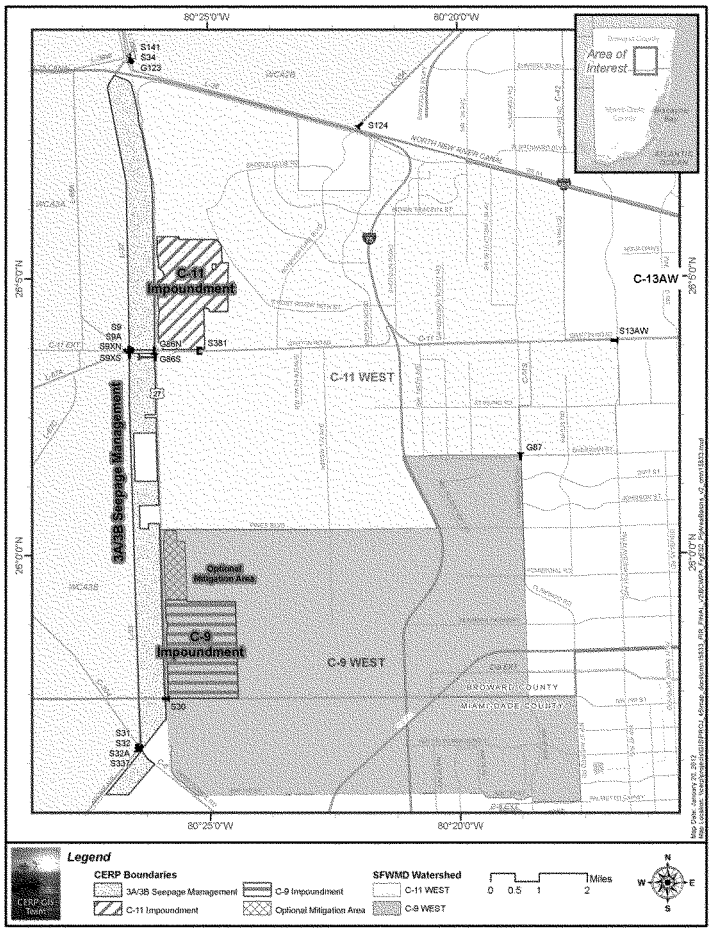
The Comprehensive Everglades Restoration Plan (CERP) provides a framework for the restoration of ecological function for the diverse and significant habitats of the south Florida ecosystem, including the Everglades, which encompasses 18,000 square miles from Orlando to the Florida Reef Tract. CERP consists of 68 components to restore, preserve, and protect the south Florida ecosystem while providing for other water-related needs of the region. Three of these projects comprise the BCWPA Project. The map below displays the study area location and project components (***FIGURE C-1***).



Source: BCWPA 2007 PIR, pg: vi (www.evergladesplan.org)

FIGURE C-1: BCWPA STUDY AREA

BCWPA Project is planned and designed primarily to perform two functions: 1) reduce seepage loss from WCA 3 to the C-9 and C-11 basins, and 2) capture and store excess surface water runoff from the Western C-11 Basin that is currently discharged untreated into the Water Conservation Area 3 (WCA 3), thus reducing nutrient loading to the natural system. The C-11 and C-9 impoundment components function to both capture the storm water runoff and aid the WCA 3A/3B Seepage Management Area (WCA 3A/3B SMA) project component in reducing seepage from WCA 3 by reducing the water level difference between WCA 3 and the drained areas immediately to the east (***FIGURE C-2***).

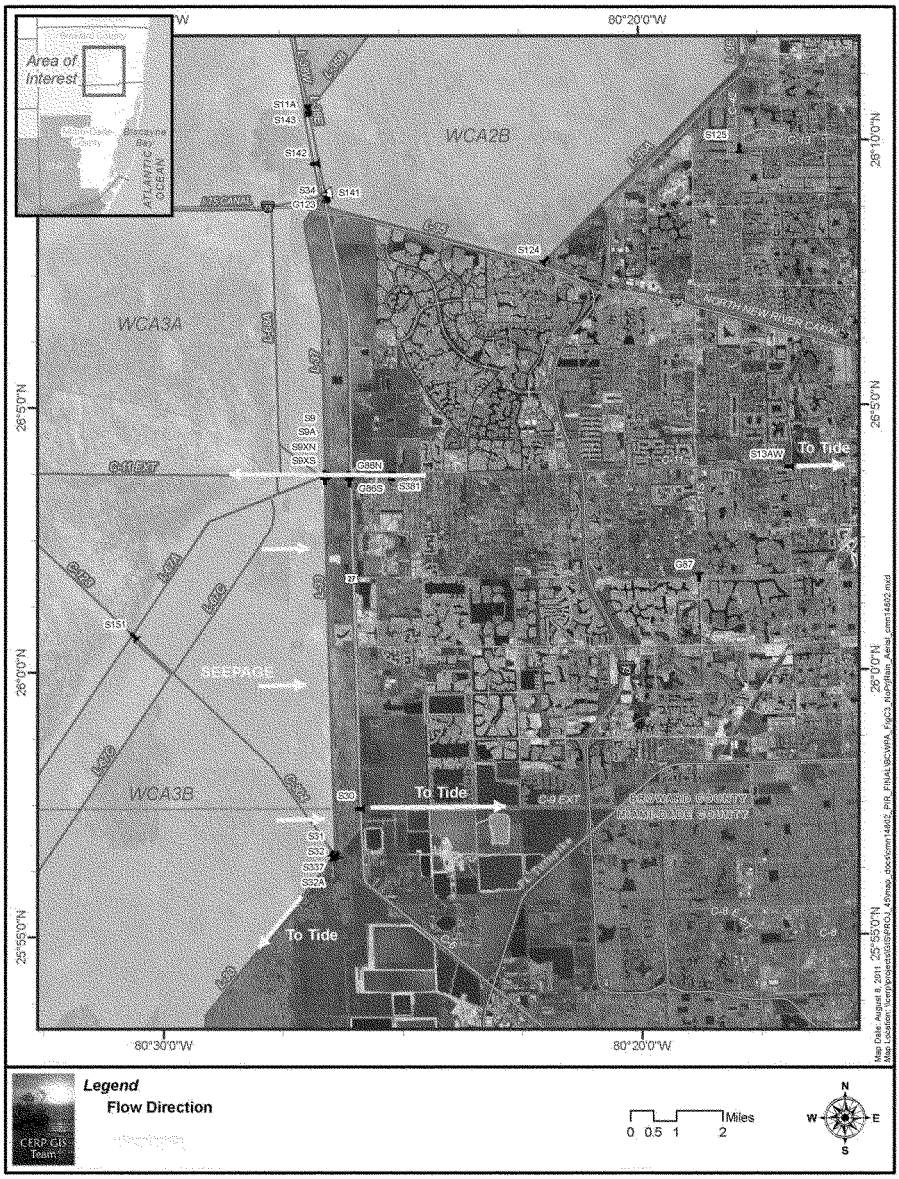


Source: BCWPA 2007 PIR, pg: vii (www.evergladesplan.org)

FIGURE C-2: BCWPA PROJECT PLAN

In its pre-drainage condition, the ridge and slough portion of the Everglades was an expansive, long-hydroperiod, freshwater marsh, characterized by low-velocity sheet flow, moderate-to-deep organic soils, and alternating sawgrass ridges and more open-water slough communities (Davis et al., 1994; Gunderson, 1994; Olmsted et al., 1997; Browder et al., 1999). Throughout the Water Conservation Areas, changes in hydrology and phosphorus inflows over the last 30 years have resulted in a conversion of ridge and slough vegetation to vast expanses of cattail (*Typha spp.*) marsh (Newman et al., 1996). The ridge and slough systems were dominated by sawgrass (*Cladium spp.*), water lily, and wet prairie species (*Eleocharis* and *Rhynchospora*) communities. A spatially variable mosaic of discreet hardwood hammock, bay head, and willow tree islands occurred throughout, ranging from widely spaced in the central Everglades to more densely distributed in the Loxahatchee basin and Shark River Slough (SRS).

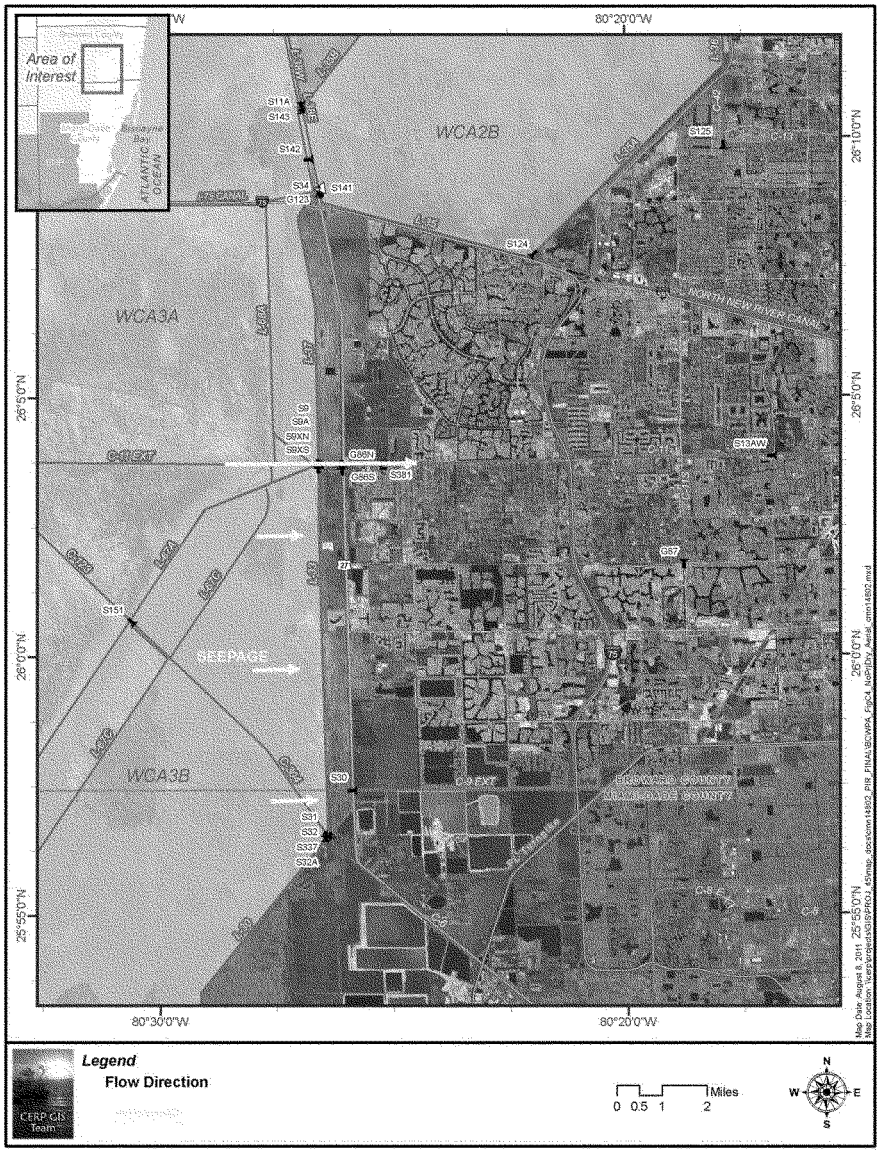
A series of flow diagrams are provided to illustrate Without and With Project conditions during various wet and dry conditions (***FIGURE C-3, FIGURE C-4***, and ***FIGURE C-5***). In the future without project conditions there will be continued releases, through the S-9 Pump Station, of excess storm water run-off that cannot be stored in the C-9/C-11 basins. It is pumped westward into the WCA 3 from C-11 Canal into the canal system west of the East Coast Protection Levee, i.e., C-11, L-67A, and L-68A. This diagram addresses Performance Measure (PM) 1 (***FIGURE C-3***).



Based on: BCWPA, 12 April 2007 Civil Works Review Board Presentation

FIGURE C-3: WITHOUT PROJECT CONDITIONS FLOWS (RAIN EVENT)

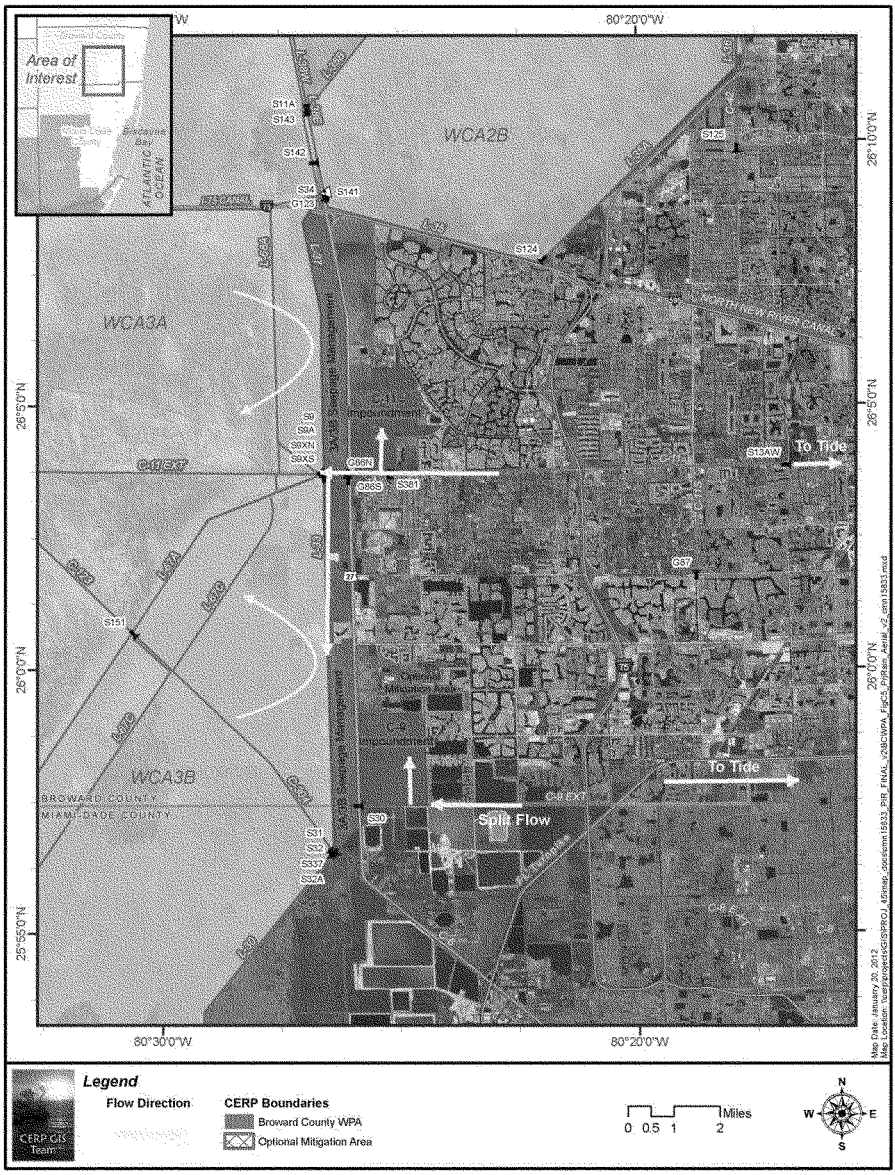
For the without project conditions during a dry event there would be water stages in the WCA 3 that would force water, in the form of seepage, eastward. The eastward seepage would reduce the amount of water available for the environment. Typically, all water supply demands are met with seepage from natural area with no structure openings required for direct flow. This diagram addresses PM 1. During these types of events there may still be times when water will need to be pumped back through the S-9 Pump Station to maintain existing levels of flood service (***FIGURE C-4***).



Based on: BCWPA, 12 April 2007 Civil Works Review Board Presentation

FIGURE C-4: WITHOUT PROJECT CONDITIONS FLOWS (SEEPAGE/DRY EVENT)

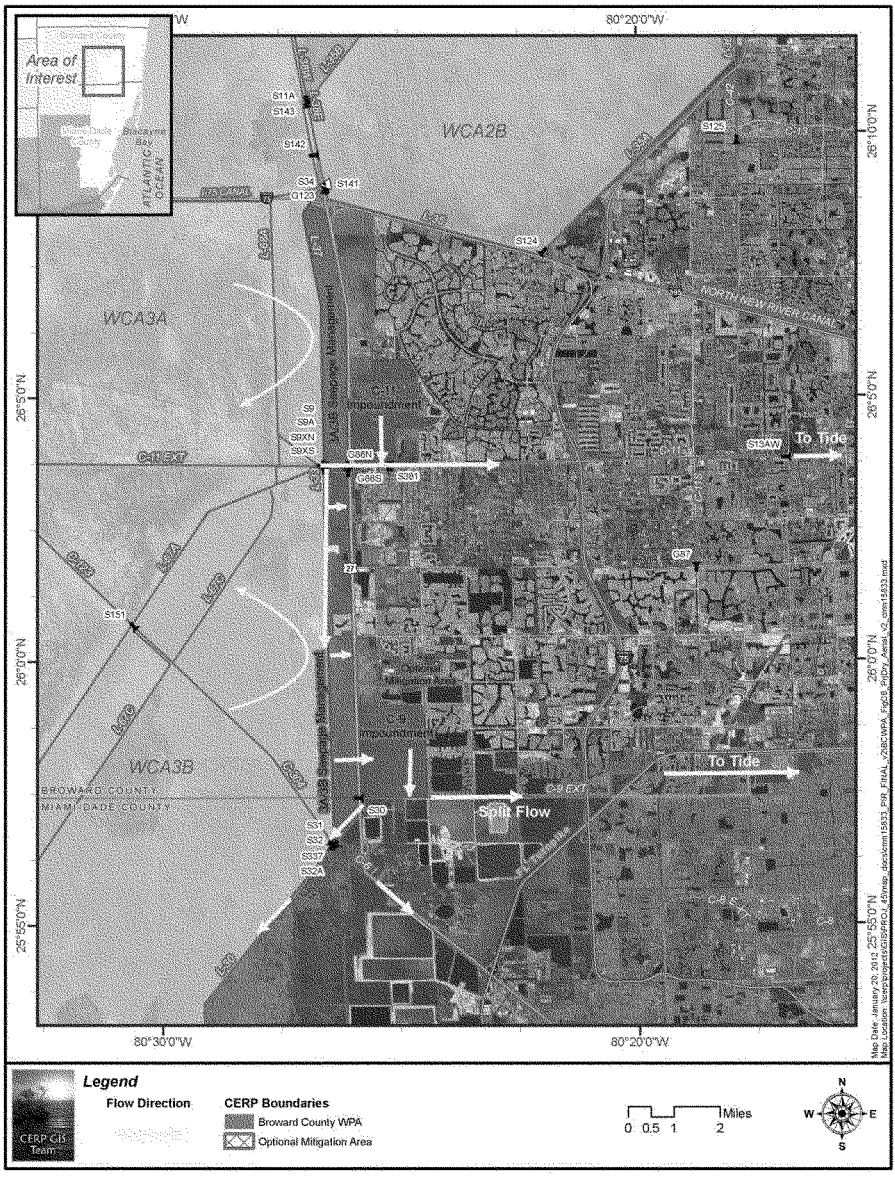
For the With Project condition rain event, the project would pump storm water runoff collected in C-11 Canal into the C-11 Impoundment rather than pumping into the Water Conservation Areas (WCAs) via S-9. When the C-11 Impoundment capacity is reached, additional stormwater runoff would be diverted to the C-9 Impoundment. Once the C-11 and C-9 impoundments and the Water Conservation Area 3A/3B Seepage Management Area (WCA 3A/3B SMA) are in place a stormwater runoff point source into WCA 3 via S-9 would be greatly reduced and seepage from the WCA 3 would be kept in the natural system. Seepage lost by the natural system is reduced by the hydraulic recharge provided by the impoundments and the "seepage step-down" provided by the Seepage Management Areas, which also have berms to hold back rainfall from draining away (i.e. rainfall driven system). This system creates a temporary higher hydraulic gradient also reducing seepage losses. This diagram addresses PMs 2 and 3. As necessary, water may still be pumped from S-9 into the WCA 3 and out the C-9 and C-11 canals (***FIGURE C-5***).



Based on: BCWPA 12 April 2007 Civil Works Review Board Presentation

FIGURE C-5: WITH PROJECT CONDITIONS FLOWS (RAIN EVENT)

During Dry events the water stored in C-9 and C-11 impoundments will be sent out the C-9 and C-11 canals in a controlled manner. A majority of the water in the WCAs will stay in the WCAs with minor seepage to the east due to the water in the WCA 3A/3B SMA and therefore be available for the natural system. This diagram addresses PMs 2 and 3. Water will be pulled in extreme events from the natural system when needed (***FIGURE C-6***).



Based on: BCWPA, 12 April 2007 Civil Works Review Board Presentation

FIGURE C-6: WITH PROJECT CONDITIONS FLOWS (SEEPAGE/DRY EVENT)

C.4 MODEL APPLICATION

CESAJ-PD requested and was granted "Approval for Use" (CECW-P, 1 Feb 2011) rather than certification of the three Performance Measures.

Regulations dictate how USACE ecosystem restoration projects (as well as other Civil Works projects) are formulated, evaluated and selected for implementation. In other USACE mission areas where both costs and benefits can be calculated in monetary terms, alternative plans are evaluated using benefit-cost analysis. While monetary costs can be determined for ecosystem restoration projects, no equivalent, universal method for quantifying environmental benefits exists. Instead, the economic tools of cost effectiveness analysis and incremental cost analysis are used to support decision making. To conduct these analyses, ecosystem restoration outputs must be clearly identified and quantified in appropriate units (e.g., include habitat units, acres of increased spawning habitat for anadromous fish, stream miles restored to provide fish habitat, increases in number of breeding birds, etc.).

Performance measures were used to calculate benefits and compare alternatives for the Broward County Water Preserve Areas (BCWPA) Project based on ecological attributes likely to show the effects of the project on the regional ecosystem, these measures directly relate to RECOVER performance measures and Interim Goals. While management measures and alternatives were evaluated in a number of ways, for multiple purposes, plan selection was based upon outputs from three planning models, and related Performance Measures (PMs). Plan selection is primarily based upon benefits to sawgrass, snail kites and ridge and slough habitat (including periphyton, fish and birds), by employing the following Performance Measures.

- PM 1: Reduction in Cattail Vegetation Expansion Rate
- PM 2: Snail Kite Habitat Quality
- PM 3: Ridge and Slough Habitat Quality

The above planning models have system-wide applications for habitat and species that are essential elements for Everglades restoration. The theories behind them were based on published papers and reports, multi-disciplinary and multi-agency collaboration, subject matter expertise and group brainstorming consensus to develop conclusions and path forward based on USACE guidance, state and federal laws (see Attachment B - References).

Theories pertinent to this document include: natural system modeling; periphyton function; nutrient effects on the system; seepage management; pre-drainage ecology; Everglades vegetation sensitivity to nutrients and hydroperiods; landscape responses to wetland eutrophication; conceptual ecological models; performance measures. Additional benefits are expected for species and communities that live within the Ridge and Slough. The methods and metrics above account for benefits

to overall habitat acreage, but not necessarily acreage associated with all species benefited.

The typical ecological benefit evaluation is accomplished in three steps:

calculate performance measure output,
compute habitat suitability index, and
compute habitat units.

Step 3, compute habitat units, involves calculating the habitat units for each performance measure on an average annual basis. The large benefitting area associated with this project justified the assumption that conditions would change slowly, at a linear rate, from the existing (base) condition to each of the various future conditions over the life of the project. The equation used to calculate average annual habitat units (AAHUs) is shown below.

Equation 1: Average Annual Habitat Units

$$AAHU_i = \frac{COND_0 + \sum_{k=1}^{n}\left(\left(\frac{COND_n - COND_0}{n-1}\right) + COND_{k-1}\right)}{n}$$

Where $AAHU_i$ is the average annual habitat units of project condition i; $COND_x$ is the habitat units at any given year x; and n=56 (1995 to 2050, inclusive)

Performance measures are quantified to the extent possible using model output (peer reviewed South Florida Water Management Model (SFWMM)), hydrologic data, project feature operation, and Geographic Information System (GIS). Numeric targets for evaluation metrics were established whenever possible. Linear extrapolation and indexing model output was a key assumption in calculating performance measure output. See http://www.sfwmd.gov/portal/page/portal/pg_grp_sfwmd_hesm/pg_sfwmd_hesm_sfwmm?navpage=sfwmm for SFWMM development, peer review, implementation and other information.

For each of the models presented here, we incorporated a linear interpolation approach, which assumed that the rate of change (the slope of the line) remains constant over time. Natural ecosystems are complex, dynamic systems and the exact functional form of the relationships among variables is often unknown. A linear function is the simplest quantitative way to describe the relationship between two variables and it identifies general trends among variables (for example, the relationship between phosphorus loading and cattail production is a positive linear relationship: an increase in phosphorus loading leads to an increase

in cattail production). Therefore, in order to simplify calculations and provide a planning-level estimate of ecosystem function, linear functions were used throughout the modeling process.

In addition, when compared to step-functions or logistic functions, which are both commonly used in representing ecosystem response, linear functions have an equal possibility of overestimating or underestimating the total benefits of the project, as shown by the differences between Point A and the step-functions and logistic functions (***FIGURE C-7***). In the long run, with a 50-year planning horizon, linear functions are also a good approximation of ecological responses, which would have otherwise been defined by different functional forms. This is because the end result is the same and the ecological response is averaged over the entire planning horizon to yield average annual habitat unit lift. Linear functions essentially split the difference between over- and under-estimation, and are more conservative estimates of ecological response.

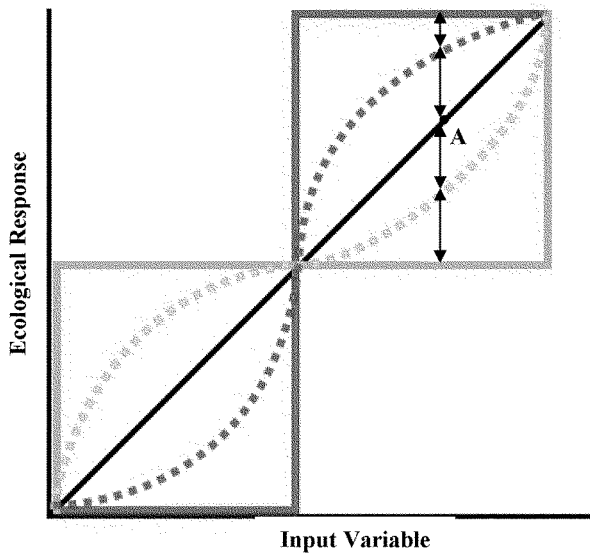


FIGURE C-7: COMPARISON OF LINEAR, STEP, AND LOGISTIC FUNCTIONS

C.4.1 Area of Impact

Benefits of the BCWPA alternatives were measured as a degree of habitat suitability for a community on a given landscape. The quantification of benefits for a restoration project essentially measures of desired hydrologic changes based upon

particular indicator species which act as a surrogate for ecological suitability or habitat units. There are two basic concepts that need to be considered before attempting to convert hydrologic responses into an ecological suitability index: establishing the area of impact and avoiding double counting benefits.

C.4.1.1 Performance Measure Distribution

For the BCWPA Project the direct area of impact encompass large expanses of WCA 3. Within WCA 3 there are three communities which have been examined, corresponding to the three Performance Measures. These include: snail kite (*Rostrhamus sociabilis*), cattail and sawgrass habitat. Outside the WCA 3, indirect areas, (through downstream flows) including Everglades National Park (ENP) were examined. The following figure is included to depict the location of the three performance measures (***FIGURE C-8***).

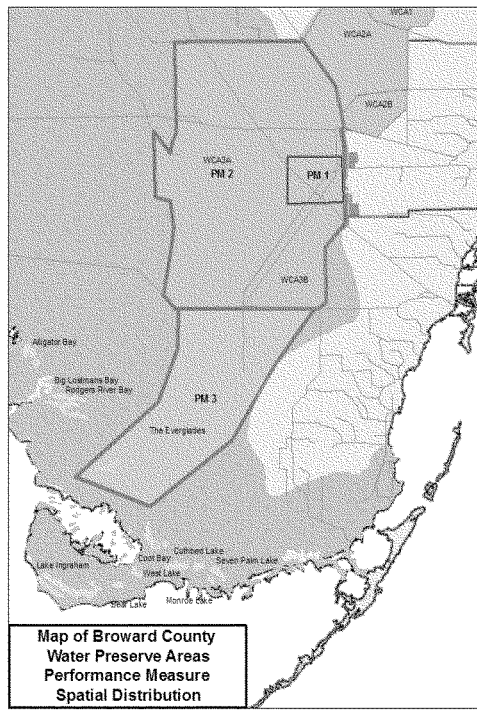


FIGURE C-8: BROWARD COUNTY WATER PRESERVE AREAS PERFORMANCE MEASURE SPATIAL DISTRIBUTION

The performance measure output is compared to the numerical targets to determine the associated habitat suitability indices. The habitat suitability indices are then applied to the total spatial extent of each ecological zone (in acres) to produce habitat units. Thus, habitat units are provided separately for each of the performance measures.

Each ecological zone can have a maximum of 1 Habitat Unit or Ecological Suitability Unit per acre. This is because a score of 1 represents 100% suitable habitat for that acre, for that specific performance measure. If there are multiple communities and performance measures per geographic area the results of the performance measure will be normalized, averaged or combined in a way to measure success on a 0 to 1 scale per acre. For BCWPA two performance measures were independently measured for a portion of the same geographic area. Cattail Expansion Rate Reduction (flow volume) and Snail Kite Habitat (inundation and dry outs) ecological suitability indices both occur in WCA 3. The lands that were dominated by cattail were removed from the acreage of snail kite foraging area, due to the high cattail abundance lands not being suitable for snail kite foraging. This eliminated the concern of double counting benefits.

C.4.1.2 Indicator Region Delineation

The area of impact does not always coincide precisely with the defined study area. The study area is typically a larger geographic area that encompasses greater elements of the watershed that could experience a degree of cumulative impacts due to implementation of the project. Therefore, the area of impact is defined as the area in which direct or indirect ecological responses occur. Within this area it is essential to distinguish ecological communities and identify indicator regions, since different communities likely require differing performance measures and targets to measures project response (***FIGURE C-9***).

Indicator regions are groups of adjacent 2-by-2 mile cells within the South Florida Water Management Model (SFWMM) and Natural System Model (NSM) grids intended to show hydrological behavior of small, logical subregions common both to present and predrainage Everglades systems. Because indicator regions have ground elevations and community structure that are similar to much more extensive areas of the natural system, hydrologic patterns in each indicator region can be used to evaluate how well alternative plans achieve hydrological restoration targets at subregional and regional scales. The set of performance measures developed for the Greater Everglades are applied to these regions in order to avoid making cell-by-cell comparisons with the NSM when evaluating model output. It should be noted that over time, as additional information is available to reduce system level uncertainties (ie: detailed topography), indicator regions may be modified as is the case between the indication region delineations used for PM 2 and PM 3. Application of PM 2 was based on an earlier version of the indicator regions.

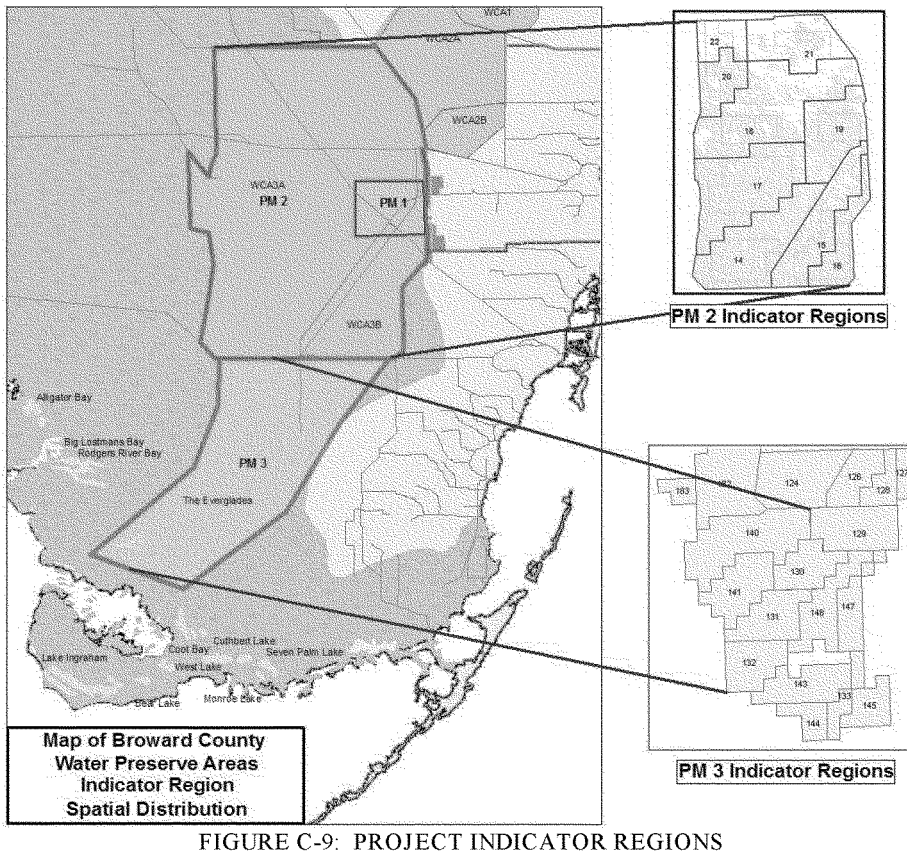


FIGURE C-9: PROJECT INDICATOR REGIONS

C.4.1.2.1 Reduction in Cattail Vegetation Expansion Rate

MODEL NAME: REDUCTION IN CATTAIL VEGETATION EXPANSION.

FUNCTIONAL AREA: Comparison of Environmental Benefit Outputs / Analysis for Ecosystem Restoration.

MODEL INPUT: USACE Certified and External PEER Reviewed SFWMM (2x2) version 3.5.and version 3.7.

LIST OF AGENCIES: South Florida Water Management District (SFWMD), US Army Corps of Engineers (USACE), US Fish & Wildlife Service (USFWS), Florida Department of Environmental Protection (FDEP).

PERFORMANCE MEASURE MODEL DEVELOPERS: Andy Gottlieb, PhD; Kevin Wittmann, USACE; Jeff Needle, SFWMD, Liberta Scotto, USFWS.

C.4.1.3 Performance Measure Background

Large areas of WCA 3 have been invaded by cattail (Rutchey et al., 1999), which tends to fill in the deeper water sloughs needed as refuge by aquatic organisms during the dry season (Rutchey K., T. Schall, and F. Sklar. 2008). ***FIGURE C-10***). Conversion to cattail can also change the biodiversity, soil structure, and the basic biogeochemical processes needed to sustain the oligotrophic nutrient regimes and the organic structure of both ridges and sloughs (Sklar et al., 2001; 2002; 2003).

In the shallow, hardwater wetland systems of the Everglades, periphyton communities are a prominent feature in the landscape and can be found as epiphytic mats, epipelic mats, epiphytes on the submersed stems of emergent macrophytes and metaphyton floating in the water column (Browder et al., 1981; McCormick et al., 1996; McCormick et al., 1998). These mats contribute more than half of the primary production in some Everglades environments (Childers et al., 2002) and have the capacity to sequester substantial quantities of phosphorus (Noe et al., 2003; Gaiser et al., 2004). Periphyton communities differ between long and short-hydroperiods and show contrasting patterns of seasonal variation in community structure. These differences, however, are primarily in species relative abundances (Gottlieb, 2005).

Periphyton provides structure, shade and temporary refugia for prey fishes. In shallow-water habitats, substrate-associated, rather than free-living, microbial communities regulate water column nutrient concentration (Gaiser et al., 2004). Poor water quality around the S-9 can lead to shifts in periphyton community structure and declining biomass. If P levels and loading continue there will likely be a decrease in periphyton biomass (Gaiser et al., 2004; McCormick et al., 1996; Gottlieb et al., 2001, etc) thereby impacting and lowering fish biomass (Trexler et al., 1999; Liston et al., 2005). This would likely affect bird foraging and corresponding nesting. Initial phosphorus loads may increase periphyton biomass but once thresholds are met senescence begins. Periphyton tissue TP concentration is already elevated in these regions while biomass is lagging behind in response, (once periphyton mats senesce, adverse affects on fish and birds are likely to follow.

Freshwater periphyton includes algal unicells, colonies, and/or filaments; but also contains a mix of microalgae, micrograzers, bacteria, and fungi. The periphyton algal component primarily consists of cyanobacteria (blue-green algae), green algae, and diatoms, though other algal groups may be present. Periphyton grows attached

to substrata in streams, lakes, and wetlands in which light levels are sufficient for growth. Periphyton provide community structure and primary productivity (Childers et al., 2001; Daoust and Childers, 2004; Gottlieb et al., 2004) that supports a wide range of other organisms and provide other benefits such as: primary source for fixed carbon; serve as food source for fish and invertebrates (Geddes et al., 2003 and Browder et al 1981); sequester nutrients such as N and P; cover for prey fish; can aid in stabilization of sediments. Periphyton is an excellent indicator of water quality (Gaiser et al., 2004) and hydrology (Gottlieb et al., 2003).

In wetlands, the periphyton uptake nutrients from the water column (N and P) and release them to the sediments upon death thereby decreasing the levels of N and P reaching the downstream system. In addition, periphyton is a common component of marshland environments (including sawgrass marshes) with alkaline water in Florida. Physical factors such as current, hydroperiod, substrate type, temperature, irradiance, nutrient levels, and degree of disturbance affect community structure and biomass of periphyton. In addition, biological factors such as grazing and the vegetative community can affect periphyton community structure and biomass (A. Dunn, 2010).

C.4.1.3.1 Detrimental Effects of Cattail

Cattail was determined to contain almost no functionality in the WCA ecosystem due to multiple reasons as explained below:

C.4.1.3.2 Cattail Expansion at the Expense of Native Sawgrass

The pre-drainage Everglades ridge and slough system was an expansive, hydrologically integrated, long-hydroperiod, low-nutrient freshwater marsh, characterized by low-velocity sheet-flow, long-term water storage capacity, moderate-to-deep organic soils, and alternating sawgrass ridges and more open-water slough communities (Ogden, 2005). Sloughs provide critical habitat supporting native populations and ecological processes/functions and are associated with an abundant and diverse community of aquatic consumers. Sloughs provide refuge for fish and invertebrates during the dry season, concentrating prey and in turn providing optimal foraging conditions for top predators such as wading birds during the nesting season (McCormick et al., 2009).

Increasing levels of water and soil P are associated with a decline in slough coverage, the loss of the abundant native periphyton community, and a shift in dominant macrophyte species. Slough macrophyte species Gulf Coast Spike Rush *(Eleocharis cellulosa)* and Fragrant Water Lily *(Nymphaea odorata)* decline as slough habitats are invaded by cattail, a species that is known to expand aggressively in response to P enrichment (McCormick et al., 2009).

C.4.1.3.3 Cattail Liberates Excessive Phosphorus into the Soil and Water Column as it Decomposes

Cattail litter decomposes quicker than sawgrass litter. Qualls et al. (2000) determined the amount of P remaining in sawgrass litter after 1 year of decomposition was higher than in cattail litter, but the initial P concentration in sawgrass litter was much lower, implying more P leaches out of cattail than sawgrass. P enrichment can speed decomposition rate of litter in the Everglades (Qualls et al., 2000) and cattail cells tend to be abundant in areas of high soil P (Newman et al., 1998). Conversion of wetland vegetation may result in significant change in wetland function by altering timing of litter input and downstream phosphorus loads (Emery et al., 1996). The potential effects on soil structure and long-term peat formation and the related implications to the Ridge and Slough patterns would, effectively flatten the system rather than support maintaining the bimodal Ridge and Slough system.

C.4.1.3.4 Sawgrass Produces more Dissolved Oxygen (DO) to the Water Column than Cattail

The surface waters of the Everglades are often low in DO, in both non-nutrient enriched sawgrass marshes and enriched cattail marshes, but hypoxic and anoxic conditions are more prevalent in cattail communities (Dong et al., 2002). High productivity in ridge and slough habitats maintains an oxygenated water column and is associated with an abundant and diverse community of aquatic consumers relative to other natural Everglades habitats (McCormick et al., 2009). Enriched P areas of marsh in the Everglades that consist of dense stands of cattail tend to be characterized by extremely low DO and periodic anoxia (Belanger et al., 1999; McCormick et al., 2003). Reduced DO impairs the health of sensitive fish and invertebrate species, leading to shifts in community composition towards populations that are more tolerant of low oxygen levels (McCormick, et al., 2003). Maintenance of the normal oxygen regime of a wetland can be critical to the maintenance of community structure and ecosystem functions, as well as the distribution and abundance of native species.

C.4.1.3.5 Cattail Expansion Encourages Fragmentation of Sawgrass Habitat

Landscape fragmentation is a serious threat to ecological conservation and preservation (Wu et al., 1997). Sawgrass is becoming increasingly patchy and heterogeneous in the Everglades landscape as a result of cattail expansion (Wu et al., 1997). Fragmentation affects sheetflow across the landscape as well as mobility of larger organisms such as alligators and some fishes. Connectivity (sheetflow) is also listed as a CERP interim goal. See report at http://www.evergladesplan.org/pm/recover/igit_subteam.aspx

C.4.1.4 Model Description and Application

The BCWPA Project is expected to reduce TP water concentrations which in turn reduces TP loading of the soil. The BCWPA Project will help to reduce TP concentration and loads in WCA-3 because less storm water, thus less TP will enter into the system through the Structure 9 Pump Station (S-9). This also benefits downstream areas by reducing the TP concentration and loads there as well. The project aids in slowing cattail expansion, which follows the anthropogenic caused elevated soil TP front. While expansion may not be completely halted, reducing the rate at which the cattail is advancing is targeted as a goal.

Several targets of the BCWPA Project are identified in the three items listed below:

1. Elevated soil phosphorus concentrations enhance rapid growth and expansion of cattails;
2. Cattail expansion reduces or eliminates sawgrass marsh wetland function;
3. Reducing TP loading to WCA 3 will reduce TP loading of soil and improve habitat quality.

This evaluation relies on estimates of S-9 flow generated by the SFWMM and the corresponding amount of lands that could potentially be primed for cattail expansion in the future to calculate the spread of cattail for each project condition. The S-9 flow data is converted to metric tons of phosphorus loading which is used to establish a spread reduction index for each of the future scenarios. This spread reduction index was multiplied by the amount of land that would be susceptible to the spread of cattail over the life of the project if no additional action was taken (referred to as primed land), to determine how many acres of cattail would be present for each project condition.

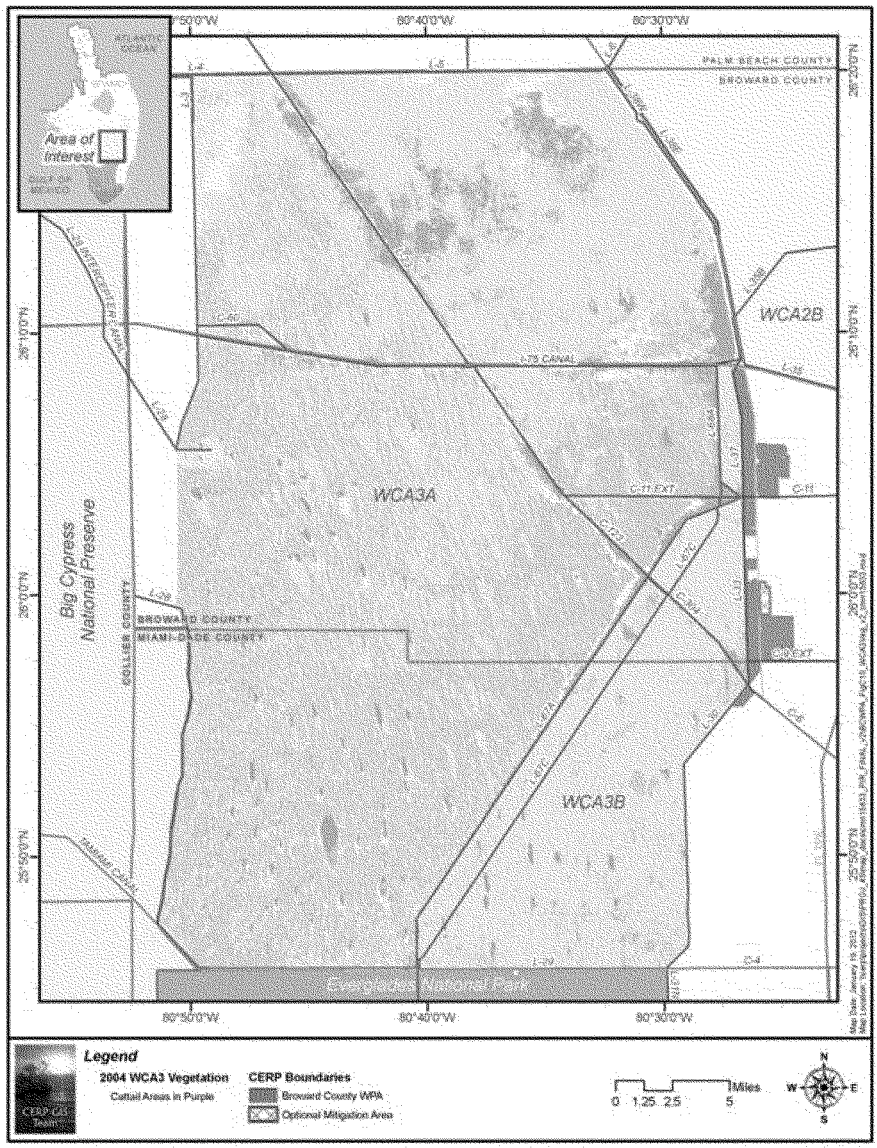
Upon identification of the amount of lands cattail would invade in each of the future scenarios, the amount of land (sawgrass) each alternative protected from invasion was computed. Habitat Suitability Indices (HSI) scores for cattail and sawgrass were then applied to their respective acreages to determine overall habitat units for the performance measure.

C.4.1.5 Description of Input Data

C.4.1.6 Lands Currently Dominated By Cattail

In order to establish the future acres of land dominated by cattails, it was important to first establish the baseline condition of cattail ($CAT_{existing}$) in WCA 3. The aerial extent of the communities were established using GIS and satellite mapping to show the defined vegetation communities by Wu et al., 1997. The 1995 map from

Rutchey et al. (2008), indicates approximately 1,600 hectares around the S-9 and 605 and 1,527 hectares of cattail in WCA 3B and WCA 3A respectively (***FIGURE C-10***). $CAT_{existing}$ equals approximately 5,500 acres.



Source: Rutchey K., T. Schall, and F. Sklar. 2008. Graphic project feature delineations are representational.

FIGURE C-10: WATER CONSERVATION AREA 3 VEGETATION MAP

Regional Environmental Monitoring and Assessment Program (REMAP) describes, diagnoses, and predicts the status of ecosystem conditions and Restoration Coordination & Verification (RECOVER) is an arm of CERP responsible for linking science with system-wide planning, evaluation and assessment tasks). REMAP and RECOVER SSR show enrichment around the S-9 and along L-67 close to the structures (***FIGURE C-10***). This increase/change in the concentration and distribution of soil TP in the region has significantly increased the probability of cattail expansion (and corresponding sawgrass and ridge and slough degradation). Increased soil TP concentrations that can be seen moving southward along the L-67 levee/canals from 2000-2005 are expected to continue without the project (***FIGURE C-11***). This will prime more acreage for conversion from sawgrass to cattail (potentially increasing the rate of conversion above historical trends).

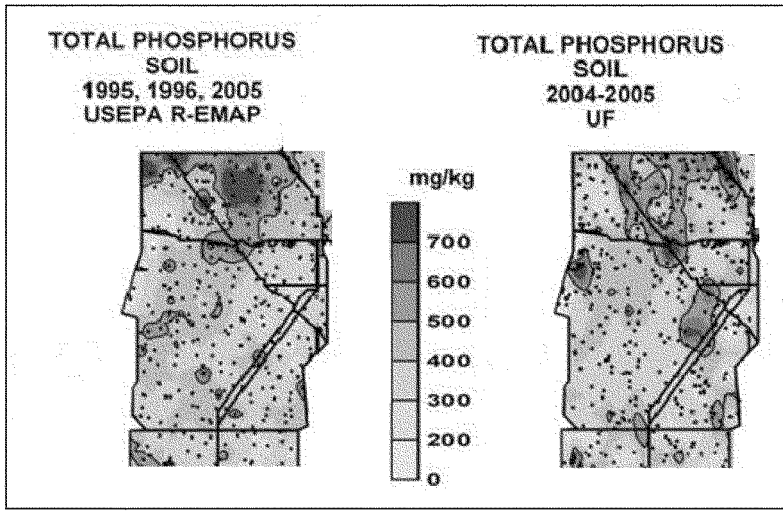


FIGURE C-11: SOIL PHOSPHORUS LEVEL MAPS COMPARISON

C.4.1.7 LANDS PRIMED FOR CONVERSION TO CATTAIL

The area primed to be dominated by cattail is defined as the land on which soil TP would exceed the 650ppb conversion threshold if the existing and historic TP loading were to continue unimpeded into the future (Wu et al., 1997). The area of land that could be primed for cattail expansion by the year 2050 is used as a benchmark to calculate how many acres of cattail expansion will be projected for each future project condition. The future without project cattail expansion will not equal the potential primed lands, since the primed lands are based upon historical

spread patterns reflecting current flow and TP concentrations, and the future without project condition assumes lower ppb of TP with different flow volume, as explained in further detail in ***Section C.2.4.1.***

Due to the inherent complexity in predicting future landscape pattern changes, three different approaches were used to identify the area of land that is set to be primed for cattail expansion. These approaches were based on historical TP loading and hydropatterns in the adjacent water conservation area (WCA 2). Reference (***FIGURE C-1***) for WCA 2 location and context.

The primed acres of land were established by using historical cattail expansion trends as noted in the literature (Belanger et al., 1989; Bruland et al., 2004; Davis et al., 1994; Gaiser et al., 2004; McCormick et al., 2004; Newman et al., 1996 and 1998; Qualls et al., 2000; Rutchey et al., 1999; Walker et al., 1999; Wu et al., 1997).

Approach 1 – This approach uses historical trend data that was collected in Water Conservation Area 2A (WCA 2A). Rutchey, et al., 2008, indicates a historical expansion rate of approximately 320 acres year, for the overall period of record (***TABLE C-10***). There were two periods of analysis presented in the study, 1991-1995 and 1995-2003. As can be noted in the table, after 1995 there was a substantial decrease in the annual expansion of cattail. This is due to a number of Best Management Practices (BMPs) and TP abatement measures for WCA 2A. In the absence of a project, it is expected that BMPs alone will help to reduce spread, but not to the post 1995 levels seen in WCA 2A, it was therefore assumed that the long term average between 1991-2003 would be a better representation of the potential spread in WCA 3 (***TABLE C-10***).

TABLE C-10: HISTORICAL EXPANSION OF CATTAIL IN WCA 2A BASED ON OBSERVED TRENDS

Years observed	Total Acres Expansion	Annual Expansion
1991-1995	3,023	756
1995-2003	823	103
1991-2003	3,846	320

Using the 55 year period between the existing acreage (1995) and the 2050 future condition, there is the potential for 17,627 acres to be primed for conversion to cattail.

Approach 2 - The SAWCAT cattail expansion model, developed by Wu et al., 1997, provided a useful expansion rate of approximately 4% per year for WCA 2A. The SAWCAT was developed to evaluate the effects of TP loadings/concentration and

flow/volume of water and its relation with soil TP on sawgrass growth and cattail expansion (Wu et al., 1997; Newman et al., 1996). To determine the expansion rate, historical vegetation maps and soil maps are utilized to simulate the area of cattail coverage and soil TP concentrations, respectively (Rutchey et al., 1999; Rutchey et al., 2008 manuscript). Cattail maps through time are utilized to show changes in acres and location of cattail and to validate the simulation results. Based on these metrics an expansion rate of cattail spread can be calculated for an area. The model forecasts the probability that sawgrass will be outcompeted by cattail by simulating the interaction between hydrology and an understanding of existing soil phosphorus distributions. The conditions are not typically favorable for cattail conversion until the soil threshold of 650 ppb is reached (Wu et al., 2005). The SAWCAT utility is limited to situations where it is useful to address the interplay of cattail and sawgrass expansion.

Applying this expansion rate to WCA 3 and incorporating the existing condition of approximately 5,500 acres, this would yield approximately 41,700 additional acres (average of 750 acres per year) of land primed for conversion to cattail.

Equation 2: Acres of Land Primed for Possible Cattail Expansion

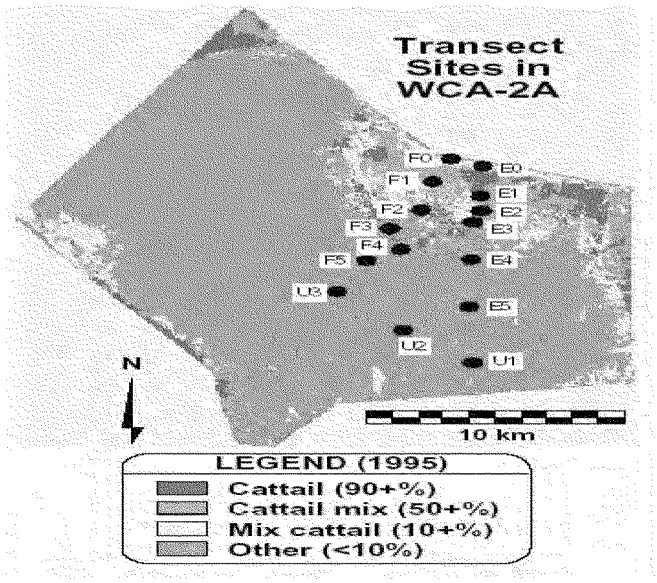
$$CAT_{primed} = (CAT_{existing} * (1 + r)^n) - CAT_{existing}$$

where CAT_{primed} and $CAT_{existing}$ represent the amount of land primed for cattail expansion and current cattail habitat, respectively, and r = 4% and n = 55 years.

Approach 3 – This approach extrapolates to Water Conservation Area 3 the measured downstream spatial extent of phosphorus loading that was observed in Water Conservation Area 2A. WCA2A F and E transects (***FIGURE C-12*** and ***FIGURE C-13***) show impacts up to 10Km downstream of highly enriched inputs and S12 transects show impacts in periphyton at least 5Km downstream (Walker et al., 1999 and Gaiser et al., 2004). The results of the preceding references suggest that similar impacts are seen over time at varying loading rates. Even at low concentrations, 10ppb, downstream functionality is impacted. The S-9 waters have TP concentrations more similar to inputs into WCA2. Assuming impacts up to 10 Km downstream and comparable width of impact (by flow path and width of impacted soils) 10 X 14 km is approximately 34,500 acres. The 10 X 14 polygon used is supported by the references cited above. The width is based on peer reviewed science and scientific interpretation by the ecological subteam since actual dye tests data was not available and could not be readily developed. It was assumed that the C-11 Impoundment discharge affects an area in the WCA 3 and Band 1 area approximately of the same width.

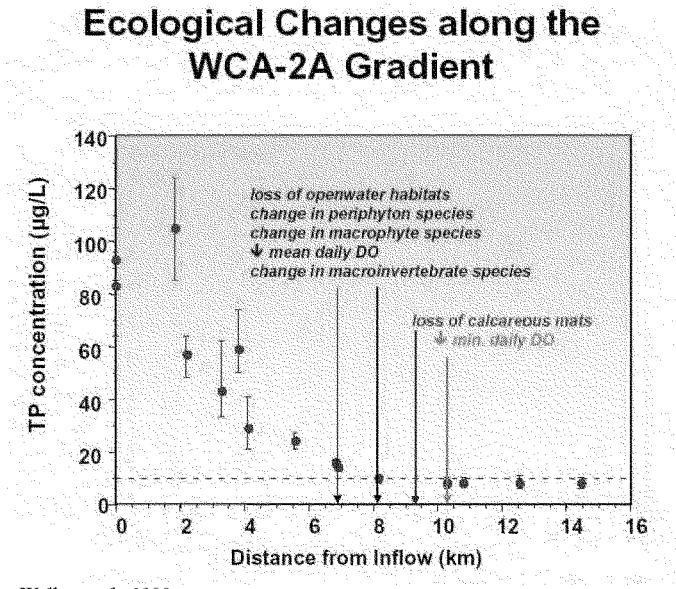
The figures below display cattail expansion in Water Conservation Area 2A (WCA-2A) due to hydrologic TP loading and TP accumulation in soils (***FIGURE C-12*** and

FIGURE C-13). This scenario could continue in WCA 3 and the ENP without the BCWPA project.



Source: Walker et al., 1999

FIGURE C-12: TRANSECT SITES IN WCA-2A



Source: Walker et al., 1999

FIGURE C-13: ECOLOGICAL CHANGES ALONG THE WCA-2A GRADIENT

Since the data spans several order of magnitude, a geometric mean of the results of these approaches was used to predict the potential primed acreage used for estimating the expected acreage of cattail dominated lands for each project condition. The following table summarizes the results of the three approaches and includes the geometric mean (***TABLE C-11***).

TABLE C-11: SUMMARY OF THREE CATTAIL EXPANSION ESTIMATES USED TO DETERMINE THE PRIMED AREA

Approach	Acres
1	17,627
2	34,595
3	41,673
	29,400
Stddev	12357

C.4.2 Description of Output Data

C.4.2.1 S-9 Flow and Phosphorus Loading Calculations

Evaluation of the BCWPA Project benefits were based upon the change in TP loading (concentrations) calculations to compare the impact of different TP loading scenarios on cattail expansion; and based on S-9 water flowing into the system to compare the different hydrological effects on cattail expansion. The data was normalized and transformed into sub-index (SI) scores to be used as input to the evaluation equation. To do this, the following assumptions were made:

1) 1995 existing condition (95B) represents a severely degraded condition worst case scenario; (i.e., highest TP loading average at 17ppb);
2) 2050 future without-project (FWO) and 2050 alternatives represents average loading conditions of 10ppb, and
3) The system will continue to degrade over time.

Phosphorus concentration for the 1995 existing condition scenario was determined from average TP concentration measurements taken at the S-9 Pump Station, which typically range from 16 to 18 parts per billion (ppb). It was assumed that phosphorus standards mandated under the 1994 Everglades Forever Act (Florida Statute 373.4592, 1994) would result in phosphorus concentrations averaging 10 ppb or less for all future scenarios.

C.4.2.2 A-Series Flow Calculations

The SFWMM hydrologic and hydraulic computer (engineering) model simulations were performed during the conceptual and preliminary design phases of the project for the A-series alternatives (Alternative A1 and A4).

This link http://my.sfwmd.gov/sfwmd/hesm/hpm/frame1/maps/wbud.htm provides a scroll down list of various alternatives. Select either WPASP (Alternative A4) or D13R (November 1998) (Alternative A1) and select 'annual budget' under Standard Water Budget Output. Using the Find (on this page) tool under the Edit pull down menu and type in S9 and this will bring you to S-9 output by year. Find the average in 1,000 acre-feet for each year of the simulation and the average for the period of record under the MEAN column.

C.4.2.3 F-Series Flow Calculations

The F-Series alternatives (F1 and F4) were not modeled, but were included in the final array of alternatives to identify whether the C-9 Impoundment provided significant additional benefits to WCA 3A. The F-Series alternatives contain the C-11 Impoundment and the WCA 3A/3B SMA but not the C-9 Impoundment. The A-Series alternatives include the C-11 Impoundment, WCA 3A/3B SNA and the C-9

Impoundment which contain more storm water storage capacity than the F-Series. Without the C-9 Impoundment less volume of storm water could be diverted away from the Everglades via the S-9 Pump Station (S-9).

A proportioning method was established to calculate the amount of storage required to reduce flows by 1,000 ac-ft/yr for the A-series alternatives and apply this proportion to the F-Series alternatives. Alternative A1 was used to establish the flows for Alternative F1 and Alternative A4 was used to establish the flows for Alternative F4. The proportion was calculated by dividing the A-series total storage by the A-series flow reduction over FWO flows. The total storage of the F-series was then divided by the storage required from the A-series calculations to determine the flow volume reduction.

Equation 3: F-Series flow volume reduction

$$Flow_{F1} = \frac{Storage_{F1}}{Storage_{A1}/(Flow_{Fwo} - Flow_{A1})}$$

where Flow and Storage represent flows in 1,000ac-ft/yr and storage represents total storage capacity of the impoundment.

Equation 4: Remaining F-Series future flow

$$Flow_{F1\,Rem} = (Flow_{Fwo} - Flow_{A1})$$

where Flow represent flows in 1,000ac-ft/yr.

C.4.2.4 Phosphorus Loading Calculations

TP (Total Phosphorus) Load (in Metric Tons) is calculated assuming concentrations of stormwater pumped through the S-9 pump station of 17 ppb of TP for the 95B alternative run (the 1995 base or existing conditions run) and 10 ppb of TP for all other runs (***TABLE C-12***). Total phosphorus loading is determined by multiplying the volume of water coming through the S-9 pump (kilo-acre-feet per year) by the concentration of phosphorus in the water column. Total phosphorus load is calculated as follows:

Equation 5: Total Phosphorus loading in WCA3A/B as pumped through S-9

$$TP_{kac-ft/yr} = Q * P_c$$

where TP, Q, and Pc represents total phosphorus load, inflow (kilo-acre feet per year) and phosphorus concentration in the water column, respectively.

The conversion needed to change from kilo-acre-feet per year to Metric Tons of Load based on a given concentration is below:

Equation 6: Conversion factor from kilo-acre-feet per year to Metric Tons of Phosphorous

$$\left(\frac{1\frac{kac}{ft}}{yr}\right) * \left(\frac{1000ac}{1\,kac}\right) * \left(\frac{43560\,ft^2}{ac}\right) * \left(\frac{1m^3}{35.3147\,ft^3}\right) * \left(\frac{1000L}{1m^3}\right) * \left(\frac{1\mu g}{L}\right) * \left(\frac{1mt}{1*10^{12}\mu g}\right) = \frac{0.00123443\,mt}{yr}$$

The metric tons of loading are then calculated by multiplying the yearly flow by the conversion factor and the TP concentration.

Equation 7: Metric tons of Phosphorous loading calculated using conversion factor

$$mt_p = TP_{kac-ft/yr} * \frac{0.00123443mt}{yr}$$

where mt_p *is the metric tons of phosphorus loading and* $TP_{kac-ft/yr}$ *is the phosphorus loading in kac-ft per year.*

The concentration for existing conditions - 1995 Base can be obtained from the South Florida Everglades Report (SFER) which reports on water quality monitoring into the Everglades Protection Area (EPA). The S-9 and S-9A flows and loads can be found in the SFER.

The results of the flows and phosphorus loading for each project condition are shown in the following table (***TABLE C-12)***.

TABLE C-12: TOTAL PHOSPHORUS LOADS CALCULATED FOR BCWPA PROJECT (PM 1. CATTAIL REDUCTION - TP LOADING REDUCTION)

ALTERNATIVES	1995	2050	ALT A1	ALT A4	ALT F1	ALT F4
FLOWS (kacft/yr)	177.0	194.0	22.0	14.0	107.3	108.0
METRIC TONS OF TP	3.708	2.391	0.271	0.173	1.323	1.331

Source: Environmental Benefits Spreadsheet "TP Loading" Tab

The table is made up of three rows; Alternatives, Flows (kacft/yr) and TP Load in metric tons. The value in the **Flow** row is the quantity of water pumped from the Western C-11 Canal Basin to Water Conservation Area 3A through the S-9 Pump Station (S-9). The S-9 values are calculated in units of 1,000 acre-feet of water pumped per year over the period of record of the model simulation. The S-9 values are averages over period of record for the model runs, either 26 or 31 years depending on the simulation. The values can be found on the Comprehensive Review Study – or Restudy website: http://my.sfwmd.gov/sfwmd/hesm/hpm/index.html .

C.4.2.5 Cattail Reduction Index

The metric tons of phosphorus loading are used to establish a spread reduction index for each of the future scenarios. The spread index reduction is applied to the amount of primed land to determine how many acres of cattail would be present for the future without project condition and for each of the alternatives. As previously mentioned, the primed land is the maximum amount of cattail expected if current conditions were to continue with no intervention. The index is established to predict how the reduction in flow and TP loading will impact the expansion rate.
The target condition for this performance measure is zero phosphorus loading (*i.e.*, no flow) into WCA 3 via the S-9. This scenario is given the optimal quality index score of 1.0, since no new phosphorus would be introduced into the system. Conversely, the 1995 existing condition represents a severely degraded system and was therefore assigned the lowest quality index score (0.00). Loading values were linearly interpolated between the upper (0 phosphorus loading) and lower bounds (3.71 mt of phosphorus) (***FIGURE C-14***). Using the predicted values for TP loading indices were assigned to the different future scenarios and are representative of the reduction in TP loading (***TABLE C-12***). The following equation was utilized to calculate the index scores.

Equation 8: Cattail Spread Reduction Index

$$Index_i = (mt_{p_{existing}} - mt_{p_i})/mt_{p_{existing}}$$

Where $Index_i$ is the spread reduction index and mt_p is the metric tons of phosphorus.

FIGURE C-14 graphically represents where each alternative and the future without project condition fall on the expansion index plot, utilizing the results of the preceding equation.

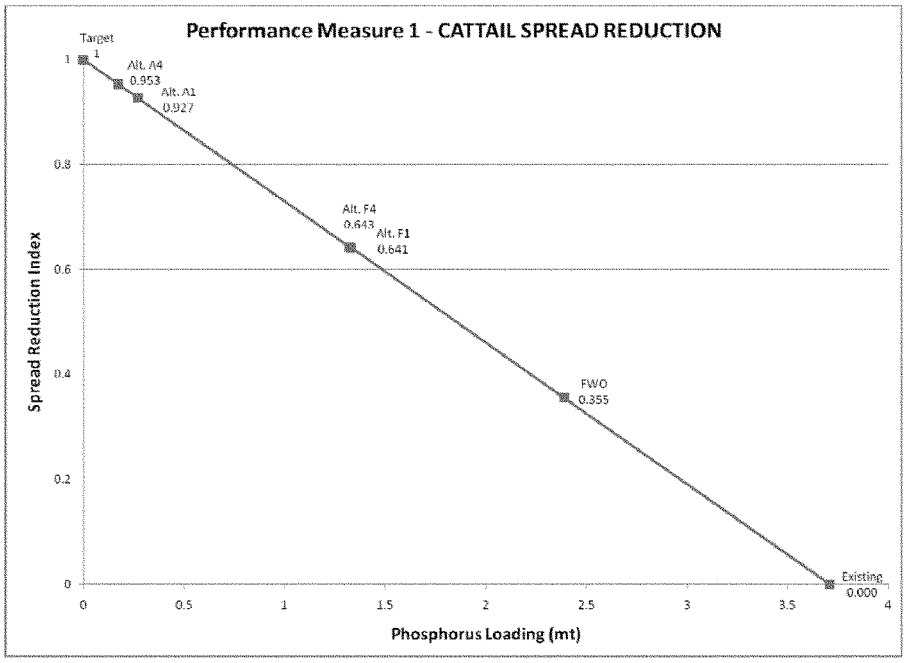


FIGURE C-14: SUB INDEX SCORES FOR PHOSPHORUS LOADING

C.4.2.6 Future Cattail Acre Expansion

The reduction in cattail spread for each future condition is calculated by assuming that the reduction in TP loading ($Index_i$) would equally apply to a reduction in future spread of cattail. For each scenario, including FWO, the total number of acres affected was calculated as follows:

Equation 9: Cattail Spread Acreage

$$CAT\ AC_i = CAT_{primed} - (CAT_{primed} * Index_i)$$

Where $CAT\ AC_i$ represents the future spread of cattail in acres for each scenario i; CAT_{primed} is the acreage of land that could possibly convert to cattail if base year phosphorus loading conditions were to continue into the future; $Index_i$ is the factor by which future total phosphorus loading will be reduced in scenario i.

For each alternative the additional projected acreage being colonized by cattail needs to be added to the existing acres of cattail. Summing the acreage established for the existing condition and the expansion acreage established in the future

without project condition determines the total amount of acreage of cattail in the future without project condition. This total acreage will be the maximum impact area for the cattail reduction ecological category. Anything occurring outside of this area will not have a relevance to cattail expansion or reduction.

Equation 10: Total Cattail Acreage

$$TotCAT_i = CAT\ AC_i + CAT_{existing}$$

Where CAT AC_i and $TotCAT_i$ represent the number of acres affected by scenario i and maximum impact area for cattail in the base year, respectively.

C.4.2.7 Protected Sawgrass Acreage

The next step is to calculate that acreage corresponding to the protected Sawgrass within the impact area. The acres of protected sawgrass are essentially the non cattail dominated lands. This is calculated by subtracting the acres containing cattail for the existing condition ($CAT_{existing}$) and With Project alternatives ($CAT\ AC_i$) from the total acres containing cattail for the Future Without Project condition ($TotCAT_{fwo}$) (Equation 11). Since the area of impact is limited to the area inundated with cattail in the Future Without Project condition, there are no acres of Sawgrass in the FWO condition.

Equation 11: Total Sawgrass Acres Protected

$SAW_i = TotCAT_{fwo} - TotCAT_i$ *Where SAW_i is the acreage of sawgrass protected; $TotCAT_{fwo}$ is the acreage of cattail in the future without project scenario; and $TotCAT_i$ is the acreage of cattail expansion in scenario i.*

The potential future spread of cattails within the study area is displayed in the following table. The following table displays existing acreage of cattail dominated lands ($CAT_{existing}$), the spread of cattail for each project condition ($CAT\ ACi_i$), the total cattail dominated land expected in 2050 ($TotCAT$), and the area remaining sawgrass (SAW_i) ***(TABLE C-13)***. Also provided is a conceptual graphical representation of the area depicting cattail distribution for each project condition (***FIGURE C-15***).

TABLE C-13: POTENTIAL FUTURE SPREAD OF CATTAIL WITH SPREAD REDUCTION FOR EACH ALTERNATIVE

	Alternative Condition					
	Existing	Future Without	Alt A1	Alt A4	Alt F1	Alt F4
$CAT_{existing}$	5,500	5,500	5,500	5,500	5,500	5,500
CAT AC	-	18,955	2,150	1,368	10,486	10,548
TotCAT	5,500	24,455	7,650	6,868	15,986	16,048
SAW	18,955	0	16,805	17,587	8,469	8,407
Total Area	24,455	24,455	24,455	24,455	24,455	24,455

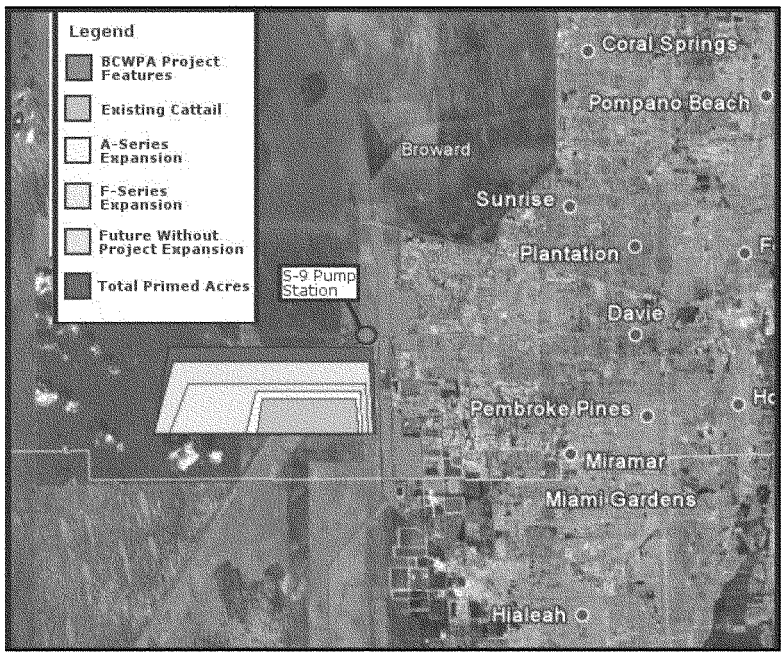


FIGURE C-15: DEPICTION OF REPRESENTATIVE ACREAGE OF CATTAIL EXPANSION FOR EACH PROJECT ALTERNATIVE

Note: The A-Series and F-Series are shown as single polygons due to the closeness of acreage between A-1 and A4; and F-1 and F-4. Graphic project feature delineations are representational.

C.5 HABITAT UNITS

C.5.1 Habitat Suitability Index

Habitat Units are calculated by multiplying the Suitability Index for Cattail and Sawgrass by the respective Cattail and Sawgrass acreage for each project condition. Since the acreage of colonization was calculated for the acreage that is expected to be totally dominated by cattail, the Cattail SI (HSI_{CAT}) was assigned a score of 0.01. The value of 0.01 was chosen for the quality index to represent a severely degraded system. Expansion of cattail directly and negatively affects multiple CERP Interim Goals (see Interim Goals and Interim Targets report). As noted the 1995 condition and the high P loading (~4metric tons/year) have led to an expanded region of impacted soils as well as dense cattail. Regions of dense cattail generally preclude wading birds and more desirable ridge and slough species. Section C.2.1.1 contains the detrimental effects of cattail and lends support for scoring the land dominated with cattail so low.

Additionally those same conditions negatively impact periphyton and those species utilizing algal mats. Once ridge and slough is replaced with dense cattail, little functionality indicative of the greater everglades exists.

Conversely, it was assumed that the Sawgrass SI (HSI_{SAW}) for this metric would receive a score of 0.99 which is essentially a fully functional acre of land.

C.5.1.1 Average Annual Habitat Units

The total habitat unit calculations are represented by the following equation:

Equation 12: Habitat Units for Performance Measure 1: Cattail Spread Reduction

$$CAT\ HU_i = (TotCAT_i * HSI_{CAT}) + (SAW_i * HSI_{SAW})$$

Where $CAT\ HU_i$ is the total habitat units present in scenario i for the cattail performance measure; $TotCAT_i$ is the acreage of cattail expansion in scenario i; SAW_i is the acreage of sawgrass protected; HSI_{CAT} is the habitat suitability index for cattail; and HSI_{SAW} is the habitat suitability index for sawgrass.

The results of the alternative condition habitat unit calculations are below (***TABLE C-14***).

TABLE C-14: SAWGRASS MARSH HABITAT QUALITY UNITS FOR THE VARIOUS PROJECT ALTERNATIVES FOR THE BCWPA PROJECT

	Alternative Condition					
	Existing	Future Without	Alt A1	Alt A4	Alt F1	Alt F4
Habitat Units	18,820	245	16,714	17,480	8,544	8,483

Source: "Environmental Benefits Model Certification Spreadsheets – Cattail HU"

Benefits and costs are compared in average annual format. In order to annualize the habitat units, a linear change rate from existing habitat units to FWO habitat units, and a linear change rate from existing habitat units to alternative condition habitat units were utilized. It was necessary to average the yearly habitat units over the period of analysis (Equation 1). The average annual lift was calculated by subtracting the without project condition average annual habitat units from each With Project average annual habitat unit condition.

The average annual habitat units (AAHUs) for sawgrass marsh habitat quality for the final array of proposed BCWPA alternatives are estimated and displayed to compare which proposed alternative would provide the most AAHUs. This information was used to help screen the final array of alternatives and choose a tentatively selected plan (***TABLE C-15*** and ***FIGURE C-16***).

TABLE C-15: ALTERNATIVE AVERAGE ANNUAL HABITAT UNITS FOR SAWGRASS MARSH HABITAT QUALITY

	A1	A4	F1	F4
Average Annual Habitat Units	8,235	8,618	4,150	4,149

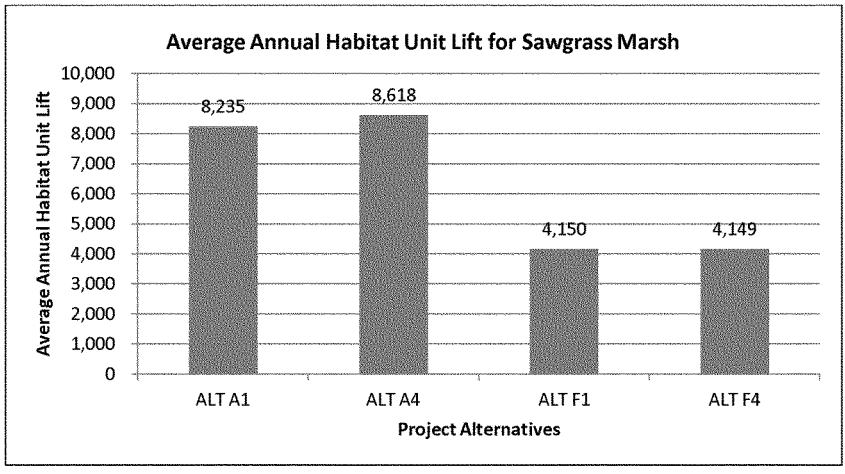


FIGURE C-16: AVERAGE ANNUAL HABITAT UNIT LIFT FOR SAWGRASS MARSH

C.6 MODEL NAME: EVERGLADE SNAIL KITE HABITAT QUALITY

Functional Area: Comparison of Environmental Benefit Outputs / Analysis for Ecosystem Restoration.

Model Proponent: SFWMD, USACE, USFWS, FDEP.

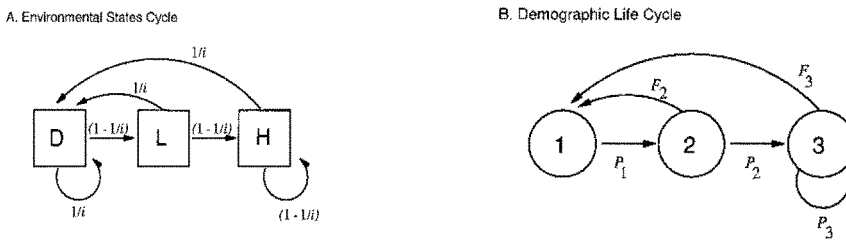
Model Developer: Broward County Water Preserve Areas, Environmental Benefits Model Subteam.

C.6.1 Performance Measure Background

The Everglade Snail Kite (*Rostrhamus sociabilis*) has been identified as a key ecological attribute, due to its Federal and State endangered species listing. Therefore, the fate of its populations can be used as an indicator of the ecological effects caused by disturbed hydropatterns in the Everglades (***FIGURE C-15***). Apple snail (*Pomacea paludosa*) reproduction and the snail kite foraging habitat vegetation structure were used to evaluate benefits of increased wetland function and improved hydropatterns in WCA 3. The Everglade snail kite primarily feeds on apple snails. The snail kite's survival depends directly on the availability of apple snails, therefore if the land was determined to be unsuitable for apple snail, the land was determined to be not suitable for snail kite, regardless of the foraging structure (Valentine-Darby, et al., 1998). The apple snail reproduction metric uses SFWMM stage output to evaluate the number of years in which water levels fall below ground surface during peak apple snail egg cluster production. The

vegetation structure analysis measured the degree of snail kite foraging habitat supported by emergent wet prairie using hydrologic stage duration data from the SFWMM.

The schematic below represents the environmental state approach to population viability analysis (PVA) (***FIGURE C-17***). Demographic processes, represented by life cycle graph for the snail kite (B), take place within cycle fluctuating environmental states (A). Environmental states, shown by squares, are discrete sets of environmental conditions that affect demography. Transition probabilities among environmental states can be assigned for the projection interval (typically 1 year). The sequence and occurrence of three environmental states (D=drought, L=lag years following drought, H= high water years preceded by continuous flooding) is determined by transition probabilities related to the number of years between drought (i) or the probability of the occurrence of drought in any given year (l/i). (B) Life cycle diagram for the snail kite based on three stage classes (1=fledgling or age 0-1; 2-subadult or age 1-2; and 3=adult or >2 year of age). Demographic rates (P=annual survival and F=fecundity) are estimated for each stage class and each environmental state (Beissinger, 1995). See Attachment C – RECOVER Snail Kite Information, for further details about the Everglade snail kite significance, ecosystem indicator regions, foraging habitat, suitability indices, modeling and other information.



Source: Beissinger, S.R. 1995. Modeling Extinction in Periodic Environments: Everglades Water Levels and Snail Kite Population Viability. Eco Apps: 5(3):618-631

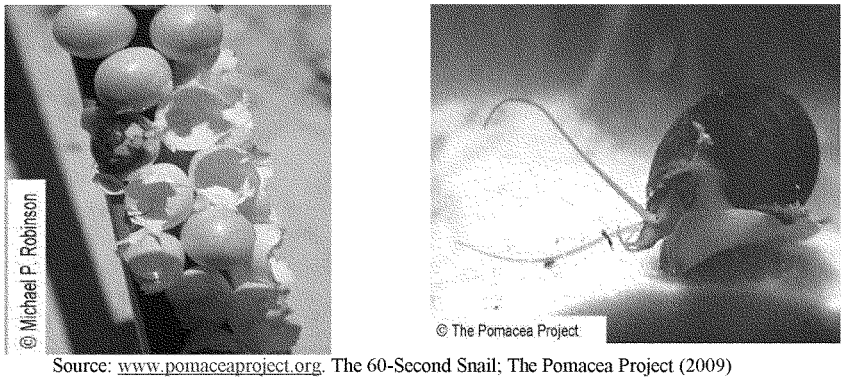
FIGURE C-17: SNAIL KITE LIFE CYCLE DIAGRAMS

The apple snail is the largest native freshwater snail in the U.S. (1 3/4" diameter). It occurs from south Georgia to the Florida Everglades. It is found in vegetated aquatic habitats of wetlands, lake littoral zones, and spring-fed rivers. Adult-sized snails are primary food of the federally-endangered snail kite and the limpkin.

The apple snail lifespan is 1-1.5 years. Large apple snail eggs produce shell bearing hatchlings after 20-25 days. Rapid growth enable snails hatched in March and

April to survive dry downs occurring in May (Darby et al., 1997). Adults die-off in summer after peak reproduction in April-June. Females lay clusters of 20-30 eggs on plant stems above the water and they hatch out as miniature adults (~1/8" diam.). The apple snail has evolved to deal with predation pressure, low DO and the annual dry season (McClary, 1964; Andrews, 1965; Aldridge, 1983). They tolerate marsh dry down conditions contingent on age/size and reproductive maturity (Darby et al., 1997).

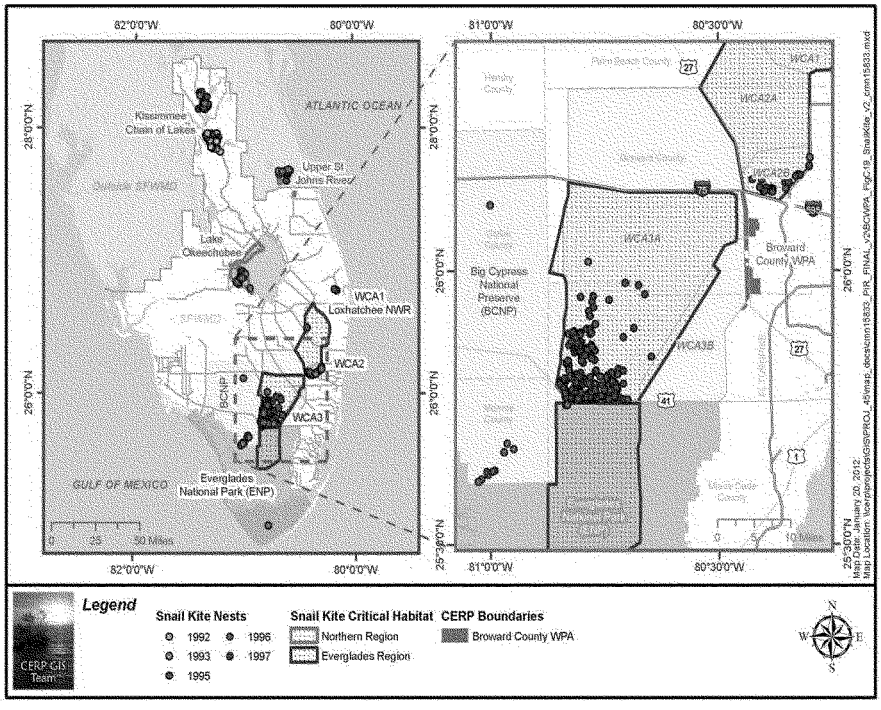
Hatchlings and juveniles (~ 3/4") are eaten by crayfish, turtles, fish and alligators. Snails eat periphyton and submerged plants (***FIGURE C-18***). Although aquatic, they must periodically surface to breathe air. The critical issue for sustaining apple snail populations is not whether drydowns occur but when and for how long (Darby et al., 1997). Distribution of snail kites and their critical habitat in the Everglades is displayed below graphically (Figure C-19).



Source: www.pomaceaproject.org. The 60-Second Snail; The Pomacea Project (2009)

FIGURE C-18: JUVENILE AND MATURE APPLE SNAILS

The map below on the left displays the Central and southern Florida, including primary wetlands used by nesting snail kites from 1992 through 1997. The map below in the right displays the distribution of snail kite nests in the southern Everglades from 1992 through 1997



GRAPHIC PROJECT FEATURE DELINEATIONS ARE REPRESENTATIONAL.

FIGURE C-19: CRITICAL SNAIL KITE HABITAT

C.6.2 Model Description and Depiction

The Everglade Snail Kite Habitat Quality performance measure is based on John Ogden's Everkite model developed for CERP. RECOVER information in Attachment C – RECOVER Snail Kite Information also supports the write-up. The Everkite model compared water levels in the Everglades with Apple Snail reproduction and inferred affects to the snail kite foraging and sustainability in the Everglades. The Everglade Snail Kite Habitat Quality model applies these tenants and expands on them. Loss of wetland spatial extent and altered hydropatterns has been identified in the CERP Total Systems Conceptual Ecological Model as important stressors on the Everglades ecosystem. The Everglade snail kite is an endangered raptor whose distribution in the United States is restricted to the south Florida Ecosystem, including watersheds of the Everglades, Lake Okeechobee, Caloosahatchee River, Kissimmee River, and Upper St. Johns River. Because snail

kites feed almost exclusively on one species of aquatic snail (the apple snail, *Pomacea paludosa*), their survival depends directly on the hydrologic functioning of these watersheds (Bennetts et al., 1998). Apple snails are more common in wet prairies that include emergent vegetation such as beakrush (*Rhynchospora* spp.) and spikerushes (*Eleocharis* spp.) than in adjacent sloughs with sparse, floating and submerged vegetation such as bladderworts (*Utricularia* spp.) and waterlilies (*Nymphaea* spp.) (Darby, 2003). Emergent vegetation allows the snails to easily access the water surface for respiration, where they are visible and accessible to foraging snail kites.

C.6.3 Contribution to Planning Effort

The Central & Southern Florida (C&SF) Project operations have disrupted natural hydrologic patterns, which have resulted in reduced hydroperiods in some areas, and increased hydroperiods in others (Weaver and Brown, 1993). The BCWPA Project is expected to help reverse these trends and support increasing areas of snail kite foraging habitat by improving groundwater elevations (hydroperiod and hydropattern) and providing seepage control for and the wetlands to the east of the WCA (the WCA 3A/3B SMA).

The apple snail reproduction and the snail kite foraging habitat were evaluated with various SFWMM model simulations by indicator region (IR) within WCA 3. Indicator regions are areas of fairly homogeneous vegetation and topography over which hydrologic parameters are characterized by means of performance measures.

C.6.4 Methodology

C.6.4.1 Apple Snail Reproduction PM

The apple snail PM was used to address the Endangered Species Act requirements to evaluate effects of CERP on listed species. Sub-indices were screened out. The apple snail PM was developed by an expert panel comprised of U.S. Fish & Wildlife Service (USFWS), Florida Fish and Conservation Commission (FWC), SFWMD, FDEP, and USACE to address water level targets for listed species sustainability.

Apple snails require water levels above ground surface in order to produce egg clusters, and newly hatched snails are less able to survive dry periods that are adult-sized snails. It has been documented by Darby (1997 and 2003) that a peak in apple snail egg cluster production occurs March through April and dry-outs below ground level prior to or during this peak can substantially reduce apple snail populations through reduced eggs cluster production and reduced hatching survival. The *Apple Snail Reproduction PM* uses SFWMM output to evaluate the number of years in which water levels fall below ground surface prior to May 1. To determine a dry-out, the simulation predicts the water level on April 30 (end or low point of the dry season) for each of the 36 year period of record, averaging the water level of

the entire indicator region (each IR is made up of several 2 mile by 2 mile grid cells from the model) and comparing them to ground elevations. The target for the PM is 1 or fewer dry-outs per 3-year period, or 10 or fewer dry-outs per 31-year period of record. The 1 in 3-year target is based on the estimated length of time for the apple snail population to recover following a pre-May dry out event.

C.6.4.2 Snail Kite Foraging Habitat Vegetation Structure PM

The habitat vegetation structure performance measure was applied to measure flood conditions necessary for vegetation essential for snail kite foraging.

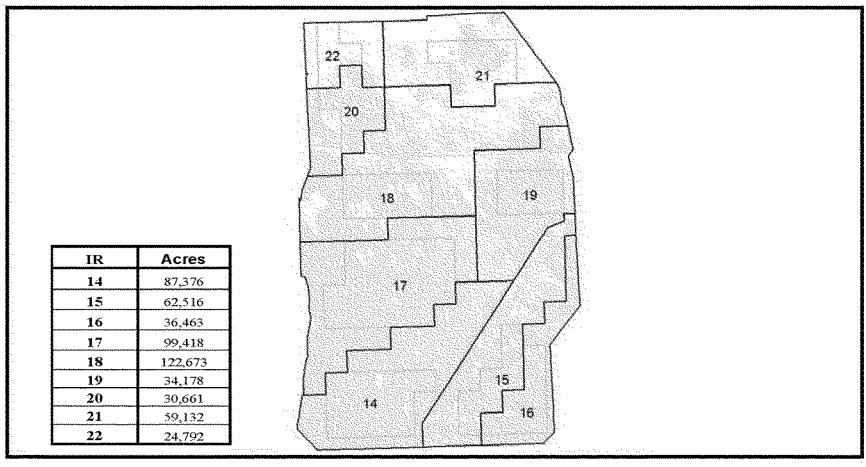
Based on Bennetts et al. (1998), optimal snail kite foraging habitat supported by emergent wet prairie vegetation is maintained in areas where water levels fall below ground surface between 1 in 3 and 1 in 5 years (157-260 week average flood duration). Marginal habitat is maintained in slightly drier and slightly wetter areas with 1 in 2 to 1 in 3 year dry-downs (104-156 weeks average flood duration) and 1 in 5 to 1 in 6 dry-downs (261-312 weeks average flood duration). Based on these hydroperiod classes, the target for this performance measure is 157 to 260 weeks of inundation duration. Inundation duration of 104 to 156 or 261 to 312 weeks is considered to be marginal for supporting snail kite foraging habitat vegetation structure. See Attachment C – RECOVER Snail Kite Information, for further details.

C.6.5 Indicator Regions

Indicator regions are represented by groups of cells within the South Florida Water Management Model (SFWMM) grids (see ***FIGURE C-9***). Where possible vegetation is consistent over the indicator region. It is preferable to characterize performance measures over indicator regions rather than for single cells because this decreases the uncertainty in the model simulation results. The Indicator Region (IR) areas were delineated using the topography map from the South Florida Water Management Model v3.5, vegetation maps, and to a lesser extent, canals and levees (***FIGURE C-20***). The green areas represent fresh marsh/wet prairie habitats (typical snail kite habitat) as determined from Fish and Wildlife Conservation Commission land use data (see below).

Acreages for each expanded IRs were determined by utilizing GIS and the performance measure results for the corresponding IRs were multiplied by the spatial extent of the expanded IR to derive habitat quality units. The habitat quality units were then summed for each alternative to derive the total number of habitat units provided by each alternative. If each IR scored a 1.0, the total potential habitat units would equal the total acreage for that IR, and the total potential habitat units for the alternative would equal the sum of the acreages of the expanded IRs.

As previously mentioned, for BCWPA two performance measures were independently measured for a portion of the same geographic area. Cattail Expansion Rate Reduction (volume) and Snail Kite Habitat (inundation and dry outs) ecological suitability indices both occur in WCA 3. To avoid double counting benefits, the lands that were inundated with cattail were removed from the acreage of snail kite foraging area. Expanded indicator region 19 was reduced by 24,294 acres (the extent of the FWO cattail inundated land from PM 1) from 58,633 to 34,178 (***FIGURE C-20***).



IR	Acres
14	87,376
15	62,516
16	36,463
17	99,418
18	122,673
19	34,178
20	30,661
21	59,132
22	24,792

Source: BCWPA 2007 PIR, pg:C-22, Figure C-2 (www.evergladesplan.org)

FIGURE C-20: EXPANDED INDICATOR REGIONS MAP FOR THE BCWPA PROJECT

C.6.6 EVALUATION

C.6.6.1 Apple Snail

For the evaluation, the apple snail PM was used as a screening factor since the snail kite's survival depends directly on the availability of apple snails. The data from the apple snail PM was normalized and was converted into suitability indices scores. In order for an IR to pass the apple snail screening test, it had to have averaged 14 or fewer dry-outs over the 31-year period of record. These conversions are presented below (***TABLE C-16***).

TABLE C-16: SUITABILITY INDEX SCORES APPLIED TO THE APPLE SNAIL REPRODUCTION PM

Dry Outs	Condition	SI Score
≤10	Sustainable	1.0
11-12	Marginally sustainable	0.66
13-14	Not sustainable	0.33
>14	Unsuitable	0

Source: BCWPA 2007 PIR, pg: C-19, Table C-12 (www.evergladesplan.org)

TABLE C-17 displays the *Apple Snail Reproduction* Performance Measure. This performance measure evaluates the BCWPA Project for various SFWMM model simulations by indicator regions (IR) within WCA 3. There are 2 scores shown in the table. The table lists each IR and number of years in which the water levels are below ground levels on April 30. The target of this performance measure is to reduce the number of dry-outs to the number in the Natural System Model. The top score is the suitability indices and based on the number of dry-outs. The number of dry-outs the model predicts for each alternative for each IR is the bottom number, in parentheses.

TABLE C-17: SUB-INDEX SCORES FOR THE APPLE SNAIL REPRODUCTION PM UNDER VARIOUS ALTERNATIVES EVALUATED FOR THE BCWPA PROJECT

IR	1995	2050 WOP	A1 (D13R)	A4 (WPA SP)
14	1.0 (0)	1.0 (10)	1.0 (9)	1.0 (9)
15	1.0 (6)	0.66 (12)	1.0 (2)	1.0 (2)
16	0.66 (12)	0 (15)	1.0 (3)	1.0 (3)
17	1.0 (9)	0 (17)	1.0 (10)	1.0 (10)
18	0.66 (12)	0 (15)	1.0 (6)	1.0 (5)
19	1.0 (1)	0.66 (11)	0.66 (11)	0.66 (11)
20	0 (21)	0 (18)	0 (16)	0 (16)
21	0 (23)	0.33 (13)	0 (19)	0 (19)
22	0 (25)	0 (18)	0.66 (12)	0.66 (12)

Source: BCWPA 2007 PIR, pg: C-20, Table C-13 (www.evergladesplan.org)
Note: The number of dry-outs predicted by the SFWMM for the indicator regions in WCA 3 is shown in parentheses.

C.6.6.2 Snail Kite Foraging Vegetation Structure

If an IR passed the apple snail test (i.e., did not score a 0), then the snail kite foraging vegetation performance measure was applied and the IRs were scored using the scoring categories in ***TABLE C-18*** below. If the number of weeks of inundation is between 156 to 260 weeks, then the suitability score would be 1, indicating the highest sub-index score for population sustainability. If inundation predictions from the model are less than or greater than that range of time, than that alternative receives a lesser score. Indicator regions that were screened out with the apple snail PM were assigned a score of 0 regardless of number of weeks of inundation duration predicted by the SFWMM. See Attachment C – RECOVER Snail Kite Information, for further details.

TABLE C-18: SUB-INDEX SCORES APPLIED TO THE SNAIL KITE FORAGING VEGETATION STRUCTURE PM

Weeks/Event	Condition	SI Score
157-260	Sustainable	1.0
104-156 or 261-312	Marginally sustainable	0.66
<104 or >312	Not sustainable	0.33

Source: BCWPA 2007 PIR, pg: C-20, Table C-14 (www.evergladesplan.org)

TABLE C-19 displays the *Snail Kite Foraging Vegetation Structure.* This PM counts the number of consecutive weeks where the predicted water level was above the average indicator region (IR) ground level. That number of weeks of inundation is in parentheses. The top number is the suitability indices that pertains to the number of weeks based on ***TABLE C-18***, above. Below are the number of indicator region and alternative dryouts for the snail kite foraging vegetation performance measure used to develop benefits for appropriate water inundations that positively affect the snail kite foraging and subsequent reproduction (***TABLE C-19***). Alternative A4 is the selected plan.

TABLE C-19: SUB-INDEX SCORES AND NUMBER OF DRYOUTS FOR THE SNAIL KITE FORAGING VEGETATION STRUCTURE PM

IR	1995	2050 WOP	A1 (D13R)	A4
14	0.66 (267)	0.33 (101)	0.66 (139)	0.66 (127)
15	0.66 (141)	0.33 (79)	0.33 (398)	1.0 (198)
16	0.33 (81)	0 (50)	0.66 (263)	1.0 (197)
17	0.66 (109)	0 (59)	0.66 (110)	0.66 (118)
18	0.33 (82)	0 (69)	0.66 (130)	0.66 (156)
19	1.0 (227)	0.33 (100)	0.66 (115)	0.33 (99)
20	0 (40)	0 (51)	0 (62)	0 (59)
21	0 (30)	0.33 73	0 (45)	0 (45)
22	0 (36)	0 (77)	0.33 (85)	0.33 (72)

Source: BCWPA 2007 PIR, pg: C-21, Table C-15 (www.evergladesplan.org)

C.6.6.3 Combined Performance Measure Score

To derive a final quality score for each project condition per IR, the mean of the sub-index scores for the apple snail reproduction and snail kite foraging vegetation structure (***TABLE C-17*** and ***TABLE C-19***) was calculated. The combined scores are shown below (***TABLE C-20*** and ***FIGURE C-21***). The effects of the project on each indicator region are spatially displayed (***FIGURE C-22***). Note that IR 19 was reduced in size to take account for PM 1 but this is not reflected in the map in ***FIGURE C-22***.

TABLE C-20: COMBINED QUALITY SCORES FOR THE APPLE SNAIL REPRODUCTION PERFORMANCE MEASURE AND THE SNAIL KITE FORAGING VEGETATION STRUCTURE PM

Indicator Regional Suitability Indices Average				
IR	**1995**	**2050 WOP**	**A1 (D13R)**	**A4**
14	0.83	0.67	0.83	0.83
15	0.83	0.50	0.67	1.00
16	0.50	0.00	0.83	1.00
17	0.83	0.00	0.83	0.83
18	0.50	0.00	0.83	0.83
19	1.00	0.50	0.66	0.50
20	0.00	0.00	0.00	0.00
21	0.00	0.33	0.00	0.00
22	0.00	0.00	0.50	0.50

Source: Environmental Benefits Spreadsheet
See Attachment C – RECOVER Snail Kite Information, for further details.

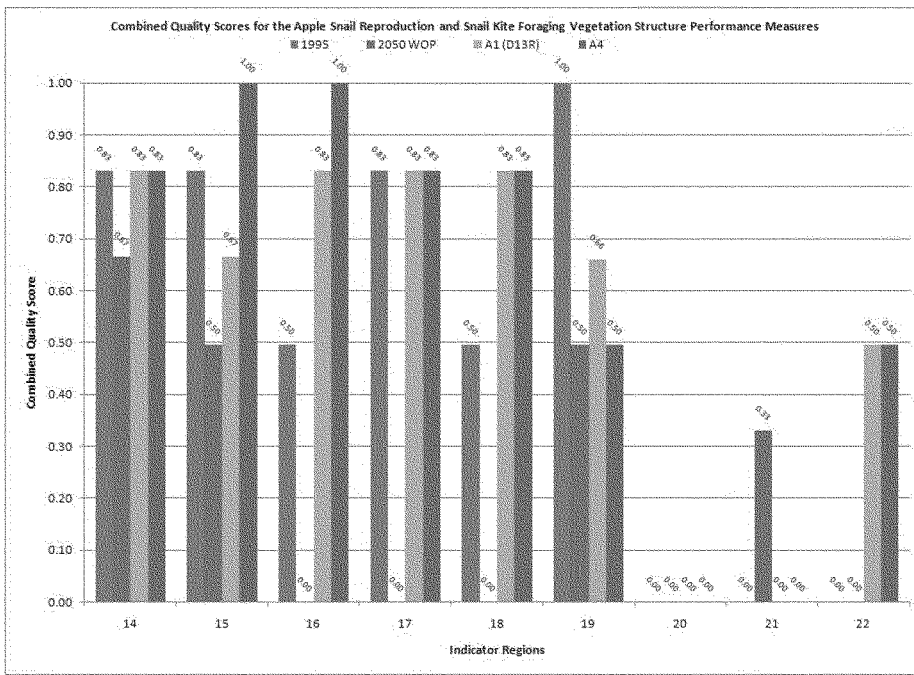


FIGURE C-21: COMBINED QUALITY SCORES FOR SNAIL KITE PERFORMANCE MEASURE

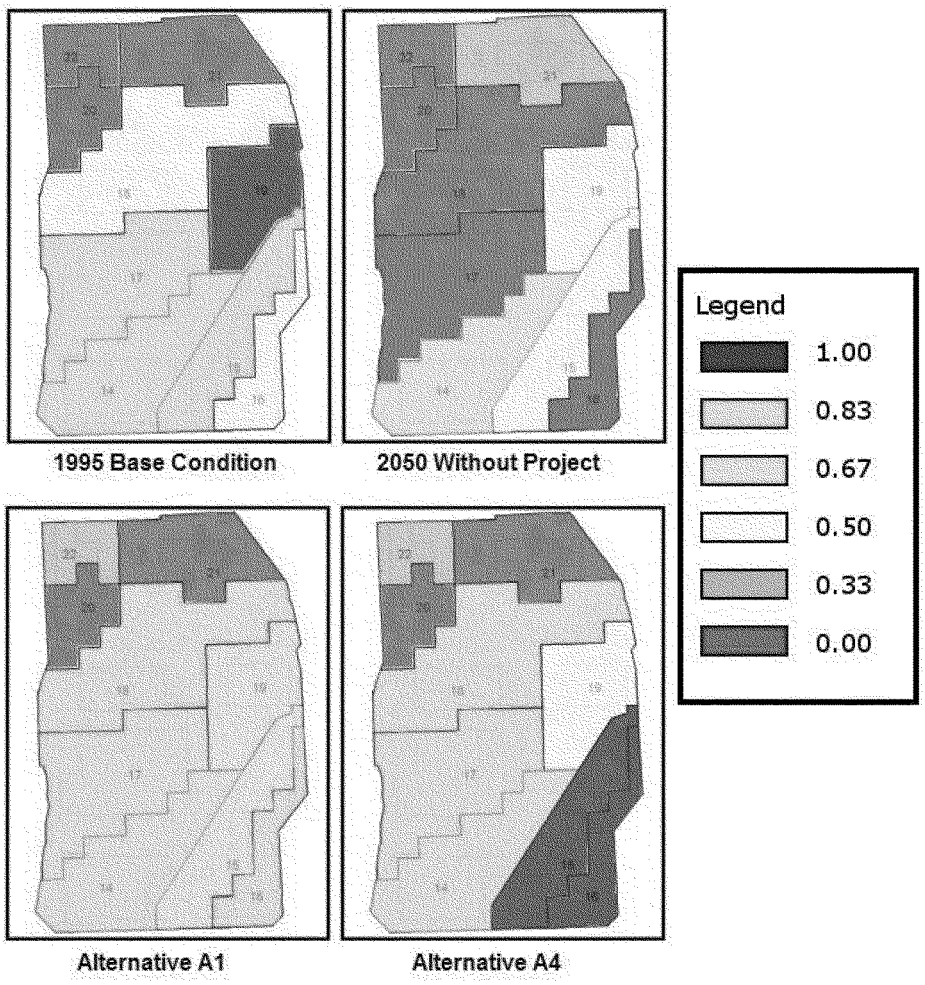


FIGURE C-22: COMPARISON BETWEEN PROJECT CONDITIONS OF HABITAT QUALITY ACROSS INDICATOR REGIONS

C.6.7 Habitat Units

The total number of habitat units for WCA 3 was calculated for each scenario using the following equation.

Equation 13: Total Habitat units for Performance Measure 2: Snail Kite

$$WCA_{tot} = \sum_{i}^{n} Hab_i$$

*Where WCA_{tot} represents the total number of habitat units (Hab) from each indicator region i. Results were compared across scenarios to determine restoration success of each scenario (**TABLE C-21**).*

TABLE C-21: SNAIL KITE HABITAT QUALITY UNITS (HUS) CALCULATED FOR THE BCWPA

Indicator Regional Habitat Units				
IR	**1995**	**2050 WOP**	**A1 (D13R)**	**A4**
14	72,522	58,105	72,522	72,522
15	51,888	30,945	41,573	62,516
16	18,049	-	30,264	36,463
17	82,517	-	82,517	82,517
18	60,723	-	101,819	101,819
19	34,178	16,918	22,557	16,918
20	-	-	-	-
21	-	19,514	-	-
22	-	-	12,272	12,272
Total	**319,878**	**125,482**	**363,525**	**385,027**

Source: BCWPA 2007 PIR, pg: C-23, Table C-17 (www.evergladesplan.org)

As previously discussed, the F-series alternatives were not modeled. The A-Series and F-Series alternative plans both include the WCA 3A/3B SMA, which is responsible for most of the benefits for the snail kite indicator measure. The WCA 3A/3B SMA retains more water in the WCA and improves the timing and duration of the available water, which provides a greater percentage of inundation, thereby improving habitat. The A-Series alternatives include both the C-11 Impoundment and the C-9 Impoundment and the WCA 3A/3B SMA. The F-Series alternatives contain the C-11 Impoundment and the WCA 3A/3B SMA but not the C-9 Impoundment. The A-Series reservoirs capture more storm water storage than the F-Series.

Without the C-9 Impoundment less volume of stormwater would be diverted away from the Everglades via the S-9 Pump Station (S-9). In addition, the difference in the configuration of the C-11 Impoundment between the 1-Series alternatives and the 4-Series alternatives has been shown by modeling efforts to offer slightly

greater hydrologic flows for the 4-Series alternatives, A4 and F4, which results in slightly greater benefits for the 4-Series alternatives compared to the 1-Series. Following the assertion that the WCA 3A/3B SMA is predominantly responsible for retaining water in the natural system and therefore reducing dry-outs, it was assumed that the total habitat unit outputs would be approximately equivalent across each of the 1-Series plans and each of the 4-Series plans, i.e. Alternative A1 = Alternative F1, and Alternative A4 = Alternative F4.

C.6.7.1 Average Annual Habitat Units

Habitat units were then computed on an average annual basis using Equation 1, and the assumption of linear growth or decline in quality over the period of analysis (*TABLE C-22*).

TABLE C-22: PERFORMANCE MEASURE 2. SNAIL KITE ANNUAL AVERAGE HABITAT UNIT LIFT

PM 2. Snail Kite Habitat	ALT A1	ALT A4	ALT F1	ALT F4
AVERAGE ANNUAL HABITAT UNIT LIFT	119,021	129,772	119,021	129,772

C.6.8 Ridge and Slough

Model Name: Ridge and Slough Habitat Model.

Functional Area: Comparison of Environmental Benefit Outputs / Analysis for Ecosystem Restoration.

Performance Measure Model: South Florida Water Management District (SFWMD), U.S. Army Corps of Engineers (USACE), US Fish & Wildlife Service (USFWS), Florida Department of Environmental Protection (FDEP).

Model Input: USACE Certified and External PEER Reviewed SFWMM (2x2) version 3.5.and version 3.7; Natural System Model Version 4.62.

Performance Measure Model Developers: Broward County Water Preserve Areas, Environmental Benefits Model Subteam.

C.6.8.1 Performance Measure Background

The Ridge and Slough model (R&S) is based on the theory that periods of inundation and dryouts in the ridge and slough ecosystem directly relate to habitat

suitability. These periods were adjusted to minimum and maximum values through the use of indices, which are specific to each indicator region.

When greater frequencies of dryouts occur, water is not available to maintain marsh and ground-water to their historic levels (Ogden, 2005). This can eventually affect fish, reptiles, amphibians, plants, invertebrates, and periphyton communities that depend on the availability of water for a certain amount of the year (McCormick et al., 2009).

C.6.8.2 Model Description and Depiction

The Ridge and Slough (R&S) Habitat Model is a spreadsheet-based model, which uses periods of inundation to estimate the expected change in R&S habitat quality of the Greater Everglades domain resulting from the project. This model is representing the level of habitat suitability provided by increasing the frequency of inundation, and the corresponding acreage affected in Everglades National Park (ENP). R&S benefit calculations are based on the assumption that the WCA 3A/3B SMA feature of the BCWPA Project will retain a greater quantity of water within WCA 3, which will subsequently provide benefits to the hydrologically connected Greater Everglades domain, specifically Shark River Slough (SRS) and ENP. The area of influence is depicted below labeled "Shark River Slough", bounded by the ENP boundary (dashed red line) on the north, and the solid white line on the south, east, and west (***FIGURE C-23***).

Since inundation periods and dry-outs are directly related to habitat suitability, these data points were adjusted to minimum and maximum (target) levels through the use of indices, which are specific to each indicator region used within the CERP Band 1 project study areas to model benefits for the Everglades vegetation along elevation gradients (RECOVER, 2006). See Attachment C - RECOVER Snail Kite Information, for further details.

C.6.8.3 Contribution to Planning Effort

This model was used in determining the ridge and slough ecosystem benefits resulting from the project, and therefore played a role in alternative plan selection. Additionally, BCWPA is an essential part of the hydrologic benefits associated with Band 1. BCWPA begins to help decrease drying durations in more than 190,000 acres of SRS and ENP, which helps maintain ridge and slough structure and function, and decreased P loading. The seepage buffer helps to keep water within the conservation areas ultimately contributing to an additional 140,000 acre-ft average annual increase in flows to SRS.

C.6.8.4 Description of Input Data

The R&S benefits are located exclusively outside the immediate project area, downstream in the SRS and ENP areas (***FIGURE C-23***). CERP system-wide measures rely primarily on evaluation at the Indicator Region (IR) level. An IR is a contiguous assembly of 2 mile by 2 mile grid cells, used in the South Florida Water Management Model (SFWMM) and Natural System Model (NSM) (see Section 1.2.1.2 for further discussion). Each IR was defined in order to examine the hydrological behavior of relatively small vegetatively and topographically homogeneous areas.

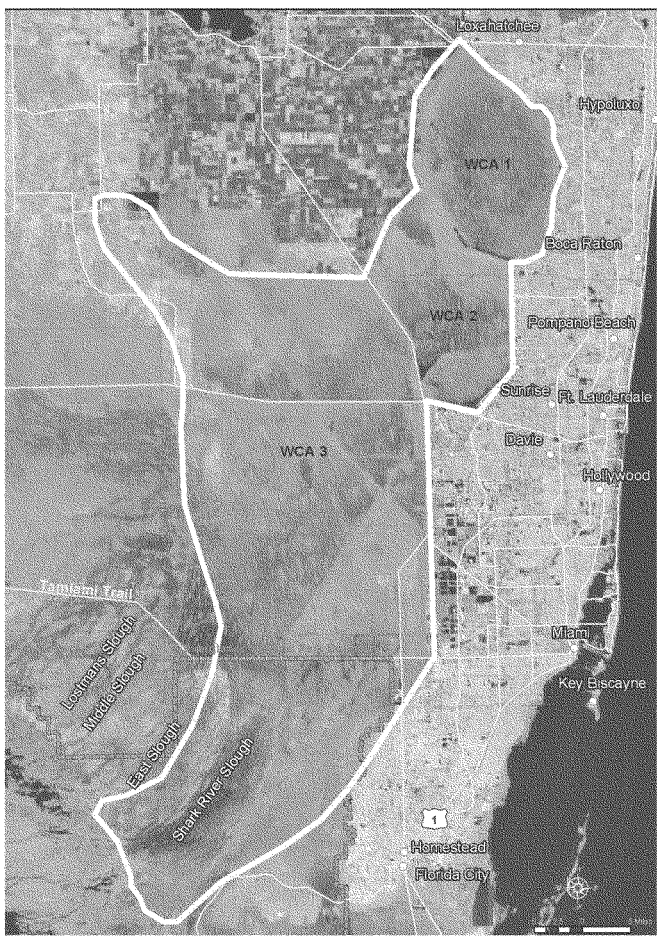


FIGURE C-23: THE BOUNDARY OF THE RIDGE AND SLOUGH PERFORMANCE MEASURE

Each IR is individually numbered for identification. The specific indicator regions that lie within SRS are: *129, 130, 131,* and *132.* Since indicator regions are meant to be smaller more-representative portions of a larger spatial area, the USFWS developed expanded indicator regions to better estimate the extent of areas that can be affected by a project's actions. These expanded IRs were drawn using canal boundaries, a topography map, the NSM landscape type map, and best professional judgment of CERP scientists, planners and GIS cartographers (***FIGURE C-24***).

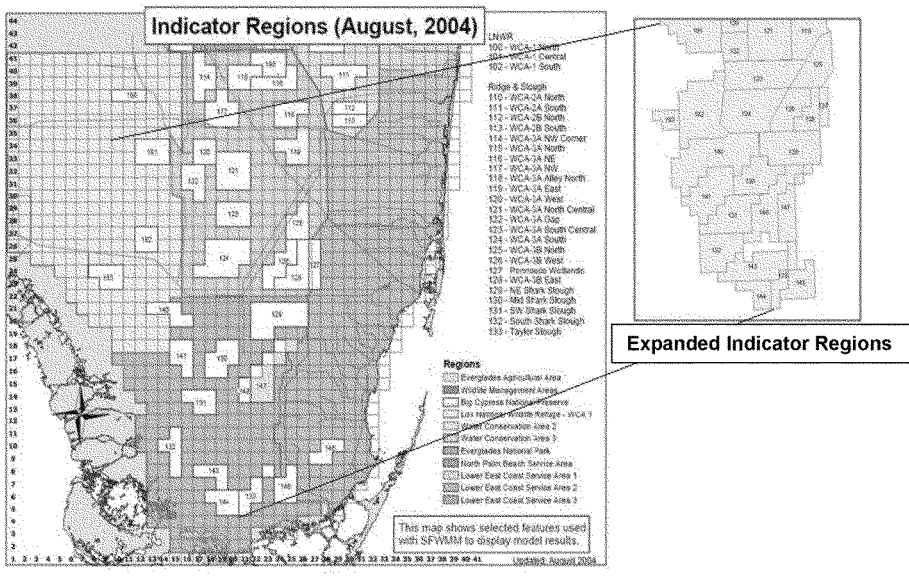


FIGURE C-24: GREATER EVERGLADES INDICATOR REGIONS AND EXPANDED INDICATOR REGIONS TO BE USED WITH CERP SYSTEM-WIDE PERFORMANCE MEASURES

The expanded IR acreages within the SRS part of ENP were used as inputs to the model in order to better capture the full extent of the project impact. The comparisons in IR acreages and expanded IR acreages are shown in ***TABLE C-23.***

TABLE C-23: PM 3 INDICATOR REGION TOTAL ACREAGE

Indicator Region	IR Acreage	Expanded IR Acreage
129	30,720	60,264
130	17,920	40,709
131	12,800	48,642
132	12,800	43,398
Total	74,240	193,013

The simulation of the effects of BCWPA on periods of inundation and dry-outs on Ridge and Slough habitat can be expressed as a suitability index-based linear equation. The Subteam brainstormed and set suitability indices by first setting maximum and minimum possible levels of suitability within the ecosystem. The maximum level of suitability was assigned an index of 0.99 because it is assumed to be near-perfect. The minimum level of suitability was assigned an index of 0.25 because it still offers some level of habitat, although it is highly degraded. For each expanded indicator region, both the most desirable and least desirable situations were assigned the maximum and minimum suitability indices, respectively. The least suitable index of 0.25 was chosen rather than 0 or 0.01 because of the relatively narrow bandwidth of changes in the percent inundation from the base condition to the future with - and without-project scenarios. This smaller change in the input variable indicated that the ridge and slough ecosystem would still retain a fair amount of its ecological productivity in the future without project scenario. Since the changes were so small, and the size of the area being affected was so large, the environmental benefits sub-team felt concluded that it was unreasonable to use 0 or 0.01 as the lower bound for the performance measure, and that benefits would have been grossly overstated if such a low value was used. However, if the drivers affecting ridge and slough are not restored beyond the planning horizon, ongoing degradation is expected. At that point it is likely that the future without-project condition SI would approach 0.01.

Target percentages of inundation over a 36-year period were based on the Natural Systems Model, Version 4.62. This target pre-drainage level of inundation was used as the most desirable situation, and assigned a suitability index of 0.99. The Future Without-project (FWO) condition percentage of inundation was obtained from the SFWMM, and it was used as the least desirable situation, with a minimum level of suitability, and assigned an index of 0.25 (Table C-24).

TABLE C-24: OVERALL HABITAT SUITABILITY INDICES FOR RIDGE AND SLOUGH PERFORMANCE MEASURE

Overall Suitability Indices	
Target	FWO
0.99	0.25

The 1995 Base-line percentage of inundation that was used as an input for calculating the future suitability index of each IR was also derived from the SFWMM. The inundation duration for Alternative Plan A4 was modeled as part of the Band 1 System Run of the SFWMM (USACE and SFWMD, 2005). Each indicator region's inundation duration percentage that was used as primary model inputs (***TABLE C-25***).

TABLE C-25: INUNDATION DURATION PERCENTAGE BY INDICATOR REGION FOR EACH CONDITION

SRS-ENP % Inundation Duration				
IR	**NSM (Target)**	**FWO**	**95 Base**	**Alt A4**
129	99	86	88	89
130	95	87	89	90
131	93	85	87	89
132	93	83	85	88

C.6.8.5 Description of Output Data

To calculate the 1995 Base Condition and Alternative Plan A4 habitat suitability indices from the given Target and FWO suitability indices, linear equations were used. These suitability indices were calculated separately for each IR based on a linear equation derived from the overall maximum and minimum suitability indices, which were attributed to the target and FWO inundation percentages, respectively. The minimum and maximum percentages of inundation were paired as the X-coordinates with their corresponding minimum and maximum habitat suitability indices as the Y-coordinates. Slopes and intercepts were then calculated to yield the following suitability index equations:

Equation 14: Habitat Suitability Index for Performance Measure 3: Ridge and Slough Habitat

$$HSI_{IR_i} = (m * ID_{IR_i}) + b$$

Where $m = \frac{(HSI_{target} - HSI_{fwo})}{(ID_{target_i} - ID_{FWO_i})}$

And b = $(ID_{target_i} - (m * HSI_{target_i})$

Where HSI_{IR_i} is the habitat suitability index for each indicator region i; ID_{IR_i} is the inundation duration for each condition i; HSI_{target} is the target suitability index; HSI_{fwo} is the future without project suitability index; ID_{target_i} is the target inundation duration for indicator region i; and ID_{FWO_i} is the future without project inundation duration for indicator region i.

HSI_{IR129}, HSI_{IR130}, HSI_{IR131}, and HSI_{IR132} are the resulting Suitability Indices for each indicator region. ID_{IR_i} is the Inundation Duration for each Condition *i* with an unknown suitability index. A graph of each IR's suitability index equation is shown in below (***FIGURE C-25***).

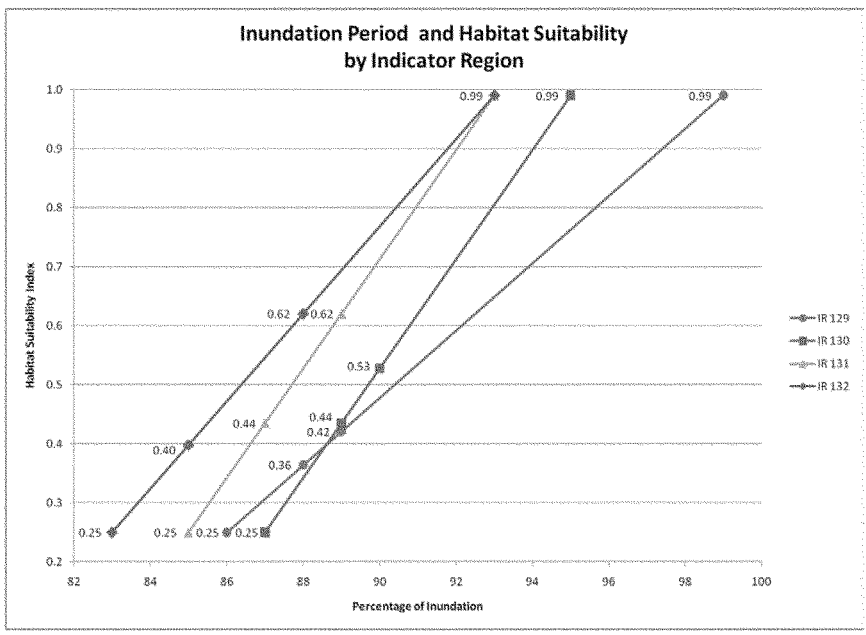


FIGURE C-25: HABITAT SUITABILITY INDICES BY INDICATOR REGION

It is warranted to use the individual IRs as opposed to using SI scores along with related model output (rather than lumping the large heterogeneous landscape into one domain). North East Shark River Slough (NE SRS) or IR 129 has been impacted the most, leading to peat loss etc., lack of inflows compared to areas downstream which receive greater volumes of water from rainfall – longer flow path and drainage than NE SRS 129). Each IR is approximately 2 miles from the next 129 to 130, 130 to 131, 131 to 132. The sites require four different indices because they are distinguished by many unique characteristics geomorphologically, ecologically, and hydrologically. Although, generally ridge and slough habitat these areas have varying topography and related hydrology. Additionally the underlying bedrock, the interaction with urban area and the interaction with the marine end member all differ from Northeast to Southwest. Increasing effects of the eastern buffer (seepage, nutrients, etc.) are found in the Northeast IRs, while increasing marine-end effects are prevalent to the southwest. It should be noted that marine effects are usually due to stochastic processes (hurricanes, etc.) but have been shown to distribute P into the bottom of the system through sediment deposition, etc. As the targets indicate, although close in space, these areas have slightly different hydrologic targets. NE SRS (IR129) is located in the area where flows changed direction and waters tended to become deeper in this area. Currently, seepage and lack of inflows impact this area the most. It should also be noted that due to varying topography and flows, these areas experience different hydroperiods.

Total habitat units were then calculated using the following equation to multiply the Suitability Index for each condition for each IR by the expanded IR acreage (***TABLE C-26***).

Equation 15: Habitat Units for Performance Measure 3: Ridge and Slough Habitat

$$HU_{Cond_x IR_i} = Acres_{IR_i} * HSI_{Cond_x IR_i}$$

Where $HU_{Cond_x IR_i}$ is the total habit units in indicator region i for condition x; $Acres_{IR_i}$ is the total acreage of each indicator region i; and $HSI_{Cond_x IR_i}$ is the habitat suitability index for each condition x in each indicator region i.

TABLE C-26: RIDGE AND SLOUGH HABITAT UNITS

Indicator Region	IR Total Acreage	95B Index	FWO Index	Alt A4 Index	95B HU	FWO HU	Alt A4 HU
129	60264	0.36	0.25	0.42	21,927	15,066	25,357
130	40709	0.44	0.25	0.53	17,708	10,177	21,474
131	48642	0.44	0.25	0.62	21,159	12,161	30,158
132	43398	0.40	0.25	0.62	17,272	10,850	26,907
Total	**193013**				**78067**	**48253**	**103896**

Ecological benefits in the SRS-ENP area are derived primarily from the additional water held within the Greater Everglades system due to the seepage management area (WCA 3A/3B SMA) feature of the BCWPA Project. The benefits at the system level are also the effects of water being delivered at the appropriate time, naturally, instead of being pumped in by the S-9 Pump Station during already wet periods. To a lesser extent, the ecological benefits to the SRS-ENP ecosystem can be attributed to the reduced levels of phosphorous loading of the water entering the SRS ecosystem through WCA 3 caused by the reduction in pumping at the S-9 pump station.

Only Alternative Plan A4 SFWMM outputs were available to simulate the ecological benefits of the project to SRS-ENP. However, a very close approximation of the same level of benefits can be found in the results of the Snail Kite Foraging Habitat Model, (***Section C.3.7***, ***TABLE C-21***). In the absence of directly comparable runs for each of the other alternative plans, the Subteam next best estimate was to simulate the modeling results calculated by using a proportioning method based on the model output of the 2x2 SFWMM for Snail Kite foraging habitat vegetation structure, which was also based on inundation duration, a similar model input to the Ridge and Slough Model. The total number of Ridge and Slough habitat units for Alternative Plan A1 was computed by finding the proportion of Alternative A1 total habitat units to Alternative A4 total habitat units from the Snail Kite Foraging Habitat Model (Equation 16). The results of this proportioning method are summarized in ***TABLE C-27***.

Equation 16: Ridge and Slough Proportioning Method to Derive Alternative A1 Habitat Units

$$HU_{R\&S(A1)} = HU_{R\&S(A4)} * \left(\frac{HU_{SK(A1)}}{HU_{SK(A4)}}\right)$$

Where $HU_{R\&S(i)}$ is the habitat units for the Ridge and Slough performance measure, $HU_{SK(i)}$ is the habitat units for Snail Kite performance measure, and i is the alternative plan.

TABLE C-27: RESULTS OF PROPORTIONING METHOD USED TO DERIVE ALTERNATIVE PLAN A1 TOTAL HABITAT UNITS

Alternative Plan	Snail Kite Habitat Units	Ridge and Slough Habitat Units
A4	385,027	103,896
A1	363,525	98,094*
Percent of A4 benefits captured by A1	94.42%	94.42%

*This value was calculated.

The A-Series and F-Series alternative plans both include the WCA 3A/3B SMA, which is responsible for most of the benefits to the R&S ecosystem. The A-Series alternative plans include both the C-11 Impoundment as well as the C-9 Impoundment, whereas the F-Series alternative plans contain only the C-11 Impoundment. In addition, the difference in the configuration of the C-11 Impoundment between the 1-Series alternatives and the 4-Series alternatives has been shown by modeling efforts to offer slightly greater flow reductions than the 4-Series alternatives, A4 and F4, which results in slightly greater benefits for the 4-Series alternative plans compared to the 1-Series. (See ***Section C.3.7***). Therefore, it was assumed that the total habitat unit outputs would be equal across each of the 1-Series plans and each of the 4-Series plans, i.e. Alternative A1 = Alternative F1, and Alternative A4 = Alternative F4.

Once total habitat units were calculated for each project condition and alternative plan, the average annual habitat unit (AAHU) lift was computed. The assumption of linear expansion was used to increase or decrease HU from the 1995 Base condition to both the FWO condition and each alternative plan condition. The number of habitat units present per year from 1995 to 2050 was averaged for each condition to calculate the average annual habitat units (Equation 1). The AAHU lift for R&S ecosystems was calculated by subtracting the FWO AAHU from each alternative plan's AAHU. The results of these average annual habitat unit lift calculations are summarized below (***TABLE C-28*** and ***FIGURE C-26***).

TABLE C-28: SUMMARY OF AVERAGE ANNUAL HABITAT UNIT LIFT FOR RIDGE AND SLOUGH ECOSYSTEM

	Alternative Plans			
	A1	**A4**	**F1**	**F4**
Future Without-Project Average Annual Habitat Units	63,160	63,160	63,160	63,160
Alternative Plan Average Annual Habitat Units	88,080	90,981	88,080	90,981
Average Annual Habitat Unit Lift over Future Without-project Condition	**24,920**	**27,821**	**24,920**	**27,821**

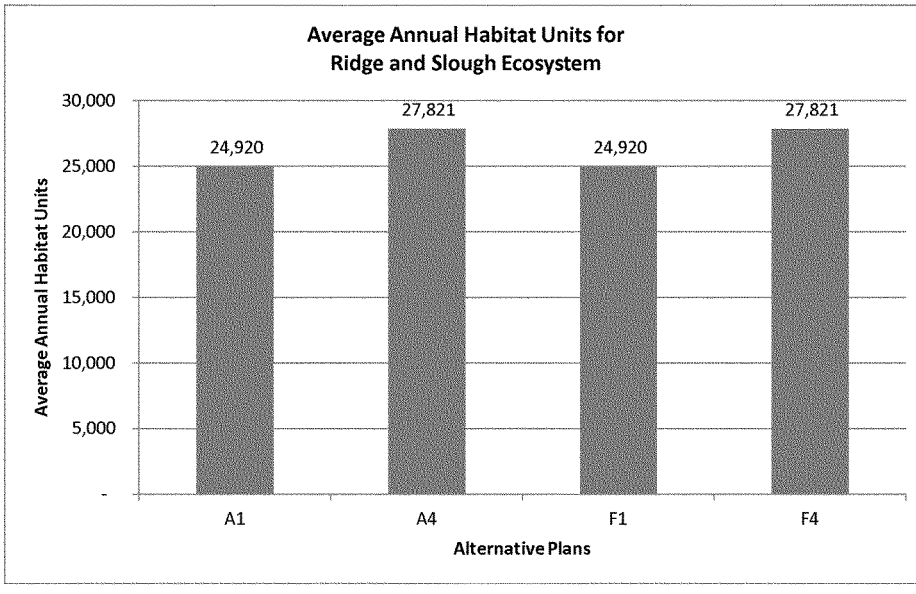


FIGURE C-26: AVERAGE ANNUAL HABITAT UNIT LIFT FOR RIDGE AND SLOUGH ECOSYSTEM

C.6.8.6 Statement on the capabilities and limitations of the model

The Ridge and Slough Model is only as capable at predicting environmental benefits as its assumptions and inputs are accurate. One major limitation of the model is the availability of input data. In the case of the SFWMM, which produced input

data for the Ridge and Slough Model, predictions of downstream hydrology have been well researched, documented and tested (CERP RECOVER Model Uncertainty Workshop Report, July 2002). Therefore, the assumptions upon which the environmental benefits are based are equally well-defined.

However, there will always be some uncertainty present in predicting environmental benefits associated with any CERP project because of the size and complexity of the Everglades ecosystem, as well as because of the difficulty present in fully understanding its physical and biological processes. Ideally, a probability distribution of errors in predictions based on model output should be employed (CERP System-wide Performance Measure Report, October 2007). Although, according to USACE planning guidance, only the most-likely future-without project and future with-project condition can be considered in the plan selection process (ER-1105-2-100, April 2000). In addition, the outputs of the SFWMM were the best data available, and they offered a high level of confidence in their accuracy to predict the most-likely hydrologic changes as a result of the project. The post-calculations to derive ecological benefits in Ridge and Slough habitat are assumed to be useful in making planning-level decisions, even though some uncertainty is recognized.

C.6.8.7 Technical Quality

The Ridge and Slough Model based its calculation of environmental benefits on inputs derived from the extensively peer-reviewed SFWMM. The detailed review of the SFWMM found that it is "an appropriate tool for planning"; "it performs satisfactorily and is quite robust" (Review of the SFWMM Adequacy as a Tool for Addressing Water Resource Issues, Final Panel Report, October 2005). The review also did not find any "missing processes or elements of the system."

The suitability indices were indexed to a target value, which was based on output from the Natural Systems Model (NSM), which simulates the hydrologic response of a pre-drained Everglades.

C.6.8.8 Assumptions

The assumptions made for this model are that the WCA 3A/3B SMA holds more water in the Water Conservation Area (WCA), which therefore provides a greater percentage of inundation downstream in the ridge and slough area, and ENP. Greater inundation duration therefore improves habitat quality. Secondly, the configuration of the C-11 Impoundment creates an additional hydrologic head which provides difference in environmental benefits between A1/F1 and A4/F4.

C.7 SUMMARY OF BROWARD COUNTY WPA PROJECT BENEFITS

Reduction in Cattail (expansion and expansion rate)- indicated that the existing condition would continue to put undesirable loads of phosphorus into WCA 3A and 3B thereby converting additional ridge and slough habitat into monotypic and nearly monotypic stands of cattail (see write up from email for reasons why this undesirable - loss of function directly related to CERP interim goals). The With Project condition is expected to provide both reduced P loading as well as some hydrologic benefit (particular when coupled with future CERP projects as seen when modeled with Band 1 projects). The combined hydrologic and reduced phosphorus benefit will directly reduce the expansion of cattail and reduce the increase in primed acreage (enriched soils). This provides benefit to wading birds, periphyton, and other R&S related species. Under Band 1 hydrologic benefit and corresponding ecological benefit are seen to the R&S. Although not meeting targets completely, the Band 1, including BCWPA, provides significant hydro-ecological benefit to the ridge and slough systems of Everglades National Park.

Conclusion: The project provides hydro-ecological benefits as well as direct water quality benefits. When combined with future CERP projects beyond Band 1 additional benefits beyond those characterized in this report are expected. The seepage feature is needed as additional water becomes available in later CERP bands (most storage is in later Bands in the IDS). Reduction in Cattail (expansion and expansion rate) indicated that the existing condition would continue to put undesirable loads of phosphorus into WCA3A and 3B thereby converting additional ridge and slough habitat into monotypic and nearly monotypic stands of cattail (see write up from email for reasons why this undesirable- loss of function directly related to CERP interim goals). The With Project condition is expected to provide both reduced P loading as well as some hydrologic benefit (particular when coupled with future CERP projects as seen when modeled with Band 1 projects). The combined hydrologic and reduced phosphorus benefit will directly reduce the expansion of cattail and reduce the increase in primed acreage (enriched soils). This provides benefit to wading birds, periphyton, and other R&S related species. Under Band 1 hydrologic benefit and corresponding ecological benefit are seen to the R&S. Although not meeting targets completely, the Band 1, including BCWPA, provides significant hydro-ecological benefit to the ridge and slough systems of Everglades National Park.

The summary of environmental benefits tied to hydrology which is linked to the natural system is displayed below (***TABLE C-29***).

TABLE C-29: SUMMARY OF BROWARD COUNTY WPA BENEFITS

	ALT A1	ALT A4	ALT F1	ALT F4
PM 1. Cattail Reduction (TP Loading Reduction)	8,235	8,618	4,150	4,149
PM 2. Snail Kite Habitat	119,021	129,772	119,021	129,772
PM 3. ENP Ridge and Slough Benefits	24,920	27,821	24,920	27,821

Source: BCWPA Spreadsheets

C.8 NEXT ADDED INCREMENT – BENEFITS EVALUATION AND ASSESSMENT METHOD (BEAM)

The Benefits Evaluation Analysis Methodology (BEAM) is an effort to unify and standardize ecological benefit quantification for the Comprehensive Everglades Restoration Project (CERP), and to minimize inconsistency due to the lack of a standardized protocol. The methodology is based on the best available science, while taking into account the needs of planners and policy makers to apply science to project decision-making. The BEAM uses both the Conceptual Ecologic Models (CEMs) and the Interim Goal (IG) indicators to establish the indicators of ecosystem health expected to be affected by CERP projects

The methods used to calculate benefits frequently rely on an array of species indicators, each with its individual associated acreage, in an effort to amass enough ecosystem benefits to justify the project authorization. These methodologies tend to rely on two components, a quality component that describes the health or suitability of an area for a specific environmental function, and a quantity component that describes the acreage associated with that function. The product of these two components is termed a habitat unit (HU) and usually represents an acre of optimal environment. A desirable environmental benefits evaluation methodology would provide output useful for comparing a range of restoration alternatives.

C.8.1 Introduction

The BCWPA Project aims to 1) reduce seepage from natural areas (WCA3A and 3B) to urban areas, 2) to improve Everglades water quality by capturing and diverting urban runoff previously released to WCA3, and lastly 3) to provide supplemental water supply and aquifer recharge to urban areas, thereby reducing demands on the natural system.

The selected plan reflects an optimization of reservoir configuration, storage volume, and seepage management features. The plan includes two aboveground impoundments and associated pumps and water control structures: the C-11 Impoundment and the C-9 Impoundment; canal conveyance improvements to connect the two impoundments; and a seepage management area to create a buffer

between developed areas to the east and the Everglades Water Conservation Areas (WCAs) to the west.

C.8.2 CERP System Wide Performance Measures

CERP System Wide Performance Measures were applied to the BCWPA Next Added Increment scenario. The Greater Everglades Indicator Regions that are used with CERP System Wide Performance Measures are shown in ***FIGURE C-24***. The following performance measures were used to evaluate projected effects on the Greater Everglades freshwater marshes and the Snake Creek Estuary. Areas where substantial change in performance is projected are highlighted along with each PM. Overall minimal difference was noted in hydrologic benefits. (http://www.evergladesplan.org/pm/recover/eval_team_perf_measures.aspx)

Greater Everglades 1 - Number and Duration of Dry Events for Shark River Slough
(http://www.evergladesplan.org/pm/recover/recover_docs/et/ge-01.pdf)

For all Shark River Slough indicator regions (Appendix A) in Everglades National Park (IR129 – IR132), no difference in the number of dry events is expected between the 2050B and the with project alternative. A slight shift toward the target in the duration of dry events is expected in IRs 130-132.

Greater Everglades 2 - Inundation Pattern in Greater Everglades Wetlands
(http://www.evergladesplan.org/pm/recover/recover_docs/et/ge-02.pdf)

Minor changes in the number of inundation events are expected under the NAI condition. Benefits were observed in indicator region 119, WCA-3A East, due to a small increase in the number of inundation events. A small decline in performance was observed in IRs 120 and 128, WCA-3A West and WCA-3B East, respectively. Minor changes were also observed in the duration of inundation events. Similar to the number of events, benefits were also observed for IR 119 due to the projected decline in inundation duration. IRs 120 and 128 are expected to move slightly further away from the target inundation durations.

Greater Everglades 3 - Extreme High and Low Water Levels in Greater Everglades Wetlands
(http://www.evergladesplan.org/pm/recover/recover_docs/et/ge-03.pdf)

Similar to the results observed for GE-2, minimal changes in the number and duration of extreme events are expected under the with project condition over the 2050B3 condition. A small decline in performance for the frequency of low events was observed for IRs 112, 140, and 141. A small increase in performance was observed for IRs 125 and 147. Small changes in the

duration of extreme low events were observed across the GE landscape. Few changes were seen in the frequency and duration of extreme high events throughout the GE ridge and slough. No changes were observed in the GE marl prairie habitats.

Proxy for Greater Everglades Phosphorus Loading and Concentration PM (http://www.evergladesplan.org/pm/recover/recover_docs/et/ge-04.pdf and http://www.evergladesplan.org/pm/recover/recover_docs/et/ge-05.pdf)

Currently there is no predictive model to apply the CERP system wide water quality performance measures, therefore a series of best professional judgment calculations were applied to determine benefits associated with increased water quality due to project implementation.

The following text outlines the series of assumptions used by the project team to determine system water quality benefits associated with decreased phosphorus loading to the Greater Everglades. Due to the uncertainty and sensitivity associated with specific assumptions, the team worked through a series of best and worst case scenario situations to estimate the range of potential water quality benefits associated with implementation of the BCWPA Project. The projected benefits associated with the best and worst case assumptions and the assumptions agreed upon by the project delivery team (PDT) and associated benefits are highlighted.

WQ Index Curve Assumptions (Worst Case):

Best case:	0 load = index score of 1
Worst case:	82 K acre/ft @ 17ppb= 1.72 metric tons= index score of 0
Base:	10 ppb and
NAI:	10 ppb

BCWPA Index score = 0.25 based on total load reduction of 84% over the 95Base condition (1.72 metric tons to 0.27 metric tons)

WQ Index Curve Assumptions (Best Case):

Best case:	0 load= index score of 1
Worst case:	82 K acre/ft @17ppb= 1.72 metric tons = index score of 0
Base:	17 ppb and
NAI:	17 ppb

BCWPA Index score= 0.42 based on total load reduction of 73% over the 95Base condition (1.72 metric tons to .46 metric tons)

Accepted assumptions:

Best case: 0 load= index score of 1
Worst case: 82 K acre/ft @ 23ppb= 2.33 metric tons = index score of 0
Base: 19.6 ppb and
NAI: 19.6 ppb

Index score = 0.36 based on a total load reduction of 77% over the 95Base condition (2.33 metric tons to 0.53 metric tons P).

Additionally, estimates of benefits related to the interaction of projects and the reduction in phosphorus loading are also provided. This is provided because of the associated uncertainty with differentiating seepage and runoff as well as differentiating the benefits associated with BCWPA Project components from interacting critical project features.

Associated assumptions recognizing expected project interactions (provided because current modeling does not differentiate benefits between interacting components):

Best Case: 0 load = index score of 1
Worst Case: 4.06 metric tons P load

After critical projects and diversion to W C-11 impoundment *: 0.49 metric tons

Index score = .76

The resulting HU lift from interaction of component projects is provided as recognition that essential interactions between projects exist. With the interacting components the potential lift due to load reduction is approximately 24,000 HU.

C.8.3 Benefits Evaluation and Assessment Method (BEAM)

Once the CERP system wide performance measures were evaluated the output was then integrated into the BEAM framework to standardize and scale performance to habitat units. The following text outlines the basis for aggregating/grouping the CERP system wide PMs. Performance was determined for the freshwater marshes and the Snake Creek Estuary for the PMs noted above. Once the scores were aggregated they were then applied to the spatial domain of the given habitat type for both the NAI and the 2050 base case scenario and the difference was considered as lift due to BCWPA.

The freshwater marsh PMs were applied to both the ridge and slough (GE-1, GE-2, and GE-3) and marl prairie habitats (GE-2 and GE-3). SE-9 was applied to Snake Creek only.

C.8.3.1 Greater Everglades

The following conceptual model and associated text provide the theoretical basis for aggregating hydrology and water quality into one index score for the Greater Everglades landscape.

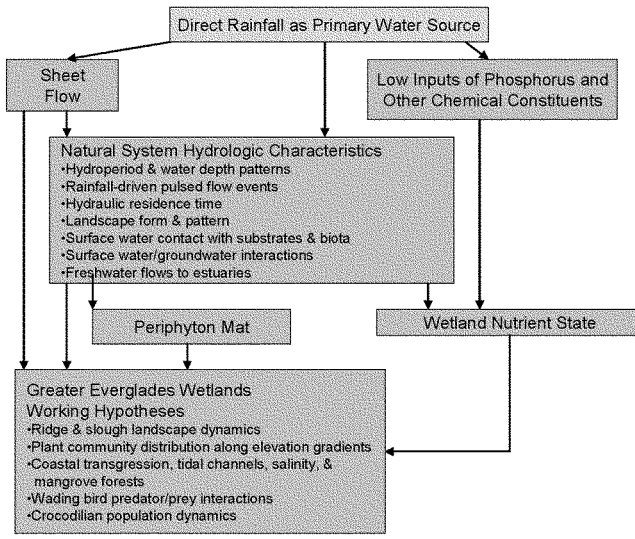


FIGURE C-27: GREATER EVERGLADES-INTEGRATED HYDROLOGY AND WATER QUALITY CONCEPTUAL ECOLOGICAL MODEL

Direct rainfall onto a vast wetland landscape of low topographic relief resulted in sheet flow and low levels of phosphorus and other chemical constituents in the pre-drainage Everglades. Restoration of the Everglades ecosystem depends on restoration of the volume, timing, and distribution of sheet flow and on restriction of inputs of phosphorus and other chemical constituents to levels approximating those in direct rainfall. Sheet flow, in combination with direct rainfall, produced fundamental hydrologic and landscape characteristics of the pre-drainage Everglades. Compartmentalization has altered or eliminated sheet flow and related natural system hydrologic and landscape characteristics throughout the Everglades. Decompartmentalization combined with resumption of natural volume, distribution, and timing of freshwater delivery is expected to restore sheet flow and pre-drainage

hydrologic and landscape characteristics to an undivided ecosystem. Increased phosphorus concentrations and loads in agricultural runoff water, and replacement of sheet flow with canal flows and point-source discharges, have produced phosphorus concentration gradients downstream of canal discharge structures, shifting wetlands from oligotrophic to eutrophic states.

Additional detail for this CEM can be found on the documentation sheet for Greater Everglades Simplified Conceptual Ecological Models.
http://www.evergladesplan.org/pm/recover/cems.aspx

C.8.3.2 Southern Estuaries

Many near-shore community habitats in the Southern Estuaries have been diminished or eliminated by past and current water management practices. Waters that are consistently of intermediate salinity tend to support highly productive, but relatively low diversity, plant and animal communities. In many nearshore areas of Biscayne and Florida Bays, freshwater flow is so variable that downstream salinity regimes are suboptimal for freshwater, brackish, and marine organisms alike. The CERP is expected to restore freshwater inflow patterns to the Southern Estuaries, which is expected to restore salinity patterns, and seagrass and mangrove communities. The restoration of salinity regime and these plant communities and will provide dynamic and structural habitat and habitat overlap for the nearshore animal communities, including fish.

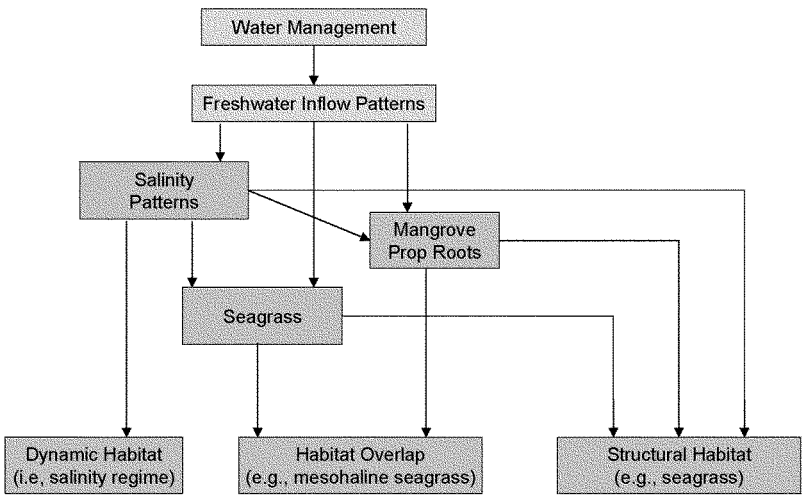


FIGURE C-28: BISCAYNE BAY- NEARSHORE COMMUNITY CONCEPTUAL ECOLOGICAL MODEL

Additional detail for this CEM can be found on the documentation sheet for Southern Estuaries Simplified Conceptual Ecological Models. (http://www.evergladesplan.org/pm/recover/recover_docs/et/pm_report/pm_rpt_4_4_se_cem.pdf)

At this point in performance measure development, the best measure of nearshore community function is habitat suitability for oyster bars in nearshore Biscayne Bay. The American oyster is not a commercially harvested resource within Biscayne Bay, but it does perform ecologically important functions as a filter-feeding primary consumer, as prey for numerous higher consumers, and as a habitat former. Habitat formation is particularly important at this location where seagrasses generally are not the primary habitat and the sediments are fine and soft. The hard substrate of the oyster reef forms an extensive habitat for oyster spat settlement and numerous other species, e.g., polychaetes, tunicates, bryozoans and barnacles, as well as red drum and other fish species.

There is an oyster bed present at the mouth of Snake Creek (Alleman et al., 1995). SE-9 restoration targets were developed to achieve salinities appropriate to maintain and improve conditions for the oyster bed growth at the mouth of Snake Creek through controlling the level of freshwater discharge through the S-29 control structure. The salinity envelopes developed for other portions of Biscayne Bay will be developed at a later date to determine the health of nearshore oyster bars along the remainder of the bay.

C.8.3.3 Index Performance Measure (PM) Hydrological Output

The information summarized in the tables below was used to determine the normalized performance measure output for each of the listed CERP system-wide performance measures.

GE-1 Number and Duration of Dry Events for Shark River Slough (Applies to IR 129-132)

Scores should be calculated independently for the number and duration of dry events for each IR and then included in the calculation of individual IR performance.

TABLE C-30: QUALITATIVE AND QUANTITATIVE DESCRIPTION OF PM INDEX VALUES FOR GE-1

Index Value (average)	Qualitative Description	Quantitative Description
1.00-0.91	Fully Restored. Full recovery of the predrainage patterns of multiyear hydroperiods. The number and duration of dry events should support and restore full structure and function of ridge and slough landscapes	# and duration of dry events that will support full restoration (+/- 5% from the IR target)
0.76-0.90	Minimum Alteration/ Structure and Function are Sustainable. The number and duration of dry events promotes maintenance and expansion of ridge and slough landscapes leading to increased ridge and slough patterning. Maintenance and promotion of ridge and slough structure and function.	# and duration of dry events (>5 % but ≤20% from the IR target)
0.51-0.75	Partially Sustainable. Number and duration of dry events leading to increased ridge and slough patterning and functionality beyond current condition.	# and duration of dry events (>20% and ≤40% away from IR target)
0.26-0.50	Minimally Sustainable. Number and duration of dry events leading to no loss of ridge and slough patterning or functionality beyond current condition.	# and duration of dry events (>40% and ≤60% away from IR target)
0.11-0.25	Mostly Degraded/Unsustainable. Number and duration of dry events leading to loss of ridge and slough patterning and functionality beyond current condition.	# and duration of dry events (>60% and ≤ 80% away from IR target)
0.01-0.10	Fully Degraded. The number and duration of dry events leads to complete loss of ridge and slough structure and function.	# and duration of dry is > 80% away from IR target.

Where NSM is used as a PM target, the percentile distribution (currently noted on the box and whiskers plots) is used to calculate each IR score. The difference between IR targets and the alternative performance provides the quantitative description from which index scores are derived. If alternative performance falls outside the whiskers, the IR score should truncate to the lowest (fully degraded) class.

GE-2 Inundation Pattern in Greater Everglades Wetlands

RECOVER previously developed a method for grading alternatives in terms of their performance relative to designated restoration targets. Alternatives are compared to target envelopes representing the range of acceptable values for all SFWMM cells within the Ridge-Slough, Shark River Slough, and Sawgrass Plain landscapes. Standard RECOVER PM output presents model results graphically, with target envelopes presented as box-whisker graphics and alternative model results overlaid as points on top of the envelopes. Target envelopes are graphically sub-divided into 20 percentile categories, and the most extreme 10 percent of values from either end

of the target distribution lie within the whiskers. Where NSM is used as a PM target, the percentile distribution (currently noted on the box and whiskers plots) is used to calculate each IR score (In the next few months this will become part of the summary table output). The difference between IR targets and the alternative performance provides the quantitative description from which index scores are derived. If alternative performance falls outside the whiskers, the IR score should truncate to the lowest (fully degraded) class.

By using only percent period of record (PPOR) as the observed metric, the actual # and duration of events is not evident. PPOR can be used to screen alternatives but the actual # and duration of events should be evaluated for the final array of alternatives. Scores should be calculated independently for the number and duration of inundation events for each IR and then included in the calculation of individual IR performance.

TABLE C-31: QUALITATIVE AND QUANTITATIVE DESCRIPTION OF PM INDEX VALUES FOR GE-2

Index Value	Qualitative Description	Quantitative Description
1.00-0.91	Fully Restored. Full recovery of the predrainage patterns of multiyear hydroperiods. The number and duration of inundation events should support and restore full structure and function of ridge and slough landscapes	# and duration of inundation events that will support full restoration (+/- 5% from the IR target)
0.76-0.90	Minimum Alteration/ Structure and Function are Sustainable. The number and duration of inundation events promotes maintenance and expansion of ridge and slough landscapes leading to increased ridge and slough patterning. Maintenance and promotion of ridge and slough structure and function.	# and duration of inundation events (>5 % but ≤20% from the IR target)
0.51-0.75	Partially Sustainable. Number and duration of inundation events leading to increased ridge and slough patterning and functionality beyond current condition.	# and duration of inundation events (>20% and ≤40% away from IR target)
0.26-0.50	Minimally Sustainable. Number and duration of inundation events leading to no loss of ridge and slough patterning or functionality beyond current condition.	# and duration of inundation events (>40% and ≤60% away from IR target)
0.11-0.25	Mostly Degraded/Unsustainable. Number and duration of inundation events leading to loss of ridge and slough patterning and functionality beyond current condition	# and duration of inundation events (>60% and ≤ 80% away from IR target)
0.01-0.10	Fully Degraded. The number and duration of inundation events leads to complete loss of ridge and slough structure and function	# and duration of inundation events is > 80% away from IR target.

***Additional notes and exceptions:**
Loxahatchee IRs (100-102) use the 2000 Existing Condition, 2000B2, as their target envelope (same number as the future without project condition). Score these indicator regions using percentile classes from the box and whisker graphics while using targets provided in graphics.

Beyond the range provided for minimally sustainable, index scores should truncate to the Fully Degraded class.

GE-3 Extreme High and Low Water Levels in Greater Everglades Wetlands

A similar process to that identified for GE-2 should be followed when generating index scores for GE-3. Calculate the index values for both # and duration of events for each IR. Index values should be calculated for both a) extreme high and b) extreme low water levels for each IR.

TABLE C-32: QUALITATIVE AND QUANTITATIVE DESCRIPTION OF PM INDEX VALUES FOR GE-3

Index Value	Qualitative Description	Quantitative Description
1.00-0.91	Fully Restored. Full recovery of the predrainage patterns of multiyear hydroperiods. The number and duration of extreme high/low events should support and restore full structure and function of ridge and slough landscapes	# and duration of extreme high/low events that will support full restoration (+/- 5% from the IR target)
0.76-0.90	Minimum Alteration/ Structure and Function are Sustainable. The number and duration of extreme high/low events promotes maintenance and expansion of ridge and slough landscapes leading to increased ridge and slough patterning. Maintenance and promotion of ridge and slough structure and function.	# and duration of extreme high/low events (>5 % but ≤20% from the IR target)
0.51-0.75	Partially Sustainable. Partially Sustainable. Number and duration of extreme high/low events leading to increased ridge and slough patterning and functionality beyond current condition.	# and duration of extreme high/low events (>20% and ≤40% away from IR target)
0.26-0.50	Minimally Sustainable. Number and duration of extreme high/low events leading to no loss of ridge and slough patterning or functionality beyond current condition.	# and duration of extreme high/low events (>40% and ≤60% away from IR target)
0.11-0.25	Mostly Degraded/Unsustainable. Number and duration of extreme high/low events leading to loss of ridge and slough patterning and functionality beyond current condition	# and duration of extreme high events (>60% and≤ 80% away from IR target)
0.01-0.10	Fully Degraded. The number and duration of extreme high/low events leads to complete loss of ridge and slough structure and function	# and duration of extreme high/low events is > 80% away from IR target.

C.8.3.4 Aggregating Index Scores

Greater Everglades (GE-1, GE-2, and GE-3 and water quality):

$$Hydrology = \left(\frac{GE1 + GE2 + \frac{GE3a + GE3b}{2}}{3} \right) \text{(for IRs 129-132) or}$$

$$= \left(\frac{GE2 + \frac{GE3a + GE3b}{2}}{2} \right) \text{(for all other IRs in R\&S habitat)}$$

Once the hydrologic metrics are integrated into a single index score, the water quality index is then integrated to derive a final integrated hydrology-water quality score. Hydrology (GE1-GE3) and water quality each account for 50% of the overall index score for Greater Everglades wetlands.

C.8.3.5 Scaling Index Scores to Habitat Units

Greater Everglades:

An area weighted average will was used to represent the hydrology and WQ quality score for the ridge and slough landscape. The acreages associated with each IR can be found in ***TABLE C-26***.

$$Hydrology\ \&\ WQCEM = \frac{\sum (IRacreage * IR)}{\sum IRacreage}$$

Index scores are scaled to habitat units by multiplying each indicator region acreage by the corresponding IR aggregate index score. The sum of the products are then divided by the sum of the acreage for all ridge and slough habitats (and marl prairie habitats). After which the scores area weighted by multiplying by the total ridge and slough (and marl prairie) acreage (see appendix B for details of calculations) to derive a habitat unit lift.

C.8.3.6 Index Performance Measure (PM) Hydrological Output

The equations and information summarized in the tables below were used to determine the performance measure quality index for each of the listed CERP system-wide performance measures.

C.8.3.7 SE-9A Snake Creek Wet Season Flows

To calculate salinities area of North Biscayne Bay including Dumfoundling Bay, Maule Lake and the Oleta River, seasonal structure flow from S29 is used. The North Biscayne Bay flow box plot produced by the SFWMM, provides a distribution of daily average flows by month over the entire period of record. The average monthly flow value for each month during the wet season (Jun-Oct) (rawscore) should be used along with the calculation below to determine the quality index.

The following is the equation to be used:

$$SE9a = \frac{\left[\sum_{Oct}^{June}\left(\frac{rawscore}{35383kacft}\right)\right]}{5}$$

Table C-33 provides a qualitative description of the quality index classifications. Additional detail for this performance can be found on the documentation sheet for SE-9 (http://www.evergladesplan.org/pm/recover/recover_docs/et/se-09.pdf).

TABLE C-33: DESCRIPTION OF QUALITY INDEX SCORES FOR SE-9A

Index Value	Qualitative Description	Quantitative Description
1.00-0.91	Fully Restored. High coverage of healthy oyster beds in Oleta River and Maule Lake; oyster beds provide valuable habitat for gastropods, polychate worms, decapod crustaceans, fish, and birds. Healthy estuarine ecosystem from Dumfoundling Bay to Bakers Haulover Inlet	Total POR average annual wet season flow is between a value greater than or equal to the target (176,915 acre-ft) and 160,993 acre-feet
0.76-0.90	Minimum Alteration/ Structure and Function are Sustainable. Fluctuating loss and increase of oyster bed coverage, resulting in declining or recovering populations of other invertebrates, fish, and birds. Oyster population is sustainable.	Total POR average annual wet season flow is between 159,224 acre-feet and 134,455 acre-feet
0.51-0.75	Partially Sustainable. Increasingly fluctuating loss and increase of oyster bed coverage, resulting in declining or recovering populations of other invertebrates, fish, and birds. Oyster population is marginally sustainable.	Total POR average annual wet season flow is between 132,686 acre-feet and 90,227 acre-feet
0.26-0.50	Minimally Sustainable. Generally loss of oyster bed coverage, resulting with declines in populations of other invertebrates, fish, and birds. Oyster population is minimally sustainable.	Total POR average annual wet season flow is between 88,458 acre-feet and 45,998 acre-feet
0.11-0.25	Mostly Degraded/ Unsustainable. Significant losses in oyster bed coverage; oyster population and the associated community is barely sustainable.	Total POR average annual wet season flow is between 44,229 acre-feet and 19,461 acre-feet
0.01-0.10	Fully Degraded. Indicates the poorest condition in the estuary. With highly fluctuating releases or lack of freshwater, entire populations of oysters do not survive and reproduce successfully.	Total POR average annual wet season flow is between 17,692 acre-feet and 1,769 acre-feet

C.8.3.8 SE-9B Snake Creek Dry Season Flows

To calculate salinities for North Biscayne Bay including Dumfoundling Bay, Maule Lake and the Oleta River, seasonal structure flow from S29 is used. The North Biscayne Bay flow box plot produced by the SFWMM, provides a distribution of daily average flows by month over the entire period of record. The average daily flow value for each month during the dry season (Nov-Jan) (rawscore) should be used along with the calculation below to determine the quality index.

The following is the equation to be used for each month where monthly flows 0 to 6,477 kacft:

$$SE9b1 = \sum_{May}^{Nov} \left(\frac{0.91}{6477kacft} * rawscore \right)$$

The following is the equation to be used for each month where monthly flows 6478 to 20,930 kacft:

$$SE9b2 = \sum_{May}^{Nov} \left(\left(\frac{0.09}{20{,}930kacft - 6477kacft} \right) * rawscore + 0.855 \right)$$

The average quality index for all months within the wet season must now be calculated:

$$SE9b = \frac{SE9b1 + SE9b2}{7}$$

Table C-34 provides a qualitative description of the quality index classifications.

Additional detail for this performance can be found on the documentation sheet for SE-9 (http://www.evergladesplan.org/pm/recover/recover_docs/et/se-09.pdf).

TABLE C-34: DESCRIPTION OF QUALITY INDEX SCORES FOR SE-9B

Index Value	Qualitative Description	Quantitative Description
1.00-0.91	Fully Restored. High coverage of healthy oyster beds in Oleta River and Maule Lake; oyster beds provide valuable habitat for gastropods, polychate worms, decapod crustaceans, fish, and birds. Healthy estuarine ecosystem from Dumfoundling Bay to Bakers Haulover Inlet	Total POR average annual dry season flow is between a value greater than or equal to the target (45,339 acre-ft) and 41,258 acre-feet
0.76-0.90	Minimum Alteration/ Structure and Function are Sustainable. Fluctuating loss and increase of oyster bed coverage, resulting in declining or recovering populations of other invertebrates, fish, and birds. Oyster population is sustainable.	Total POR average annual dry season flow is between 40,805 acre-feet and 34,458 acre-feet
0.51-0.75	Partially Sustainable. Increasingly fluctuating loss and increase of oyster bed coverage, resulting in declining or recovering populations of other invertebrates, fish, and birds. Oyster population is marginally sustainable.	Total POR average annual dry season flow is between 34,004 acre-feet and 23,123 acre-feet
0.26-0.50	Minimally Sustainable. Generally loss of oyster bed coverage, resulting with declines in populations of other invertebrates, fish, and birds. Oyster population is minimally sustainable.	Total POR average annual dry season flow is between 22,670 acre-feet and 11,788 acre-feet
0.11-0.25	Mostly Degraded/ Unsustainable. Significant losses in oyster bed coverage; oyster population and the associated community is barely sustainable.	Total POR average annual dry season flow is between 11,335 acre-feet and 4,987 acre-feet
0.01-0.10	Fully Degraded. Indicates the poorest condition in the estuary. With highly fluctuating releases or lack of freshwater, entire populations of oysters do not survive and reproduce successfully.	Total POR average annual dry season flow is between 4,534 acre-feet and 453 acre-feet

C.8.3.9 Aggregating Index Scores

C.8.3.10 Biscayne Bay-Snake Creek

Project benefits can come from achieving the two aspects of SE-9 (wet season flow and dry season flow); however, achieving the total flow pattern is the Performance Measure goal. The following provides a template for combining the two aspects into a single index value for the Performance Measure.

$$SalinityPattern_{SnakeCreek} = (0.6 * SE9a) + (0.4 * SE9b)$$

Tolley et al. 2004, Volety et al. 2004, and Volety et al. 2003 indicate that pulse releases that lead to drastic and prolonged reductions in salinity are more harmful to oyster communities than periods of low flow; therefore, the index values have been differentially weighted by season.

C.8.3.11 Scaling Index Scores to Habitat Units

C.8.3.11.1 Biscayne Bay

A similar process is followed for the SE-9. The acreage associated with potential oyster habitat is used as the multiplier in order to derive habitat unit lift.

$$NearshoreCEM = SalinityPattternSnakeCreek * \left(\frac{SnakeCreekArea}{TotalArea} \right)$$

The area defined as Snake Creek is located downstream of the C-9 discharge within Oleta River and Little Maule Lake.

C.8.4 Results of BEAM

Once the performance measure scores were aggregated and scaled, total lift due to the project was calculated. In the Greater Everglades indicator regions 119, 125, and 126 showed the greatest lift with 4525, 6975, and 2602 habitats units respectively. Declines in performance were seen in indicator regions 120, 128 and 129 each showing a decline in performance of approximately 1000 habitat units. Overall lift associated with the agreed upon assumptions resulted in an increase in approximately 12,000 habitat units. When the water quality assumptions were shifted slightly and the interaction of critical projects was considered potential lift increased from approximately 12,000 to approximately 24,000 habitat units. Lift associated with the Snake Creek estuary was limited to 37 habitat units. Benefits to the estuary are limited due to the small spatial extent of the Snake Creek estuary and the associated potential oyster reef habitat.

C.8.5 Conclusions and Recommendations

The previously discussed performance measures were integrated into the Benefits Evaluation and Assessment Method (BEAM) to standardize the output and to convert performance scores in to HU. The results of the BEAM indicate a significant water quality benefit associated with the BCWPA Project to Greater Everglades as well as hydrologic benefits to the Snake Creek estuary. Of the approximately 12,000 HU gained by project implementation, approximately 90% of the benefits are due to phosphorus load reduction to GE. The load reduction is a result of decreasing urban runoff entering WCA3. Further, potential water quality benefits may also be gained within the impoundments themselves. This can be investigated using Eutromod, Vollenweider regression model, COE Walker Model or

others. These benefits were not included in the above estimates. It should be noted that considerable uncertainty exists in differentiating seepage from runoff as well as differentiating interacting project components (BCWPA from related critical projects). The above benefits are based on estimates of runoff volumes alone and not the combination of runoff and seepage. Additionally, the interactions of the BCWPA features with other CERP and non-CERP critical projects were not included in the runoff only analysis. If we assume related projects depend on the BCWPA project and do not differentiate seepage from runoff, considerable additional lift can be expected. The upper range of benefits based on load reduction and project component interaction increases from 14,670 HU to approximately 24,000 HU.

Although few hydrologic benefits were observed (GE1-GE3) in the Greater Everglades, hydrology/salinity benefits were observed in the estuary. Exceedances above target flows were suggested by the model. It is unclear if these exceedances are due to flood control requirements or issues surrounding model formulation. It is suggested that the coastal gradient be reviewed using updated RECOVER targets.

Overall, the project design is consistent with attaining project goals and objectives. Operational flexibility will lead to increased benefits by further minimizing potential high flows to the estuary as well as by minimizing discharges (and associated sediment loads) to the freshwater marshes.

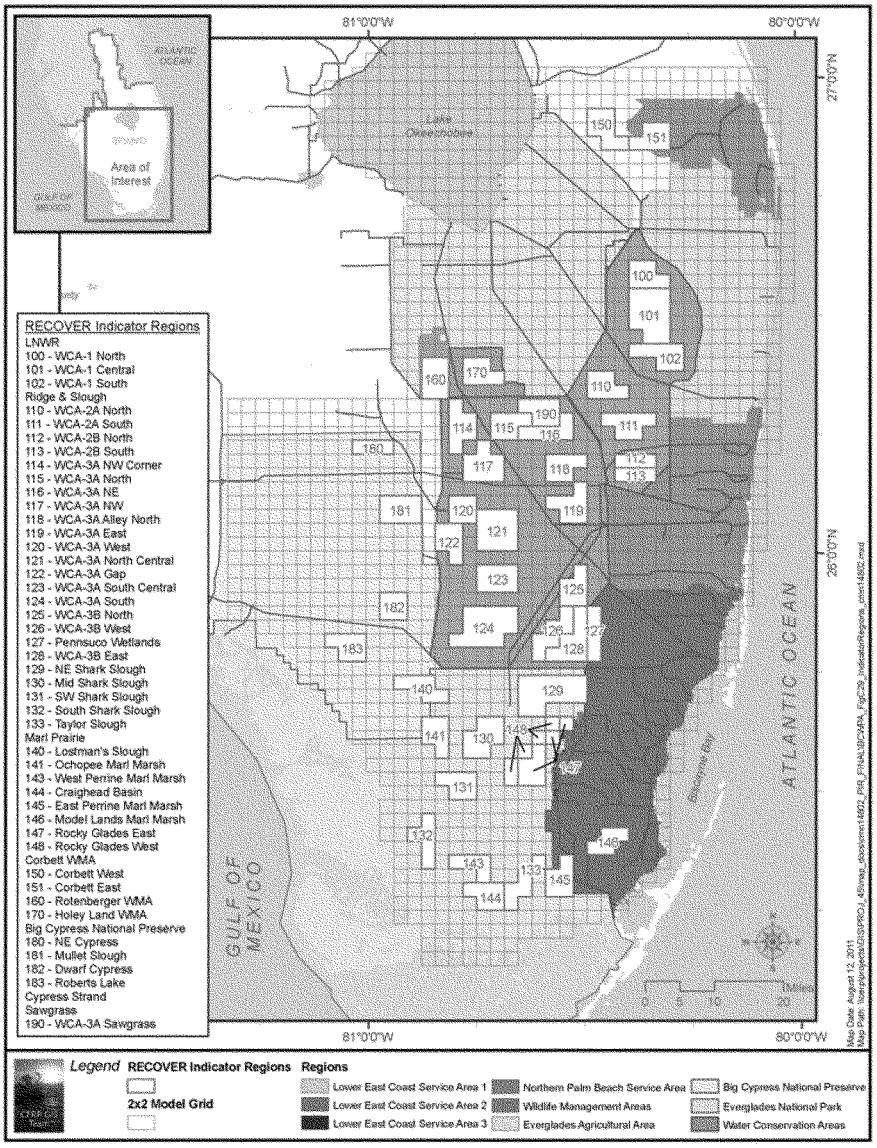


FIGURE C-29: GREATER EVERGLADES INDICATOR REGIONS TO BE USED WITH CERP SYSTEM-WIDE PERFORMANCE MEASURES

		GE-2				GE-3 (Low)				GE-3 (High)				GE-4				WQ Loading		Avg IR Qi		Acreage	Area Weighted IR	
		FREQUENCY		DURATION		FREQUENCY		DURATION		FREQUENCY		DURATION		FREQUENCY		DURATION								
		2050B3	WPANA1	2050B3	WPANA1	2050B3	WPANA1	2050B3	WPANA1	2050B3	WPANA1	2050B3	WPANA1	2050B3	WPANA1	2050B3	WPANA1	2050B3	WPANA1	2050B3	WPANA1		2050B3	WPANA1
WCA-1	100	0.946	0.946	0.938	0.939	0.855	0.855	0.775	0.775	0.722	0.722	0.830	0.830							0.869	0.866	36090	0.029	0.029
	101	0.897	0.897	0.918	0.915	1.000	1.000	1.000	1.000	0.910	0.910	0.940	0.940							0.934	0.934	69108	0.026	0.026
	102	0.733	0.733	0.826	0.828	1.000	1.000	1.000	1.000	0.768	0.768	0.866	0.866							0.810	0.810	33985	0.024	0.024
WCA-2a	110	0.929	0.929	0.932	0.933	0.779	0.779	0.702	0.702	0.512	0.512	0.539	0.539							0.775	0.776	46533	0.032	0.031
	111	0.754	0.754	0.805	0.804	0.780	0.780	0.694	0.693	0.393	0.393	0.517	0.519							0.693	0.693	51854	0.035	0.035
WCA-2b	112	1.000	1.000	0.865	0.865	0.922	0.918	0.816	0.815	0.855	0.855	0.961	0.966							0.857	0.856	14613	0.011	0.011
	113	0.813	0.813	0.711	0.711	0.102	0.102	0.123	0.113	0.168	0.168	0.944	0.944							0.385	0.385	13763	0.029	0.029
WCA-3A North	114	0.209	0.209	0.256	0.256	0.240	0.240	0.354	0.354	0.569	0.569	0.114	0.125							0.288	0.290	34911	0.009	0.029
	115	0.862	0.862	0.896	0.841	1.000	1.000	0.894	0.894	0.285	0.289	0.198	0.207							0.737	0.709	21149	0.014	0.013
	116	0.187	0.187	0.170	0.170	0.137	0.137	0.373	0.373	0.198	0.198	0.218	0.188							0.190	0.189	18995	0.003	0.003
	117	0.916	0.916	0.893	0.893	0.389	0.389	0.833	0.841	0.393	0.413	0.332	0.285							0.695	0.691	21043	0.013	0.013
	190	0.256	0.256	0.061	0.061	0.070	0.070	0.060	0.060	0.040	0.061	0.345	0.215							0.131	0.130	45496	0.005	0.005
WCA-3A East	118	0.808	0.808	0.788	0.788	1.000	1.000	0.819	0.473	0.244	0.249	0.280	0.296							0.642	0.647	39951	0.022	0.023
	119	0.692	0.692	0.554	0.621	0.844	0.844	0.273	0.273	0.101	0.101	0.000	0.000					0.415	0.773	0.444	0.529	52727	0.020	0.024
WCA-3A Central	120	0.584	0.584	0.535	0.535	0.962	0.962	0.784	0.784	0.467	0.467	0.350	0.383							0.538	0.544	21149	0.011	0.010
	121	0.746	0.746	0.787	0.787	0.916	0.916	0.897	0.897	0.385	0.385	0.232	0.246							0.657	0.639	77091	0.043	0.043
	122	0.913	0.913	0.876	0.876	1.000	1.000	0.897	0.941	0.413	0.413	0.398	0.374							0.657	0.663	20074	0.013	0.013
	123	0.464	0.464	0.517	0.521	0.969	0.969	0.592	0.592	0.367	0.367	0.263	0.278							0.408	0.491	45422	0.027	0.027
	124	0.692	0.692	0.700	0.765	0.916	0.916	0.805	0.805	0.324	0.335	0.725	0.740							0.644	0.652	72162	0.041	0.041
WCA-3b	125	0.342	0.342	0.333	0.331	0.788	0.872	0.644	0.425	0.162	0.163	0.485	0.493					0.415	0.773	0.463	0.634	42774	0.016	0.023
	126	1.000	1.000	0.928	0.927	0.990	0.990	0.989	0.929	0.973	0.981	0.860	0.963							0.762	0.839	33982	0.023	0.025
	127	0.373	0.373	0.243	0.242	0.042	0.046	0.114	0.095	0.815	0.815	0.827	0.829							0.378	0.375	10498	0.003	0.003
	128	0.907	0.906	0.549	0.453	0.062	0.065	0.149	0.183	0.444	0.473	0.944	0.969							0.515	0.499	21296	0.010	0.009
Shark River Slough	129	0.992	0.992	0.998	0.998	0.221	0.221	0.553	0.313	0.585	0.609	0.776	0.843	0.992	0.992	0.408	0.408			0.295	0.280	50054	0.015	0.015
	130	0.286	0.286	0.280	0.281	0.368	0.368	0.847	0.847	0.731	0.731	0.777	0.777	0.358	0.281	0.846	0.697			0.457	0.459	40708	0.016	0.016
	131	0.439	0.439	0.485	0.485	0.358	0.358	0.863	0.863	0.731	0.731	0.739	0.739	0.839	0.839	0.926	0.846			0.606	0.608	49843	0.026	0.026
	132	0.447	0.447	0.149	0.147	0.808	0.808	0.838	0.839	0.736	0.731	0.739	0.739	0.180	0.180	0.994	0.993			0.548	0.549	43398	0.021	0.021
Taylor Slough	133	0.100	0.100	0.805	0.805	0.376	0.376	0.990	0.990	1.000	1.000	1.000	1.000							0.597	0.597	20910	0.011	0.011
Marl Prairie	140			0.000	0.000	0.801	0.764	0.872	0.998	0.967	0.967	0.860	0.860							0.379	0.380	94084	0.108	0.111
	141			0.000	0.000	0.766	0.766	0.739	0.794	0.794	0.794	0.934	0.934							0.380	0.383	54072	0.062	0.063
	143			0.000	0.000	0.939	0.939	0.900	0.900	1.000	1.000	1.000	1.000							0.880	0.880	46841	0.131	0.131
	144			0.000	0.000	0.779	0.779	0.834	0.839	1.000	1.000	1.000	1.000							0.452	0.452	20653	0.028	0.028
	145			0.994	1.000	0.837	0.837	0.914	0.924	1.000	1.000	1.000	1.000							0.960	0.920	25379	0.079	0.079
	146			0.000	0.000	0.808	0.808	0.875	0.875	1.000	1.000	1.000	1.000							0.460	0.460		-	-
	147					0.963	0.963	0.963	0.945	0.602	0.602	0.703	0.703							0.580	0.963	33535	0.059	0.037
	148					0.394	0.339	0.778	0.778	1.000	1.000	1.000	1.000							0.781	0.778	51132	0.121	0.120
Corbett WMA	150																							
	151																							
Holeland and Rotenberger	160	0.333	0.333	0.243	0.243	0.120	0.120	0.387	0.387	0.604	0.604									0.329	0.329	39627	0.008	0.008
	170	0.050	0.050	0.026	0.026	0.223	0.223	0.099	0.099	0.050	0.050	0.000	0.000							0.088	0.088	34528	0.002	0.002
Big Cypress	180																							
	181																							
	182																							
	183																							

Total Acreage	2050B3	WPANA1
1,147,886	0.563	0.573
330,967	0.586	0.588

	2050B3	WPANA1
R&S HU	646,265	655,229
Marl HU	194,089	194,961

	LR	WPANA1
R&S HU LIR		11,960
Marl HU LIR		871

12,832

Theoretical Uft by IR

	WPANA1
WCA-1	1,71405
	0
	0
WCA-2a	0
	-150
WCA-2b	6
	1,444
WCA-3A North	134,04
	(7,19)
WCA-3b	329
	50,558962
WCA-3A Central	-572
	-29
WCA-3A East	-97
	-46,7819935
WCA-3b	498
	221
Shark River Slough	4525
	4748
Taylor Slough	499
	139
Marl Prairie	131
	181
WMAs	980
	640
TOTAL	12,832

	1,71405
	0
	0
	-150
	6
	1,444
	134,04
	(7,19)
	329
	50,558962
	-572
	-29
	-97
	-46,7819935
	498
	221
	4525
	4748
	499
	139
	131
	181
	980
	640
	4525
	4748
	499
	139
	131
	181
	980
	640
	1875
	2602
	-27
	-1068
	-337
	68
	94
	67
	708
	7
	931
	155
	0
	3
	551
	0
	-619
	-129
	0
	0
	1
	0
	1
	0
	12,832

173

Water Quality Benefit Calculations

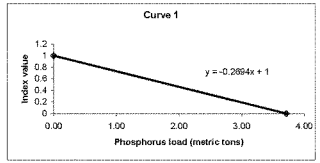
Water Budget

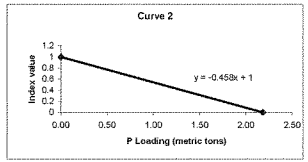
Condition	S9-S	S9-R	S9A-S	S9A-R	Total Runoff	Total seepage	Total
2050B3	0	32.1	114.1	24.2	56.3	114.1	170.4
NAI	0.7	0.4	65.3	21.4	21.8	66	87.8
					34.5	48.1	82.6

1 ac-ft = 1233482 L

Curve 1 **Based on seepage and runoff @ 17ppb**

Alternative	volume (Kacre-ft)	Load (MT)	score	Lift
95B	177	3.71	0.000	
2050B	170.4	2.10	0.434	
BCWPA	87.8	1.08	0.708	0.27
Best condition	0	0	1.000	



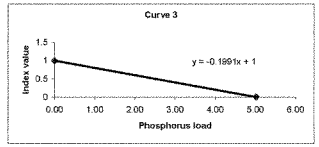


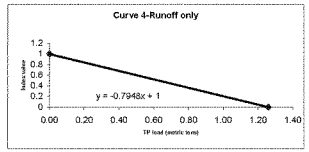
Curve 2 **Based on seepage and runoff @ 10ppb**

Alternative	volume (Kacre-ft)	Load (MT)	score	Lift
95B	177	2.18	0	
2050B	170.4	2.10	0.04	
BCWPA	87.8	1.09	0.50	0.46
Best condition	0	0	1	

Curve 3 **Based on seepage and runoff @ 23ppb**

Alternative	volume (Kacre-ft)	Load (MT)	score	Lift
95B	177	5.02	0.000	
2050B	170.4	2.10	0.582	
BCWPA (NAI)	87.8	1.08	0.784	0.20
Best condition	0	0	1.000	



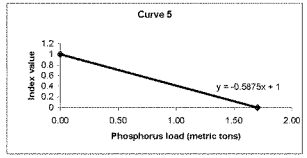


Curve 4 **Based on runoff only @ 17ppb**

Alternative	volume (Kacre-ft)	Load (MT)	score	Lift
95B	60	1.26	0.000	
2050B	56.3	0.69	0.448	
BCWPA (NAI)	21.8	0.27	0.788	0.34
Best condition	0	0	1.000	

Curve 5 **Based on runoff only @ 23 ppb**

Alternative	volume (Kacre-ft)	Load (MT)	score	Lift
95B	60	1.70	0.000	
2050B	56.3	0.69	0.592	
BCWPA (NAI)	21.8	0.27	0.842	0.25
Best condition	0	0	1.000	



174

Additional Assumptions

Condition	S9-S	S9-R	S9A-S	S9A-R	Total Runoff	Total seepage	Total
2050B3	0	32.1	114.1	24.2	56.3	114.1	170.4
NAI	0.7	0.4	65.3	21.4	21.8	66	87.8
					34.5	48.1	82.6

Curve 1

Alternative	volume (Kacre-ft)	Load (metric tons)	score		Lift
95B	177	3.711547338	0		
2050B	170	2.0969194	0.435089914		
BCWPA	88	1.08546416	0.707575955		0.272486042
Best condition	0	0	1	used 10 ppb for loading except 95Base used 17ppb	
		1.855773669	0.5	mid point just an average of high and low to drive linear index	

Curve 2 **Based on 10 PPB for 95 Base**

Alternative	volume (Kacre-ft)	Load (metric tons)	score		Lift
95B	177	2.18326314			
2050B	170	2.0969194	0.039610915		
BCWPA	88	1.08546416	0.502857415		0.4632465
Best condition	0	0			
			2.183263	0	
			0	1	

Curve 3 **Based on 23 PPB for 95Base and**

Alternative					Lift
95B		5.021505222	0		
2050B			0.582503		
BCWPA (NAI)			0.783884	0.201380738	
		0	1		

Curve 4 **Based on runoff (@17ppb) only not seepage and runoff**

Alternative	Total S-9&S-9A runoff volume (Kacre-ft)	liters (thousands)	Load (metric tons)	score	score 2	Lift
95B	60	74008920	1.25815164			
2050B	56.3	69445036.6	0.694450366	0.812915	0.448050849	
BCWPA (NAI)	21.8	26889907.6	0.268899076	0.927559	0.786279014	0.338228165
				1.258152	0	
				0	1	

Curve 5 **Based on runoff only but used 23 ppb rather than 17 in curve 4**

Alternative	volume (Kacre-ft)	liters (thousands)				Lift
95B	60	74008920	1.70220516			
2050B	56.3	69445036.6	0.694450366	0.59201		
BCWPA (NAI)	21.8	26889907.6	0.268899076	0.842022		0.250011383
				1.702205	0	
				0	1	

Curve 6

Alternatives	Runoff only		load	index scor	lift
95B	82	101145524	2.326347052		
2050B	56.3	69445036.6	1.361122717	0.414853	
NAI	21.8	26889907.6	0.527042189	0.773425	0.358571219
				2.326347	0
				0	1
			0.834080528		
			0.358536585		

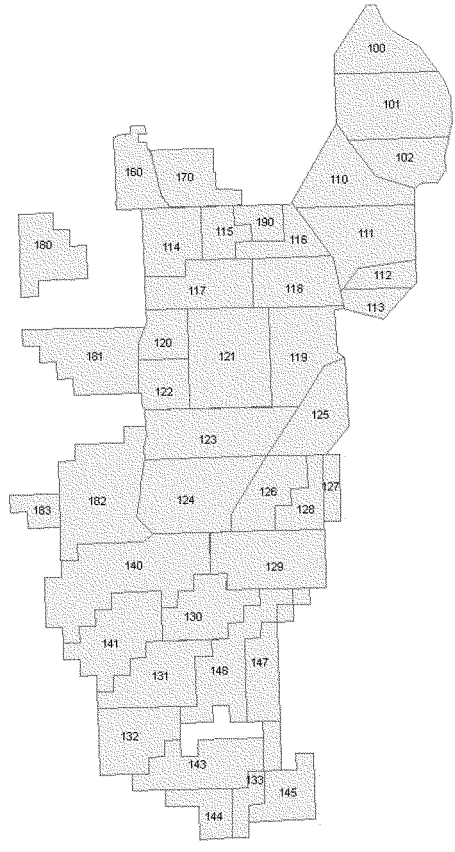


FIGURE C-30: EXPANDED GREATER EVERGLADES INDICATOR REGION MAP

TABLE C-35: EXPANDED INDICATOR REGIONS

Indicator Region	Expanded Indicator Region Acreage
100	38,090
101	69,108
102	33,985
110	46,535
111	57,854
112	14,613
113	13,763
114	34,911
115	18,995
116	21,843
117	43,486
118	39,951
119	52,727
120	21,146
121	77,091
122	23,074
123	63,422
124	72,162
125	40,774
126	33,982
127	10,466
128	21,296
129	60,264
130	40,709
131	48,642
132	43,398
133	20,810
140	94,364
141	54,072
143	48,641
144	20,653
145	28,570
147	33,535
148	51,132
160	29,027
170	34,628
180	36,494
181	56,812
182	80,965
183	13,034
190	14,071

Here's an excerpt from an e-mail to the GE subteam on March 1, 2005, that provides a little background:

"GE subteam,

Several CERP projects are currently in the process of calculating ecological benefits using Habitat Units for project alternatives. As you may know, Habitat Units are the product of an index score multiplied by the acreage that the index applies to. To assist projects in determining the appropriate acreage to use in the Greater Everglades, Heather McSharry, Mike Duever, and I have created a draft map showing polygons drawn around each indicator region. The concept is to multiply some index score for the indicator region by the acreage captured in the polygon (an area usually larger than the IR). We created the polygons on this map utilizing canal boundaries, a topo map, the NSM landscape type map, and best professional judgment.

Please note that areas have not yet been drawn around the indicator regions for Corbett or Model Lands pending input from folks more familiar with those areas."

Southern Estuaries Benefits

Benefits Calculations

Month	2050B3 2050 w/o project	NAI 2050 w/ BCWPA	Target
January	6736	11851	6477
February	5561	9361	6477
March	6987	10528	6477
April	6285	9147	6477
May	11087	13867	6477
June	35115	38320	35383
July	26328	31363	35383
August	22952	28931	35383
September	26126	31983	35383
October	30205	37096	35383
November	16635	24978	6477
December	7908	14005	6477

2050B3 2050 w/o project	NAI 2050 w/ BCWPA
259.00	5374
-916	2884
510	4051
-192	2670
4610	7390
-268	2937
-9055	-4020
-12431	-6452
-9257	-3400
-5178	1713
10158	18501
1431	7528

Index 2050B3 2050 w/o project	Index NAI 2050 w/ BCWPA
0.90	0.94
0.77	0.92
0.90	0.93
0.87	0.92
0.93	0.95
0.99	1.00
0.74	0.89
0.65	0.82
0.74	0.90
0.85	1.00
0.97	1.00
0.91	0.95

		2050B3 Raw Score	NAI Raw Score
SE-9a	Wet Season	140726	167693
SE-9b	Dry Season	61199	93737

		2050B3 Index Value	NAI Index Value	Lift
SE-9a	Wet Season	0.80	0.92	0.13
SE-9b	Dry Season	0.89	0.94	0.05
	GeoMean	0.84	0.93	0.09
	Average	0.85	0.93	0.09

	2050B3	NAI	Target
Total Wet	140726	167693	176915
Total Dry	61199	93737	45339.00
	Index Value	Index Value	Lift
Wet Season	0.80	0.92	0.13
Dry Season	0.89	0.94	0.05
			Lift
Salinity Pattern			0.10
Based upon 392.14 acres available in the downstream estuary			
habitat units			37.37

179

Southern Estuaries Habitats Units

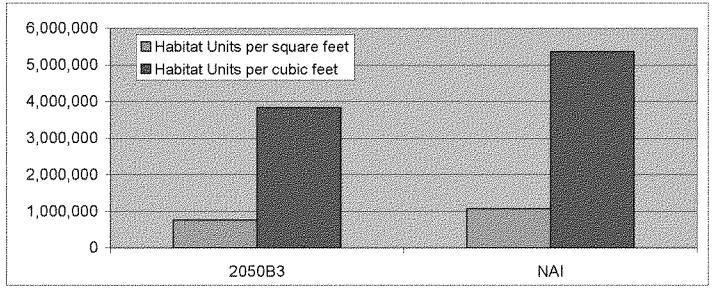
Acres	Square Ft	Cubic feet
24.478	1,066,262	5,331,308

	Lift	Habitat Units Square Feet	Habitat Units Cubic feet
Wet Season	0.15	162,529	812,647
Dry Season	0.42	444,928	2,224,642
GeoMean	0.29	305,736	1,528,678
Average	0.28	303,729	1,518,644

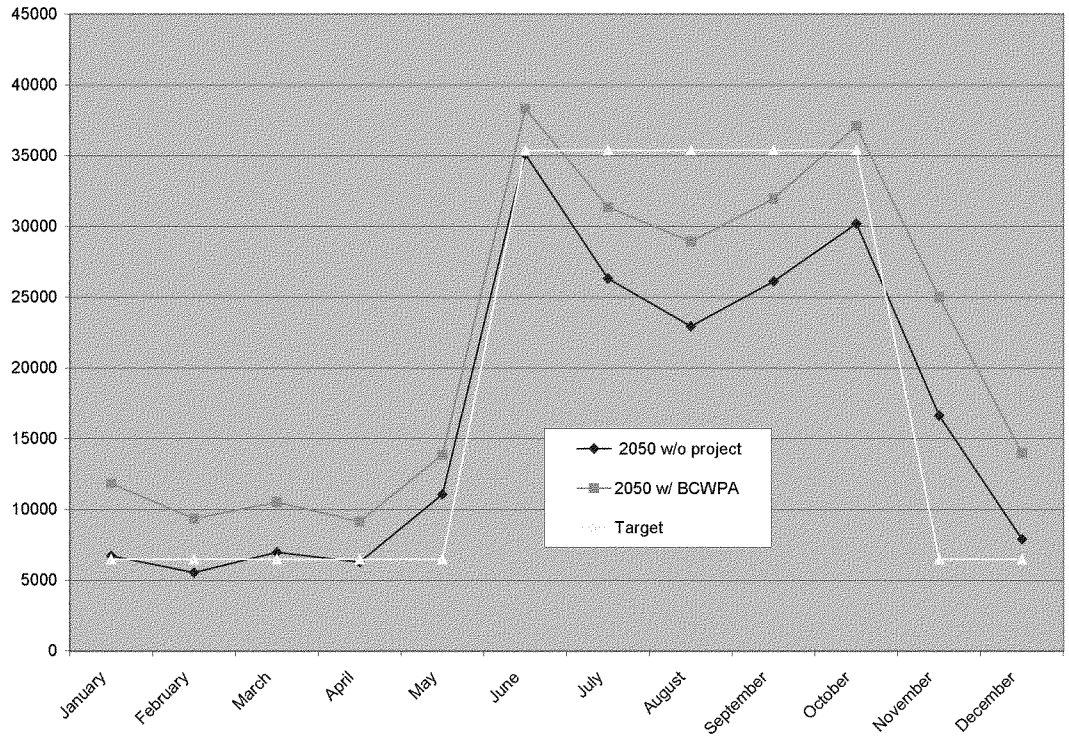
Assumptions

24.478 acres includes Maule Lake & Oleta River
A 5-foot average depth was used to calculate cu.ft.
Lift = 2050B3 - BCWPA NAI

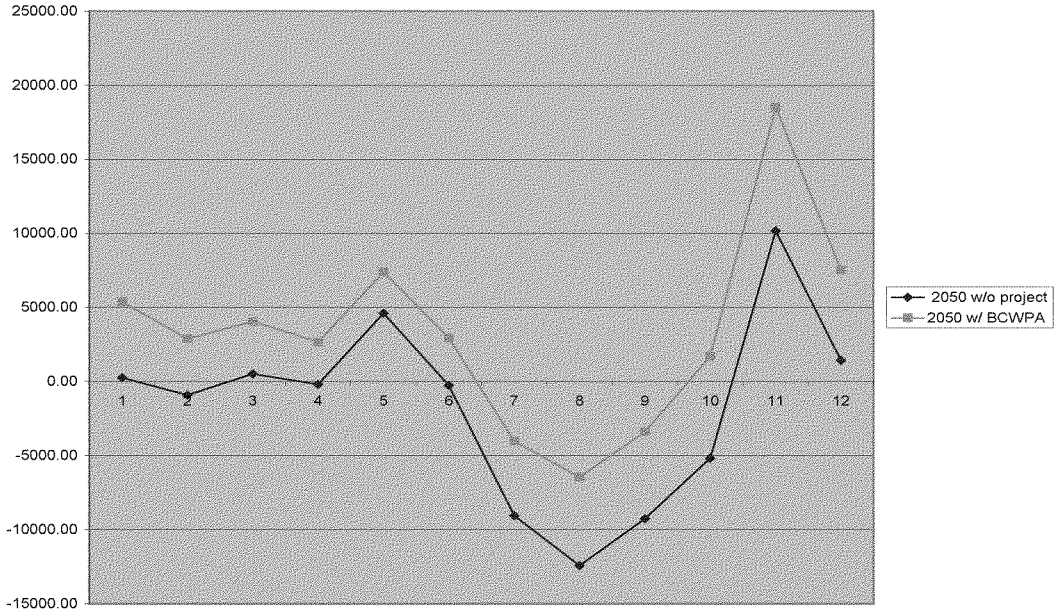
2050B3 Index Value	2050B3 HU/sq.ft.	2050B3 HU/cu.ft.	NAI Index Value	NAI HU/sq.ft.	NAI HU/cu.ft.
0.80	848,152	4,240,758	0.95	1,010,681	5,053,405
0.65	693,274	3,466,368	1.07	1,138,202	5,691,009
0.72	766,812	3,834,061	1.01	1,072,548	5,362,739
0.72	770,713	3,853,563	1.01	1,074,441	5,372,207



Monthly Flows through Snake Creek



Deviation from Target Flows



C.9 EVERGLADES RIDGE AND SLOUGH CONCEPTUAL ECOLOGICAL MODEL

C.9.1 Model Lead

John C. Ogden, South Florida Water Management District

C.9.2 Introduction

In its pre-drainage condition, the ridge and slough portion of the Everglades was an expansive, long-hydroperiod, freshwater marsh, characterized by low-velocity "sheet flow", moderate-to-deep organic soils, and alternating sawgrass "ridges" and more open-water "slough" communities (Davis et al. 1994, Gunderson 1994, Gunderson and Loftus 1993, Olmsted and Armentano 1997, Browder and Ogden 1999). The ridge and slough systems were dominated by sawgrass (*Cladium*), water lily, and "wet prairie" species (*Eleocharis* and *Rhynchospora*) communities. A spatially variable mosaic of discreet hardwood hammock, bay head, and willow tree islands occurred throughout, ranging from widely spaced in the central Everglades to more densely distributed in the Loxahatchee basin and Shark River Slough. The ridge and slough system modeled here (***Figure C-31***) is that portion of the Everglades basin where there are Loxahatchee or Everglades Peat soils (the combined "wet prairie/slough, tree island, sawgrass mosaic" and "sawgrass dominated mosaic" in Davis et al. 1994). The ridge and slough system makes up the deeper central portion of the total Everglades basin. On a much smaller scale, ridge and slough systems occur on both the eastern and western flanks of the Shark Slough in the southern Everglades (e.g., Taylor, East, Middle, Lostman's Sloughs). These sloughs are within the boundaries of the Southern Marl Prairies Conceptual Ecological Model, but are ridge and slough systems, not marl prairie systems. The ridge and slough Everglades was the principal center for primary and secondary production and interannual survival of aquatic organisms in the pre-drainage, freshwater wetlands of southern Florida.

The major, known changes in the ridge and slough systems have been caused by modern land use practices, and by drainage and water management programs in South Florida (Davis and Ogden, 1994; Science Subgroup, 1993). The stressors resulting from these regional "drivers" include reduced spatial extent, compartmentalization and reduced sheet flow, loss of organic soils, altered water depth, distribution and flow patterns, altered water and soil chemistry, and the introduction of exotic species. It is the effects from these "stressors" that are modeled in the conceptual ecological model for the ridge and slough system.

C.9.3 External Drivers and Ecological Stressors

During the workshops to develop the Everglades Ridge and Slough Conceptual Ecological Model, four major sources of societal influences (drivers) on the

Everglades ridge and slough systems were identified: urban and agricultural expansion, influences from industrial and agricultural practices, water management practices, and cultural influences on species composition. These drivers lead to five major ecosystem stressors: reduced spatial extent, degraded water quality, reduced water storage capacity, compartmentalization, and exotic species. The combined effects from these stressors explain much of the ecological changes that have occurred in the ridge and slough system ***(Figure C-33, Section C.9.9)***. The four societal drivers, their respective stressors (bold face in text), and the ecological significance of the prestressed condition in the natural system, are discussed below.

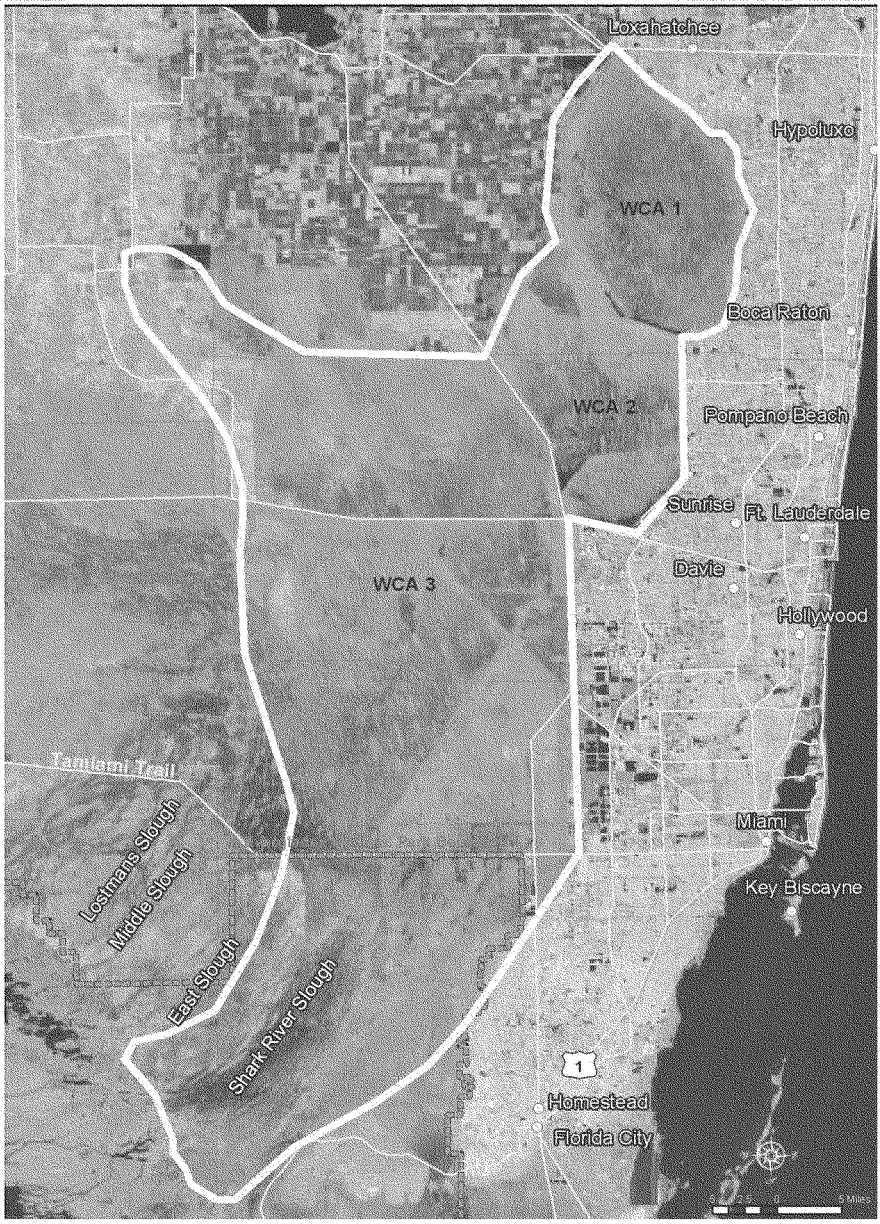


FIGURE C-31: THE BOUNDARY OF THE RIDGE AND SLOUGH CONCEPTUAL ECOLOGICAL MODEL

C.9.3.1 Urban and Agricultural Expansion

Drainage of wetlands and the subsequent conversion of ridge and slough habitat into agricultural and urban uses have reduced the total spatial extent of the ridge and slough system in the main Everglades from 490,000 hectare in the pre-drainage system to 365,000 hectare in the current system (Davis et al., 1994). Space was the one physical characteristic of the South Florida wetlands that was necessary for all other physical and ecological components of these systems to be in place. The broad spatial extent of the pre-drainage ridge and slough system was essential for collecting and storing the amount of regional rainfall that was required to maintain the ecological vigor of these systems (Davis and Ogden, 1994; Ogden et al., 1999). Large spatial extent provided the foundation for the processes that created and maintained a mosaic of habitats in a low profile terrain (Craighead, 1971; DeAngelis and White, 1994). Disturbances, such as fire, freezes, tropical storms, and animal related impacts (e.g., an abundance of alligator created ponds and trails), served to increase the complexity of habitats, as well as the range of habitat choices for species of wildlife with either small or large home ranges (Craighead, 1968; DeAngelis, 1994; Duever et al., 1994; Gunderson and Snyder, 1994; Davis and Ogden, 1994). Extensive space was necessary for supporting robust numbers of animals requiring extensive feeding and hunting ranges during different seasons and a range of hydrological conditions. For example, the location of feeding and nesting sites for white ibis and other wading birds, snail kites, and other common aquatic birds shifted across large spatial scales, across seasons and years, in response to variability in hydrological patterns (Kushlan, 1979; Bennetts et al., 1994; Hoffman et al., 1994; Ogden, 1994). The large number of ponds and depressions occurring over an extensive region allowed for comparatively sedentary species such as the alligator to maintain very large regional numbers (Craighead, 1968). Greater space enabled the system-wide aquatic production in a nutrient-poor ecosystem necessary to support large numbers of wading birds and alligators (Browder, 1976; Mazzotti and Brandt, 1994).

C.9.3.2 Influences from Industrial and Agricultural Practices

Another stressor on the Everglades ridge and slough system is degraded water quality. Increased loads of phosphorus and mercury, originating as by-products from an array of agricultural and urban industrial practices, were identified as the two alterations in water and soil quality that have been demonstrated or hypothesized, respectively, to have had the greatest ecological significance in the ridge and slough systems (Roelke et al., 1991; Spalding and Forrester, 1991; Lange et al., 1994; Browder et al., 1994; Davis, 1994; Frederick et al., 1997; Fink and Rawlik, 2000).

The pre-drainage ridge and slough Everglades was a shallow, clear-water, low nutrient system (Davis et al., 1987; SFWMD, 1992). Aside from fire and infrequent frosts, the unique vegetation of the Everglades evolved in response to both low-

nutrient water quality conditions and the seasonal fluctuations of water levels. Gleason and Spackman (1974) described a periphyton community in the northeastern Everglades that may be a remnant of a more widespread community prior to the impacts of elevated phosphorus levels. This is a noncalcareous periphyton (less than 10 percent calcium carbonate) community that is rich in desmids, a type of green algae found most abundantly in low-mineral, oligotrophic waters. Although the dynamics of mercury in the pre-drainage Everglades are poorly known, the level of total mercury in Everglades peat soils was about one-sixth the level found during the 1990s (Fink and Rawlik, 2000).

C.9.3.3 Water Management Practices

All five of the major ecological stressors acting on the ridge and slough systems, reduced spatial extent, the introduction and spread of degraded water, reduced water storage capacity, compartmentalization, and the introduction and spread of exotic species, have had part or all of their origins in water management practices. Major objectives of water management have included water supply and flood control, which have been achieved by means of a complex system of structural and operational modifications to the natural system. These modifications have 1) contributed to the substantial reduction in spatial extent, 2) provided a network of canals and levees that have accelerated the spread of degraded water and exotic species, 3) greatly reduced the water storage capacity within the remaining natural system, 4) created an unnatural mosaic of impounded and overdrained marshes in the Water Conservation Areas, and 5) substantially disrupted natural patterns of sheet flow direction, location and volume (SFWMD, 1992; Science Subgroup, 1993; Davis and Ogden, 1994; Light and Dineen, 1994; Fennema et al., 1994).

The pre-drainage ridge and slough Everglades was a single, hydrologically integrated system, with water depth and distribution (temporally and spatially) largely determined by seasonal and annual rainfall, evaporation, transpiration, natural topography, outflow through natural streams into the ocean, and the system's capacity for surface and ground water storage of water (SFWMD, 1992, Fennema et al. 1994). A key feature of the pre-drainage system was its large water storage capacity for extended periods of time, resulting in a system that was much wetter (but not necessarily deeper) than the current system. Water storage was facilitated by the natural damming effects of the east coast ridge and downstream coastal embankments, the large spatial extent of the system, the sponge-like properties of the peat soils, and the slow flow rates through the extensive marshes. As a result, the pre-drainage Everglades sloughs maintained multiyear surface water hydroperiods throughout the deeper, central marshes and along the downstream, marsh-mangrove ecotone, and extensive, shallow water "edges" that varied both spatially and temporally among seasons and years. The depth, distribution, and duration of surface flooding in this environment largely determined the vegetation patterns, as well as the distribution, abundance and seasonal movements and reproductive dynamics of all of the aquatic and many of

the terrestrial animals in the Everglades (Kushlan, 1989; Davis and Ogden, 1994; Holling et al., 1994; Walters and Gunderson, 1994).

C.9.3.4 Cultural Influences on Species Composition

The introduction, both intended and unintended, of large numbers of exotic species of plants and animals that have been considered desirable from the perspective of a wide range of human values, has resulted in regions of improved recreational fishing, localized shifts in fish community structure, loss of tree island habitat, and changes in marsh plant community structure. These changes are due to the interaction of nonnative species with changes in habitat, water quality, and hydrology. Although large areas of the ridge and slough are still considered "pristine," if current trends continue or if vegetation management funds do not increase there may be substantial impacts locally and regionally to the ridge and slough landscape pattern, food web dynamics, and genetic biodiversity. Cultural impacts considered most likely to require both monitoring and assessment include a) invasions by *Melaleuca*, *Schinus* and lygodium, and b) the distribution of nonnative fishes (Thayer et al., 2000; Loftus, 1990; Loftus and Kushlan, 1987; Goodyear, 2000).

C.9.4 Ecological Attributes

The Everglades ridge and slough model workshops recommended seven biological attributes of the ridge and slough systems that collectively, will provide the best measure of system responses to restoration projects (***Figure C-33, Section C.9.9***). The model shows how each attribute is linked to one or more stressors. The recommended measures for each attribute should be treated as priority components for a system-wide ecological monitoring program designed to measure the success of the CERP.

C.9.4.1 Peat Soils

The prevailing soils of the ridge and slough systems are Loxahatchee and Everglades peats, which are hydric soils created by depositions of decayed aquatic plants (e.g., *Nymphaea*, *Pontederia*, *Utricularia*, *Sagittaria*, and *Cladium*). Peats are indicators of prolonged flooding, characterized by 10 to 12 month annual hydroperiods, and ground water that only uncommonly dropped more than one foot below ground surface (Tropical BioIndustries, 1990). Soil accretion rates for peats in the pre-drainage system were estimated at 7.5 centimeters per 100 years.

Losses of peat soils of a few centimeters up to a meter have occurred widely in the ridge and slough Everglades, beginning with the earliest water management practices (Stober et al., 1996; Sklar et al., 2000). Shortened hydroperiods and lowered ground water levels in the ridge and slough system have caused extensive desiccation of soils. The overdrained soils have been lost through oxidation, and

increased frequencies and intensities of fires (especially during dry seasons). Loss of soils has substantially altered hydrological gradients, microtopography and flow patterns, increased surface concentrations of phosphorus, and contributed to changes in the structure and distribution of plant communities.

C.9.4.2 Periphyton

The species composition of the microalgal mats in the ridge and slough Everglades is broadly controlled by water depth, duration of surface flooding, and water chemistry (Browder et al., 1994). These algal mats are highly important as a food web base, and for oxygenating the water column. Communities of green algae and diatoms may be especially important to periphyton grazers.

Water management practices and changes in water chemistry including increased levels of total phosphorus have changed the spatial distribution and species composition of the periphyton mats (Browder et al., 1994; Davis, 1994). Water management practices have shortened hydroperiods in some areas and increased water depths in other areas. Shortened hydroperiods cause a reduction in the proportion of diatoms and green algae, and an increase in calcareous blue-green algae, thus reducing the food value of periphyton, and affecting the overall productivity of the Everglades. In nutrient enriched areas, species characteristic of low-nutrient waters are replaced by filamentous species.

C.9.4.3 Marsh Plant Communities

The pre-drainage Everglades ridge and slough system was a network of discreet sawgrass (*Cladium*) strands (ridges) and more open water sloughs dominated by water lilies (*Nymphaea*), spikerush (*Eleocharis*), and beakrush (*Rhynchospora*) (Gunderson, 1994; Gunderson and Loftus, 1993). It has been hypothesized that flow volumes in the pre-drainage ridge and slough system were largely responsible for maintaining the sharply discreet community and elevation differences between the ridges and sloughs (Sklar et al., 2000). The sloughs, deeper than the ridges, were the primary refugia for aquatic animals during dry periods, and were the most important wading bird foraging habitats in the Everglades.

The reduced water storage capacity of the managed Everglades, and the compartmentalization of the northern and central ridge and slough system, have slowed flow rates, have created areas that are either overdrained or are more deeply flooded than was the case in the pre-drainage system, have substantially altered the affects of fire on the marsh communities, and have altered the rates and magnitude of flooding and drying events. As a result, sawgrass has invaded sloughs and wet prairies, beak rush communities have been lost, woody plants have invaded marsh communities, and the extent and species composition of marsh communities has become extensively altered (Kolopinski and Higer, 1969; Davis et al., 1994; Sklar et al., 2000). Substantial increases in levels of total phosphorus in water and

soil have converted both ridge and slough communities into extensive beds of cattails (*Typha*).

C.9.4.4 Tree Islands

Discreet hardwood tree and shrub islands are a conspicuous feature of the Everglades ridge and slough system. Depending on elevation, these islands are dominated by swamp hardwoods (e.g., *Acer*, *Salix*, *Persea*, and *Annona*) or upland temperate and tropical species (e.g., *Ficus*, *Celtis*, *Eugenia*, *Mastichodendron*). Gawlik and Rocque (1998) found that tree islands support more species of birds than any other habitat in the central Everglades. Because the maximum elevations of the highest tree islands are only slightly above mean annual maximum water levels, tree islands with their less flood tolerant vegetation are the most sensitive component of the Everglades ridge and slough systems to changes in hydrology (Van der Valk et al., 1998).

Water management practices have substantially impacted Everglades' tree islands (Van der Valk et al., 1998; Sklar et al., 2000). An increase in the frequency and duration of unnatural high water events during wet seasons and an increase in the frequency and intensity of fire during dry seasons has damaged or destroyed many tree islands. The number of tree islands in Water Conservation Area 3 declined from 1,041 to 577 between 1940 and 1995 (Patterson and Finck, 1999; Sklar et al., 2000). For this same period, the total spatial extent of tree islands in Water Conservation Area 3 declined by 13,527 acres (61.5 percent).

C.9.4.5 Marsh Fishes, Invertebrates, and Herps

The Everglades ridge and slough systems were the most important centers of secondary production in the freshwater marshes of South Florida. In addition, the deeper, open sloughs were the principal refugia for fishes and aquatic invertebrates during low water periods, and were the places in the Greater Everglades where great numbers of wading birds concentrated to forage during dry seasons (Loftus and Eklund, 1994; Hoffman et al., 1989; Kushlan, 1986).

The total abundance (numbers and biomass) of fishes, crayfish, grass shrimp, frogs, and turtles in the ridge and slough system has been greatly reduced due to the combined effects of reduced spatial extent of total wetlands, increased frequencies and durations of dryouts in remaining wetlands, altered water recession rates, and possible reductions in secondary production associated with shifts in periphyton composition (Loftus and Eklund, 1994; Trexler and Jordan, 1999; Browder et al., 1994).

C.9.4.6 Alligators

The American alligator is a keystone species in the Everglades basin. Alligators create trails and ponds that become important wetland corridors and refugia during low water periods. They are top level predators that greatly influence the size classes, distribution, and abundance of marsh animals. Alligators were abundant in the pre-drainage Everglades. Highest numbers and densities in the pre-drainage system apparently were in the broad marl prairies that flanked the southern ridge and slough Everglades, and in the inner, "freshwater" mangrove forest zone downstream from the southern Everglades (Craighead, 1968).

In the modern Everglades, alligators are most numerous in the remaining ridge and slough systems (Craighead, 1968; Mazzotti and Brandt, 1994). It is hypothesized that alligator numbers have been greatly reduced in the marl prairies because of overdrainage and substantially lowered ground water levels (especially during dry seasons). Numbers have been reduced in the lakes and streams of the mainland mangrove forest because of reduced freshwater flow from the Everglades and the resulting higher salinities in these waters. Conversely, alligators may have increased in some portions of the ridge and slough systems (particularly Shark River Slough) where management practices have lowered wet season depths, thereby increasing the extent of suitable, shallowly flooded nesting and foraging habitat. Improved conditions for nesting have not occurred in all portions of the remaining ridge and slough systems, particularly in Water Conservation Areas 2 and 3 where compartmentalization has caused unnaturally deep water in the southern "conservation" areas and overdrained conditions in the northern areas. Alligators have also suffered in the managed system because of increased frequencies of nest flooding caused by impoundments and regulatory flows, reduced survival of juveniles in canals during low water periods, and poor rates of growth and development due to reduced prey populations in overdrained marshes (Jacobsen and Kushlan, 1984; Kushlan and Jacobsen, 1990).

C.9.4.7 Wading Birds

The large numbers of wading birds that once nested in the Everglades basin was one of the most defining features of the region. The largest and most persistent wading bird nesting colonies in the pre-drainage Everglades were located at the southern edge of the ridge and slough system along the marsh/mangrove ecotone at the lower end of Shark River Slough, and in the downstream mangrove region (Ogden, 1994). It is hypothesized that the unusually large "super colonies" (nesting numbers greater than one standard deviation in excess of the long-term annual mean; Frederick and Ogden in press) that periodically formed in the historical Everglades were a response by wading birds to extreme peaks in prey abundance created in the system by the affects of multiyear wet and dry cycles (Frederick and Ogden, 2001).

Wading birds in the current managed system have shown a 75 to 90 percent reduction in the number of nesting birds compared to 1930s numbers (primarily by snowy egrets, tricolored herons, white ibis and wood storks), have relocated colonies away from the estuaries and into the impounded central and northern Everglades, and for white ibis and wood storks, have altered the timing of nesting compared to historical patterns (Ogden, 1994). The percentage of wading birds nesting in and adjacent to the southern ridge and slough system in southern Everglades National Park has declined from greater than 90 percent during the 1930s to less than 5 percent for 1996-1999 (Gawlik, 1999). The vast majority of wading birds now nest in the Water Conservation Areas.

It is hypothesized that the reduction in number of nesting birds is largely due to a substantial decline in the abundance and availability of the aquatic prey base, caused by water management practices that have overdrained substantial portions of the remaining sloughs, and have altered the location, seasonal timing and magnitude of high water and low water events, relative to traditional colony locations. These hydrological changes have served to alter the location and timing of the centers of prey concentrations in the system. For animals such as wading birds, which operate over large spatial scales, compartmentalization and peripheral drainage have combined to convert a single, expansive wetland system into several, much smaller and hydrologically independent systems. Levees and canals have replaced shallowly flooded marsh edges with more deeply flooded marsh along levee slopes.

C.9.5 Ecological Effects: Critical Linkages Between Stressors And Attributes/Working Hypotheses

The ecological effects of the five principle stressors in the Everglades Ridge and Slough Conceptual Ecological Model are based on seven key hypotheses developed during the conceptual ecological model workshops. These hypotheses build on earlier Everglades' hypotheses presented in Davis and Ogden (1994) and Ogden et al. (1999). These seven hypotheses determine the content and organization of the Everglades Ridge and Slough Conceptual Ecological Model. The seven hypotheses are presented here, organized by stressor.

C.9.5.1 Reduced Water Storage Capacity

The ridge and slough Everglades has lost much of its original capacity to store natural volumes of water due to the reduction in the spatial extent of marshes. Two hypotheses have been developed for this effect.

C.9.5.1.1 Wet Season

Greater than historical (pre-drainage) water depths occur in the ridge and slough system when the spatial extent of natural wetlands (and of man-made water

storage areas) is insufficient to hold and distribute the wet season and/or wet year volumes of water that enter the system either as rain or surface flow. As a result of this reduction in region-wide storage capacity, water becomes "stacked" to unnatural depths in the marshes during wet seasons and wet years. Increased wet season/wet year depths leads to flooding of tree islands, loss of shallow feeding habitat for wading birds, altered and stressed periphyton communities (reduced light penetration), flooding of alligator nests and reduced quality of alligator feeding conditions, and altered species composition and size classes of fishes.

C.9.5.1.2 Dry Season

Greater than historical (pre-drainage) frequencies and durations of marsh dryouts occur in the ridge and slough system when the spatial extent of natural wetlands (and of man-made water storage areas) is insufficient to hold the wet season and wet year accumulations of water into the following dry season and dry years, respectively. As a result, water is not available to maintain marsh and ground water levels during dry periods. Increased frequencies and durations of dryout leads to increased rates of loss of organic soils due to increased fire and oxidation, spread of woody vegetation into marshes, reduced survival of fishes, small herps, and aquatic invertebrates, altered periphyton communities (diatoms/greens to blue-greens), reduced alligator nesting effort (dry marshes during courtship period), and expansion of sawgrass into slough communities (i.e., a degradation of the discreet ridge/slough mosaics).

C.9.5.2 Compartmentalization

The ridge and slough Everglades have been converted from a single, hydrologically integrated ecosystem to a collection of hydrologically independent systems (SCT 2003). This change was brought about by the current network of internal levees and canals, and the water management operational criteria that were established for each discreet compartment. Two hypotheses have been developed for this effect.

C.9.5.2.1 Effects of Levees

Internal levees have disrupted the directions, timing and rates of sheet flow, and have created mosaics of shallowly and deeply flooded marshes that are unnatural in location, juxtaposition, and in the duration and depths of flooding. Reduced rates of sheet flow have contributed to the leveling of pre-drainage ridge and slough topography and the loss of large amounts of open slough habitats. Ponding, in place of the strong seasonal and multiyear differences in flow rates and volumes that once characterized the interior Everglades, has disrupted the dynamics of cycling and transport of natural nutrients, and has substantially reduced the levels of primary and secondary production in the system. The patchwork of overdrained and overflooded marshes has changed the locations and times when and where aquatic animals operate in the Everglades. Wading bird nesting colonies have moved away

from the traditional estuarine locations, and have relocated around the less productive pools that have been created in each impoundment.

C.9.5.2.2 Effects of Canals

Internal and peripheral canals have altered the timing of water movement through the Everglades, and have created unnatural deep water corridors and habitats in many formally shallow water marshes. Increased rates of water movement in canals have substantially increased the rates of change in the depth of water in the marshes, and have altered the timing and duration of high water and low water events. These hydrological changes, in turn, have stressed many aspects of animal reproductive cycles (e.g., rapid increases in depth have flooded everything from alligator nests to apple snail egg clusters; rapid reductions in depth lead to longer periods of marsh dryout and reduced survival by aquatic animals). Deep-water corridors have degraded water quality by introducing nutrients and toxins into the interior marshes, and have reduced the amount of water that moves through the marshes as sheet flow. Deep-water corridors and habitats have altered the dynamics and sizes of alligators and fishes, and have opened up much of the Everglades to invasions by exotic fishes.

C.9.5.3 Exotic (Nonnative) Species

Exotic plants have invaded marsh and tree island communities in the ridge and slough Everglades, resulting in substantial shifts in species composition and community structure, and, where exotic plants have formed dense "stands," have reduced habitat diversity (e.g., where *Schinus, Melaleuca,* and *Lygodium* have invaded tree islands). The introduction and spread of nonnative fishes into localized habitats of the Everglades marshes may alter the dynamics of marsh fish communities, foraging behavior of wading birds, or genetic biodiversity. The CERP assumes a "precautionary conservation" approach in this regard. That is, nonnative animal introductions are not targets for restoration and are assumed to have negative impacts unless monitoring data can prove otherwise.

C.9.5.4 Reduced Habitat Extent

The spatial extent of the ridge and slough Everglades has been reduced from an estimated 490,000 hectare in the pre-drainage system to 365,000 hectare in the current system (a loss of 25 percent). The large extent and comparatively longer hydroperiods that characterized the original ridge and slough system made it the major center for total secondary production in the freshwater Everglades, and the most important refugia for the survival of aquatic animals during dry seasons and years. The reduced extent of this habitat type has 1) substantially reduced the number of options for where animals with large feeding ranges can find suitable foraging sites (e.g., wading birds and snail kites), 2) lowered the overall amount of aquatic production in a naturally, nutrient-poor environment, where space may

have been essential for producing the total biomass of prey necessary to support large numbers of higher vertebrates, and 3) eliminated large areas of long-hydroperiod habitat that kept many fishes and aquatic invertebrates alive during dry periods.

C.9.5.5 Degraded Water and Soil Quality

The pre-drainage ridge and slough system was characterized by clear, clean water; low levels of nutrients; and a periphyton community dominated by species of green algae and diatoms. Slower flow rates, unnatural patterns of ponding and overdrainage, and the addition of excess nutrients and toxins, have greatly altered the water and soil chemistry of the Everglades sloughs. Soil oxidation has resulted in increases in surface concentrations of phosphorus. Excess nutrients have contributed to the conversion of extensive strands and patches of sawgrass into dense cattail "plains," resulting in the loss of plant diversity and a reduction in the extent of useable wildlife habitat (e.g., for foraging wading birds). The increased nutrient loadings also have shifted the dominance of periphyton communities to species of blue-greens, resulting in considerable disruption in aquatic food chains. Toxins such as methylmercury have killed individual animals, and may be causing behavioral changes that interfere with the reproductive success and long-term rates of survival by many aquatic vertebrates.

C.9.5.6 Critical Ecological Linkages

The seven key hypotheses described above are converted into four critical ecological pathways in the Ridge and Slough Conceptual Ecological Model. These pathways show that the principal, broad-scale ecological responses from the combined effects of the five major ecosystem stressors acting on the ridge and slough systems have been 1) a substantial alteration and degradation in the natural patterns of plant community composition and structure and 2) substantial changes in the distribution, and reductions in abundance, among many of the native animals that are dependent on aquatic habitats and food chains. The relative contribution made by each of the stressors, along the different pathways to these two primary responses is not well known. For example, the presence of physical and biological thresholds, some of which may have been crossed as a result of the affects of the stressors, have yet to be demonstrated for most functions and relationships in the sloughs (an exception might be the 10 parts per billion value for phosphorus). Never-the-less, current understandings of the ridge and slough systems, as expressed by the conceptual ecological model workshop participants, suggest that these four ecological pathways have been most important for explaining how these two broad-scale, ecological responses have been linked to the stressors. These four pathways are as follows:

- The pathway that links the reduction in water storage capacity and the substantial increase in the extent and frequency of overdrained marshes

(shortened hydroperiods), with an array of ecological effects characterized by a spread in woody vegetation, reduced numbers of nesting alligators, reduced marsh production, reduced dry season survival by aquatic organisms, and the loss of peat soils.

- The pathway that links compartmentalization, and the adverse affects that levees have on water depth/distribution patterns and sheet flow, with altered patterns of nutrient cycling and reduced marsh production, and relocated animal distribution, production and survival centers.
- The pathway that links the reduction in water storage capacity, compartmentalization and the adverse affects of regulatory releases, with flooded tree islands and flooded alligator nests.
- The duel pathways that link degraded water quality and the effects of canals with increased phosphorus loading, resulting in the spread of cattail monocultures, degraded periphyton communities, and reduced marsh production.

C.9.6 Research Questions

Key uncertainties regarding causal relationships in the Everglades Ridge and Slough Conceptual Ecological Model need to be researched. The recommended research to support this conceptual ecological model is discussed in this section.

Causal Factors Determining the Spatial Coverage, Directionality and Persistence of Sawgrass Ridges, Sloughs, and Tree Islands in the Landscape

How do hydrology and fire interact to sustain the spatial coverage, directionality and coexistence of sawgrass ridges, sloughs, and tree islands that characterized pre-drainage landscapes? What are the respective roles of hydrologic variables and fire as causal factors that sustain discreet, directional slough systems and prevent encroachment by sawgrass? What are the respective roles of hydrologic variables and fire as causal factors that sustain viable tree islands and prevent drowning under high-water conditions and burn-out under low-water conditions? What are the potential impacts and eradication technologies for *Lygodium* spread on tree islands?

Prevention and Reversal of Cattail Spread under Conditions of Elevated Soil Phosphorus in Nutrient-Enriched and Nonenriched Areas in the Landscape

In nutrient-enriched areas of the ridge and slough landscape, how can current trends of cattail expansion be reversed once phosphorus inputs are reduced? In overdrained, nonenriched areas of the ridge and slough landscape, how can elevated phosphorus concentrations in the subsided peat be sequestered in forms that are unavailable for cattail growth upon the recovery of more natural hydropatterns?

Functional Role of Periphyton Mats in Driving Food Webs

How are populations of marsh fishes and other aquatic fauna related to the spatial cover, primary productivity, and taxonomic composition of periphyton mats?

Functional Importance of Crayfish in Everglades Food Webs

What is the functional importance of the crayfish as an intermediate trophic level and prey base supporting higher consumers, in that the former abundance of white ibis and otter suggests that the Everglades was dominated by a crayfish-based food chain? How are crayfish population density and taxonomic composition related to annual and interannual patterns in hydroperiod and depth, including droughts?

Causal Factors Related to the Formation of Wading Bird Super Colonies

What triggers the formation of super colonies of white ibis and other wading birds after major droughts following multiyear hydroperiods? What are the functional contributions and interrelationships of pulsed nutrient releases, reduction in numbers of predatory fishes, and spikes in abundance of small aquatic prey (particularly crayfish) in supporting super colony formation?

C.9.7 Hydrologic Performance Measures

The four critical pathways (above) suggested by the Everglades Ridge and Slough Conceptual Ecological Model are largely driven by hydrological stressors (reduced extent of wetlands, degraded water quality, reduced water storage capacity, and compartmentalization). These pathways suggest that the need for four high priority hydrological restoration targets for meeting the ecological objectives of the CERP.

C.9.7.1 Hydropatterns

The performance measure for hydropatterns includes hydroperiod, water depth and depth-duration patterns, and sheet flow. The targets for each of these aspects of the performance measure are discussed below.

For hydroperiod, the target is the reestablishment of pre-drainage, as depicted by the Natural System Model (NSM), annual and multiyear patterns in the duration of uninterrupted surface flooding in Everglades National Park and the Water Conservation Areas. The frequency, duration, extent and magnitude of marsh dry outs must be reduced. Included in this target is an increase in duration of flooding in the overdrained, northern ends of the Water Conservation Areas without an increase in unnatural flooding in the southern Water Conservation Areas, and a recovery of the pre-drainage patterns of multiyear hydroperiods in Shark River Slough.

The target for water depth and depth-duration patterns is the recovery of more natural water depth and depth/distribution patterns throughout the ridge and slough systems. This includes the elimination of both overdrainage of the northern portions of the Water Conservation Areas and overflooding of the southern portions of the Water Conservation Areas.

For sheet flow, the target is the recovery of natural patterns in the volume and direction of sheet flow throughout the ridge and slough systems. This includes eliminating or reducing unnatural ponding, and altering patterns of volume and direction of marsh flow.

C.9.8 Ecological Performance Measures

C.9.8.1 Peat Soils

The performance measure for peat soils is accretion rate. The recovery of a peat-accreting system throughout the Everglades ridge and slough should be the short-term restoration target. Included in this target are the recovery of peat accretion in portions of the sloughs where overdrainage has converted soil production from peats to marls (e.g., northeastern Shark River Slough), and the minimization of anthropogenic enrichment of soils. The long-term target is the recovery of pre-drainage soil depth and microtopography contour patterns.

C.9.8.2 Periphyton

The performance measure for periphyton is community composition, distribution and productivity. The restoration target for periphyton is to increase mat cover, biovolume, organic content, and percent noncalcareous algae and diatom composition. Measures of species composition can be used to reflect improvements in water and soil chemistry, and in hydroperiod and depth parameters.

C.9.8.3 Marsh Plant Communities

The performance measures for marsh plant communities are community distribution, proportions, and composition. The long-term restoration targets for marsh plant communities are 1) recover, at a system-wide scale, the expected mosaics and spatial and temporal dynamics of the marsh communities, as should occur with natural patterns of hydrology, fire and soils; 2) decrease the proportion and extent of sawgrass, where sawgrass has invaded slough and wet prairie habitats; and 3) reestablish spatial patterns of ridge and slough communities by restoring pre-drainage flow directionality and volumes. The short-term goal for cattails and exotic plants is to minimize the invasions of these species into ridge and slough communities. The long-term goal for cattails is to eliminate large, monotypic stands.

C.9.8.4 Tree Islands

The performance measures for tree islands are distribution, size and composition. The restoration targets for the ridge and slough tree islands are as follows:

> Prevent any further net loss in the extent and quality of tree islands, using the following criteria: 1) landscape distribution and spatial extent, 2) vegetation community composition, 3) habitat value and ecological function, and 4) geomorphology, including accretion, shape, elevation profile and orientation
>
> Recover lost tree island habitat where natural elevation rises are preserved, and where natural patterns of succession would be expected, using the above four criteria as measures of recovery
>
> Recover a more natural mosaic of tree island types across the landscape

C.9.8.5 Marsh Fishes and Invertebrates and Herps

The performance measures for marsh fishes and invertebrates and herps are community composition, size distribution and abundance. The following targets have been established:

- Recover multiyear patterns of fish dynamics, including multiyear increases in marsh fish numbers and biomass, to levels comparable to those measured in Shark River Slough following multiyear, uninterrupted hydroperiods
- Increase densities of the pig frog (Rana grylio) in portions of the ridge and slough system where hydroperiods have been unnaturally reduced to densities comparable to those found in remaining long-hydroperiod marshes
- Increase density of apple snails (Pomacea)
- Increase the size range in biomass and length distributions of marsh fishes
- Increase the relative of abundance of centrarchids and chubsuckers
- Increase the frequency of the species of crayfish typical of long hydroperiod marshes (Procambarus fallax) in relation to the species more characteristic of shorter hydroperiod marshes (P. alleni)
- Maintain the current low frequencies of exotic fishes in the interior ridge and slough system
- Reduce levels of mercury and other toxins in marsh fishes

C.9.8.6 Alligator

The performance measures for alligators are abundance, distribution, nest success, and occupied holes. The targets for alligators in the Everglades ridge and slough system are as follows:

- Shift the highest densities of nests in Everglades National Park from the center to the edges and downstream portions of Shark River Slough
- Establish more uniform density and distribution of alligators, occupied holes, and nests in the Water Conservation Areas
- Improve the overall "health" of alligators in Shark River Slough and the central/southern Water Conservation Areas and establish baselines for contaminant loadings for alligators
- Increase alligator reproduction rates in Shark River Slough and the central and southern Water Conservation Areas, as measured by 1) the frequency of alligator nesting, 2) the frequency of hatching, and 3) the survival of hatchlings
- Decrease the incidence of nest flooding caused by wet season regulatory releases and other water management practices in the Shark River Slough and Water Conservation Areas
- Increase the proportion of juveniles size classes in the total alligator population

C.9.8.7 Wading Birds

The performance measures for wading birds are the abundance, location, and timing of colonies, and the return frequency of super colonies. The targets are 1) increase in total number of wading birds nesting in and adjacent to the ridge and slough Everglades to those proposed by Ogden et al. (1997); 2) substantially increase the proportion of the total birds that nest in the area of the southern Everglades marsh-mangrove ecotone; 3) reestablish historical (1920s-1960s) timing patterns for nesting wading birds, especially for the wood stork and white ibis; and 4) return super colonies to the system at a return frequency of 1 to 2 events per decade. To recover their historical size, super colonies should occur in the headwaters' ecotone at the lower end of Shark River Slough. Super colonies may be the best indicators of the effects of natural hydrologic variability in the system.

The size, timing, and location of wading bird nesting colonies, as well as the occurrence and frequency of "super colonies", should reflect improvements in foraging habitat options under a range of climatological conditions. The quality of foraging habitat depends upon marsh production rates, survival rates of marsh organisms during dry periods, and the location of the major production and survival centers in the slough systems. Protective criteria need to be established for contaminant levels in sediment and water that result in no negative impact to wading birds.

C.9.9 Model

The diagram for the Everglades Ridge and Slough Conceptual Ecological Model is presented in ***Figure C-32***. The key to the symbols used in the diagram is presented in ***Figure C-33***.

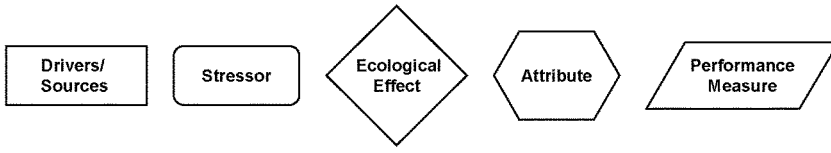


FIGURE C-32: KEY TO THE SYMBOLS USED IN THE FOLLOWING DIAGRAM

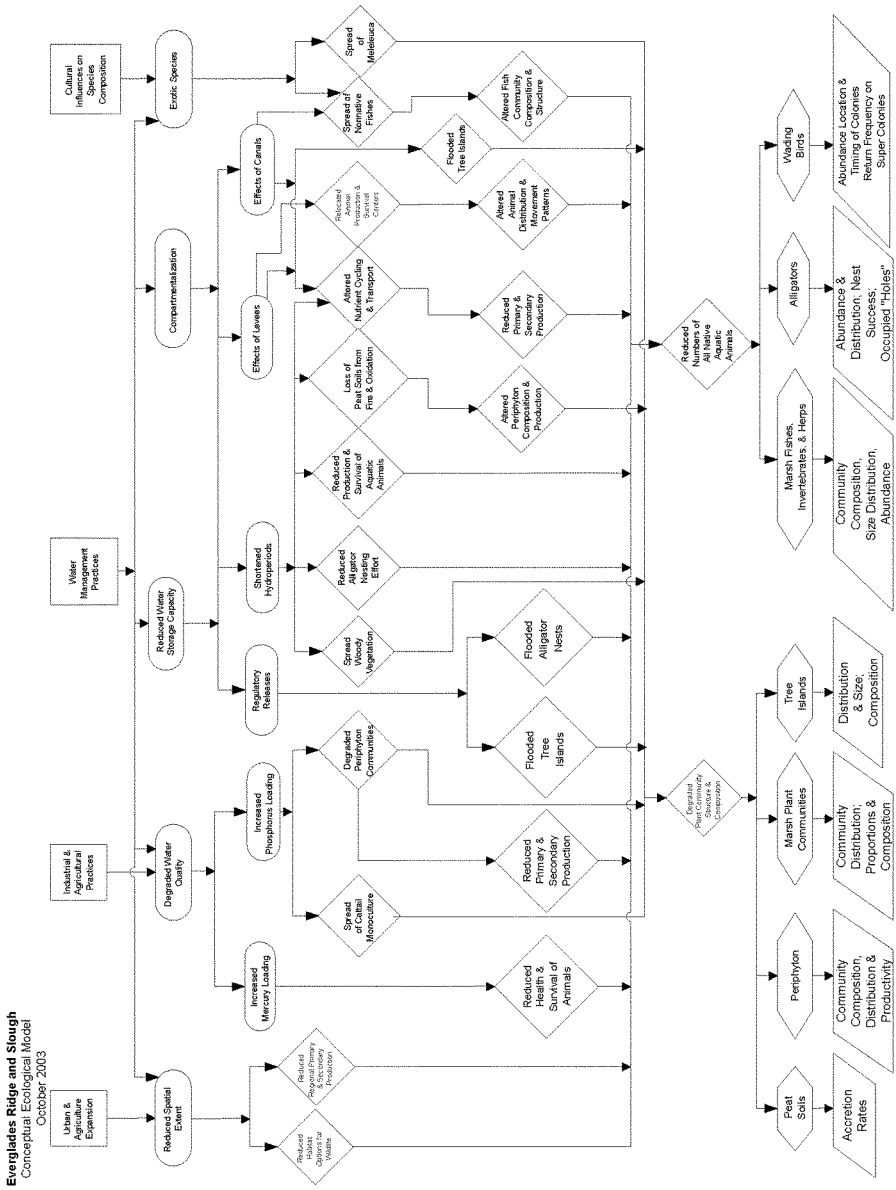


FIGURE C-33: EVERGLADES RIDGE AND SLOUGH CONCEPTUAL ECOLOGICAL MODEL DIAGRAM

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C.10 WATER QUALITY PLAN FORMULATION AND EVALUATION METHODOLOGY FOR THE WPA COMPONENTS

This information was modified from the Plan Formulation and Evaluation Methodology for the Water Preserve Area (WPA) Components report (SFWMD 2001) to focus on the Broward County Water Preserves Area (BCWPA) Project which includes the C-11 and C-9 impoundments and the WCA 3A/3B Seepage Management Area (WCA 3A/3B SMA).

C.10.1 Background and Introduction

The WPA Water Quality Team (WQT), which was created to evaluate the effect of five WPA alternatives on water quality conditions of the study elements (components) and co-chaired by the USEPA and the SFWMD in conjunction with the other WPA sub-teams, determined that the WPA Pre-Selected Plan (PSP) was preferred over other alternatives (Alternative 1 (ALT1), Alternative 2 (ALT2), Alternative 3 (ALT3)) and the selected Restudy Alternative (Alternative D13R (D13R)). The WQT consisted of staff from the following agencies: SFWMD, USEPA, FDEP, USACE, ENP, Loxahatchee National Wildlife Refuge (LNWR), Miami-Dade County Department of Environmental Resources Management (DERM), USFWS, Seminole Tribe Representative, and the Broward County Department of Natural Resources Protection (DRNP).

The main tasks of the WQT were to:

1. Develop water quality performance measures to use as decision making tools in the feasibility study.
2. Interpret results of the WPA groundwater modeling in terms of hydroperiod changes within WPA elements (wetting or drying of the WPA elements by exceedance or non-exceedance of a selected water depth).
3. Evaluate the performance of the WPA reservoirs in terms of water quality parameter changes as water transits through the WPA elements.
4. Assess the Inherent Capacity of Wetlands to improve and maintain water quality. This technique is known as Water Quality Functional Assessment (Zahina, 2001).
5. Make recommendations to the WPA managers about which of the alternatives effectively improve water quality conditions.

Items 2 and 3 mentioned above are quantitative in nature; they are determined using measurable parameter values. Item 4 is of a qualitative nature; it assesses the physical or chemical functions of a wetland or reservoir to improve water quality.

The variables that were used as performance indicators for the groundwater models were depth of the reservoir (frequency of drying or wetting by exceeding or not

exceeding a selected or pre-established depth) and the residence time in the reservoir. Although not explicitly stated, at times duration curves or stage graphs were used to interpret the groundwater data for water quality analysis.

The water quality constituents that were used in evaluating the fate of water quality constituents in the WPA elements were total phosphorus (TP) and dissolved oxygen (DO). These two constituents seem to be the most important in the study areas. The concentration and load reduction of TP or the depletion of DO as water moves through the reservoirs were the key variables used as performance indicators.

The functional assessment approach uses the characteristics of the WPA elements such as hydroperiod, pH, vegetation types and soil properties to determine whether or not the component can support pollution mitigating mechanisms. Special models are used to describe the major pollution mitigating mechanisms in wetlands (e.g., denitrification and soils sorption). The performance measures of the functional assessment are qualitative values of "low," "moderate" or "high".

Water quality performance indicators were obtained using first level planning water quality models. The primary models are Bill Walker's Model (1998) developed to assist with the analysis of water quality performance of the Restudy and the EUTROMOD developed by Rechow (1992). These are empirical models that are highly data dependent.

Walker's model assumes complete mixing of the water body and simulates phosphorus concentration changes over long time periods. Walker (1998) pointed out that model results may be conservative (i.e., the model tends to underpredict actual phosphorus retention amounts). This limitation should be kept in mind when interpreting the results of the model. Walker's model has been used to size all the Everglades Construction Project (ECP) stormwater treatment areas (STAs).

The EUTROMOD also assumes complete mixed conditions and is used to predict TP, total nitrogen (TN) and chlorophyll-a levels in a water body. The EUTROMOD has been calibrated to Florida conditions, but still remains a very empirical model.

The above named models and other water quality models used in the Water Preserve Areas Feasibility Study (WPAFS) are described in detail later in this report. The WQT used these models because first level design issues were being addressed in the WPAFS. In addition, most of the key restoration projects such as Everglades Nutrient Removal (ENR) and the STAs of the ECP were built using Walker's model and approach. It is anticipated that short time step models could be used at the detailed analysis level to improve on the analyses conducted through the WPAFS process and to determine an optimal operation scheme that maximizes water quality benefits.

For each alternative, groundwater model outputs were reviewed. The flows from these models were processed, the water quality models were run and the functional assessment of each component was evaluated. The WQT team met to compare the alternatives to D13R and to determine if the alternatives improved conditions beyond D13R. Two decision matrices were developed: one for the quantitative approach and one for the functional analysis. Both matrices were evaluated and decisions were made by the team to select the best alternatives. The process used in selecting one alternative over another are defined later in the report.

During the final evaluation process all the WPA sub-teams met to decide which alternative to use for a given component. The WQT was faced with the need to make trade-offs in the selection of the PSP. The main factor in choosing the best alternative was the purpose or designated used of the impoundment or WPA element. Although water quality improvement is desired, there were times where other variables such as water supply needs or natural area improvement features were key considerations in the design of the impoundment. In those cases, preference was given to the alternative that met the designated function the best. Therefore, as shown later in the report, the best water quality alternative was not necessarily the one selected for the PSP.

C.10.2 Description of Components Analyzed

C.10.2.1 General Description

For the purpose of this analysis, the WPA components were grouped into three major categories:

1. The conveyance components: Dade/Broward Levee Improvement, the C-4 East Structure and the North New River Conveyance Improvement.
2. The reservoir components: C-9 Impoundment and C-11 Impoundment.
3. The WRAs (Water Redistribution Areas): The C-9 and C-11 impoundments could be classified as WRAs if necessary.

The conveyance components do not include storage areas (except as canal storage) because they are flow through elements. Water moves through these components as long as there is the necessary conveyance capacity. The conveyance components were generally not targeted for water quality analysis. The impoundments are used as water storage areas. Some of the impoundments are associated with aquifer storage and recovery (ASR) wells which could cause the impoundments to dry out because much of the water is stored in the ASR wells. WRAs are used as treatment areas and are made up of polishing cells or units. The WRA requirements to meet water quality standards are not as strict as those for STAs. The reservoirs, WRAs, and STAs were targeted for in-depth water quality analysis.

During the Restudy, STAs and WRAs were proposed at strategic locations to treat the water to meet certain standards before release. These locations were typically adjacent to sensitive areas, such as the Water Conservation Areas, to treat TP to 50 ppb with a settling rate of 10.2 m/yr (Everglades Construction Project settling rate) based upon data gathered from adjacent canals in the study area. It is believed that the new treatment systems will have a higher settling rate than 10.2 m/yr, which could reduce effluent TP concentration to levels lower than 50 ppb. The early findings of Dr. Bob Knight revealed that periphyton-STAs could reach a settling rate of close to 27.0 m/yr.

C.10.2.2 Description of Components Water Quality Criteria (Source and Outflow Waters)

In order to effectively assess the performance of a WPA component in terms of water quality improvement, it was necessary to examine the inflow source of water being sent to the component as well as the receiving body of water.

Table C-36 contains background water quality criterion that the WPA components should meet.

In the review process, the WQT established the following overall water quality criteria:

- For components discharging to sensitive areas such as WCA 1, water is to be treated by available technology (polishing cells or STAs) so as to meet existing non-degradation criterion for water releases to the sensitive water bodies. Criteria such as the Everglades Forever Act (EFA) for TP or 80 percent load reduction of constituents that may cause impairment of the quality of the receiving water body should apply.
- When the component's primary use is for storage for water supply purposes, the main water quality criterion is to meet the ambient water quality standard of the discharge canal of the designated component. A reduction of concentration or load from the impoundment is deemed as a positive effect for non-dissolved oxygen parameters (an increase is desired for DO). Polishing cells can also used to improve effluent quality at the detailed design phase of the project if necessary.
- Issues concerning the restoration of existing canals classified as impaired water bodies (303d list) are not specifically addressed in the WPAFS. Canal restoration issues are part of the overall CERP integrated water quality plan that is to be developed by the FDEP, EPA, local agencies, and the SFWMD. It is assumed that all the benefits to be gained from the future restoration of the canals such as achieving total maximum daily load (TMDL) goals and implementing best management practices (BMPs) (wetlands, spreader swales, ponds, infiltration trenches, etc.) will help enhance the performance of the WPA components.

- ASR water quality concerns are addressed by the ASR project team.
- Groundwater quality issues were not addressed in the same level of detail as the surface water quality. It is assumed that except for the ASRs, the CERP Project Delivery Team (PDT) will address groundwater quality issues and provide additional information to refine the estimates summarized in this report.
- Several of the few components have a direct impact on regional water quality (Acme Basin B and S-9). It has been a challenge to determine the impact of WPA components on the coast because the majority of the components are not located near the coast. However, when the component decreases water quality constituent loads in sensitive areas, it is a great benefit to the regional water quality.
- Issues not addressed in the WPAFS could be addressed at the detailed design level.

TABLE C-36: WPA COMPONENTS' WATER QUALITY INFORMATION

WPA Component Name	Source Inflow to the Component	Receiving Water Body	Water Quality Criteria
C-11 Diversion Impoundment and Canal	C-11 Canal System	1. Western C-11 Diversion Canal G-86S 2. C-11 Canal	1. Meet Ambient Canal Water Quality Criteria. 2. ESP and Integrated Water Quality Plan to address water pumped to WCA 3A
C-9 Impoundment	1. Water From North Lakebelt Reservoir when Reservoir Exists 2. C11 Diversion Canal	1. C-9, C-6/C-7, C-2/C-4 Canals 2. 125 MGD ASR Wells	1. Meet Ambient Canal Water Quality Criteria 2. Meet Condition for Pumping to ASR Wells

C.10.2.3 Description and Screening Components for Water Quality

The first step in the analysis of the WPA alternative was to obtain available data for the components being analyzed. A meeting was conducted to gather the data in three geographical areas: Palm Beach, Broward and Miami-Dade counties. Representative from the counties provided very valuable information for the study. Whenever possible, data that was collected over the last ten years was used for the data screening process.

In some regions, there were numerous stations monitored. In these areas, the WQT chose only those sampling stations that could have an impact on the impoundment water quality. The ultimate goal in a water quality analysis is to use measured flow proportional data for selected constituents to determine the effectiveness of the component in improving water quality using predictive water quality models. For

some of the components, such as the C-11 Impoundment, flow proportional nutrients data were available for use. For the components that did not have flow proportional data available, grab sample data were used.

Statistical software programs were used to screen the water quality data and the mild or extreme outliers were removed from the data before analysis. The following is a detailed description of the stations and the data used for analysis in the report.

C.10.3 The C-11 Impoundment Water Quality Data

The C-11 Impoundment is located in the western C-11 Basin and the S-9 pump station discharges to WCA 3A. Flow and water quality are monitored and recorded at the S-9 pump station as indicated in ***Figure C-34*** below. Data recorded over the period of May 1989 to April 1999 was used in the analysis and these data were collected as either grab or weekly flow composite samples. An auto-sampler was installed at S-9 in 1996.

Data were provided by the SFWMD ECP staff who has conducted an extensive water quality data review of site. The range of concentration over the period of record is 14 ppb to 20 ppb on average annual. The average inflow DO concentration is 2.12 ppm and the average inflow TP concentration is 0.016 ppm.

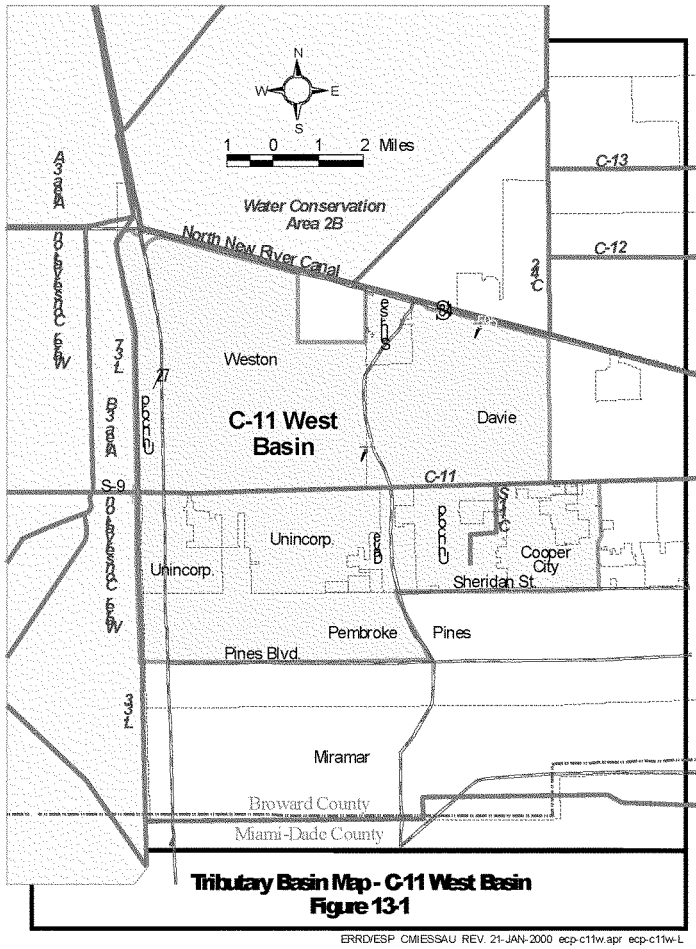

FIGURE C-34: MAP OF THE C-11 IMPOUNDMENT RELATED WATER QUALITY SITE

C.10.4 The North New River Water Quality Data

Water quality data collected at Station G-123 (DNRP site 23) were used in the analysis (see ***Figure C-35***). The TP data range from 4 ppb to 51 ppb with an

average of about 18 ppb. DO levels vary between 0.5 mg/ to 8.15 mg/l with an average concentration of about 3.47 ppb.

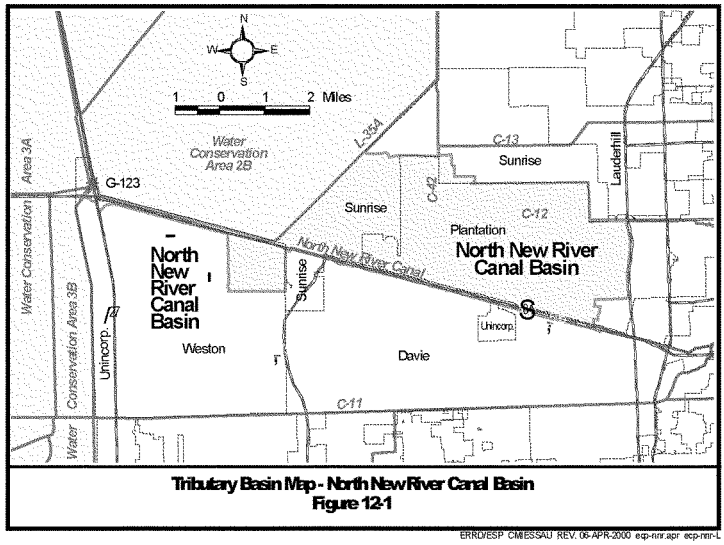

FIGURE C-35: MAP OF THE NORTH NEW RIVER WATER QUALITY SITE

C.10.5 The C-9 Impoundment Water Quality Data

Water quality data from two sites, Station 31 and 32, were used for the analysis. These stations are monitored by the Broward County Department of Planning and Environmental Protection. Data are collected on monthly and quarterly basis at the stations shown in ***Figure C-36*** below. The period of record for the data is 1989 to 1999.

The range of DO concentration at both sites is 0.1 mg/l to 7.2 mg/l. TP values ranged from 0.02 mg/l to 0.141 mg/l. The average values for DO and TP are reported in ***Table C-37*** below. More than 82 points for each constituent were collected during the period indicated above.

TABLE C-37: AVERAGE OF TP AND DO CONCENTRATIONS FOR THE C-9 IMPOUNDMENT

WPA Element Designation	Average Inflow DO Levels (ppm)	Average Inflow TP Concentrations (ppm)
C-9 Impoundment (C-9)	3.26	0.039

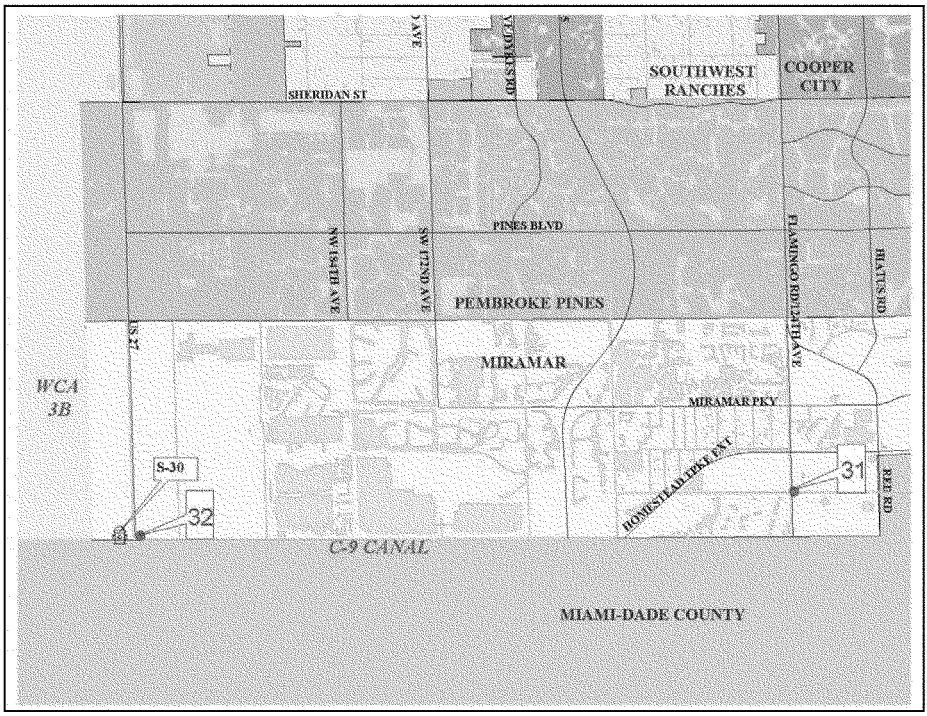

FIGURE C-36: MAP OF THE C-9 WATER QUALITY SAMPLING SITES

C.10.6 WPA ALTERNATIVE ANALYSIS SCHEME

C.10.6.1 General Analysis

C.10.6.1.1 Quantitative Analysis

One of the challenges that the WQT faced was to develop a scheme to compare various alternatives with D13R and select the best alternative in terms of meeting flood control, water supply, water quality and environmental needs requirements. The components were evaluated according to two main criteria:

- Hydrologic Criterion (residence time, dry-out/wet frequency, optimum depth criterion)
- Water Quality Criterion (TP concentration reduction, load reduction; DO concentration increase or decrease.)

The water quality models mentioned earlier in the report were used to evaluate the performance of the WPA elements in terms of concentrations and TP load reductions. The EUTROMOD has given more consistent results when used to evaluate the fate of TP in the reservoir. Therefore EUTROMOD was used to estimate the average outflow TP concentration from WPA reservoirs for a given inflow TP concentration and a yearly inflow volume. Dr. Walker's STA model was used determine the fate of TP in STAs. The STA Model is used to determine concentrations at the outlet of an STA when the inflow volume and concentration are known. A regression model proposed by Kadlec and Knight (1996) was used to evaluate DO concentration at the outflow in the impoundments. The retention times were also evaluated with a method proposed by Kadlec and Knight (1996).

C.10.6.1.2 Qualitative Analysis: Inherent Capacity Of Wetlands To Improve Or Maintain Water Quality

One component of the water quality functional assessment analysis is the inherent capacity of wetlands to reduce, degrade, or offer long-term storage of a specific pollutant. This is based on the concept that not all wetlands are created equal, therefore they do not all have the same capacity to moderate pollution inputs. Some wetlands have conditions (such as hydroperiod, pH, vegetation type, and soil properties) that promote the function of pollution-mitigating mechanisms, while others have unfavorable conditions. Models were developed to describe the major pollution mitigating mechanisms in wetlands (e.g. denitrification and sorption to soil particles) with respect to physio-chemical characteristics. Databases with the appropriate input parameters and model output were used to screen WPA components for characteristics that support pollution mitigating mechanisms. The rating products from the functional assessment are qualitative values of "low," "moderate," or "high." The following pollutants were considered: nitrogen, phosphorus, micronutrients, heavy metals, suspended particulates, pathogenic organisms, and pesticides. Pollution mitigating mechanisms considered in the analysis are as follows:

- Nitrogen: loss due to denitrification and long-term uptake/storage by the plant community
- Phosphorus: long term sorption to soil particles and long term uptake/storage by the plant community
- Micronutrients: long term sorption to soil particles and long term uptake/storage by the plant community
- Heavy metals: long term sorption to soil particles
- Suspended solids: settling out/retention
- Pathogenic organisms: settling out/retention
- Pesticides: retention and conditions necessary for degradation

The assessment was conducted for each alternative in the WPAFS with input data provided by several sources. Soil data was supplied by the Natural Resources Conservation Service's county soil survey database (NRCS 1995). This database includes pH, surface texture, presence of a spodic layer, and depths to a confining layer (soil thickness). Hydroperiod and mean depth of flooding were derived from sub-regional groundwater model output.

C.10.6.2 Description of Evaluation Matrix and Performance Measures

The following matrix was use to rate and select the PSP. At the start of the matrix development process the performance measures were given different weights; however, after review it was suggested that the same weight be given to all performance measure variables.

C.10.6.2.1 Quantitative Matrix Analysis

TABLE C-38: MATRIX WITH PERFORMANCE MEASURES AND ASSOCIATED PERFORMANCE RATING

Objective	**Weight (W)**	**Performance Measure**		**Performance Rating (R)**			
Evaluation of The Hydrology of WPA and its effect on Water Quality (WQ)		**Hydrologic Criteria**	**Target**	**D13R**	**Alt 1**	**Alt 2**	**Alt 3**
Prevent Dry-out of WRAs/STAs	1	Frequency of Depths < 0.5 ft	Lower is Better Unit: Frequency				
Allow WRAs/STAs to function in optimum Depth Range	1	Frequency of Depths > 2.0 ft for WRAs	Lower is Better Unit: Frequency				
Prevent Dry-out of Reservoir	1	Frequency of Depths < 0.75 ft for Reservoirs	Lower is Better Unit: Frequency				
Increase performance of Reservoir for WQ Constituents Reduction	1	Frequency of Depth > 3.0 ft for Reservoirs	Higher is Better Unit: Frequency				

Objective	Weight (W)	Performance Measure		Performance Rating (R)			
Allow water to stay in WRAs or Reservoir for Assimilation or Sedimentation	1	Residence Time Unit: Days	Longer is Better				
Evaluation of Concentration Changes in WPA		**Criteria**	**Target**				
Determine the ability of WPA to reduce Water Quality Constituents Concentrations	1	Concentration Reduction for TP Unit: Percentage	Higher is Better				
Determine the ability of WPA to increase DO Levels	1	Concentration Increase for DO Unit: ppb	Higher is Better				
Evaluation of Constituent Mass Reduction In WPA	**N/A**	**Load Criteria**	**Target**				
Measure Ability to reduce constituent loads in WPA	1	Load Reduction Unit: Percentage	Higher is Better				

For a WRA/STA the following performance measures are used:

- Frequency of depth less than 0.5 ft: A lower frequency is better because when an STA/WRA is dry, it cannot reduce pollutant concentrations.
- Frequency of depth less than 2.0 ft: A lower frequency is better. STAs function better when depths are between 0.5 to less than two 2.0 ft. Too much water may impede the plant uptake. Maximum STA/WRA is about 4.0 ft.
- Residence time: The higher the residence time the better chance the STA/WRA will fix phosphorus thereby reducing STA outflow concentrations.
- TP concentration reduction: The higher the reduction the better the system will function.
- TP load reduction: The higher the reduction the better the system.

- DO concentration increase: The system is assumed to perform better when there is a DO concentration increase. The ultimate goal is to meet the 5.00 mg/l Class III criterion whenever possible.

For reservoirs, the following performance measures were used:

- Frequency of depth less than 0.75 ft: A lower frequency is better because when an STA/WRA is dry, it is less effective reducing pollutant concentrations.
- Frequency of depth greater than 3.0 ft: A higher frequency is better. Reservoirs are more effective in reducing concentration when depths are close to one meter (about 3 ft) (NURP, 1996).
- The TP concentration and load reduction criteria and the DO increase criterion remain the same as defined for WRA/STAs.

C.10.6.2.2 Qualitative Matrix Analysis

The wetland functional assessment method uses various colors to express whether or not a given component will reduce a specific water quality parameter. The following legend as shown in the ***Table C-39*** below is used to qualify a given component.

TABLE C-39: CAPACITY TO REMOVE, DEGRADE, SETTLE OUT, OR PROVIDE LONG-TERM STORAGE OF SPECIFIC POLLUTANTS FOR A GIVEN ALTERNATIVE

	Nitrogen	Phosphorus	Micro-nutrients	Heavy Metals	Suspended Solids	Pathogenic Organisms	Pesticides
C-11 Impoundment/Diversion	G	G	G	G	G	G	G
C-9 Impoundment	G	Y	G	G	Y	Y	G

Color Key: G (green) = high capacity to improve water quality, Y (yellow) = moderate capacity to improve water quality, R (red) = low capacity to improve water quality, "N/A" = insufficient data for analysis.

C.11 WATER QUALITY EVALUATION METHOD

C.11.1.1 Quantitative Matrix Analysis

The purpose of the evaluation matrix is to comparatively look at the D13R, ALT1, ALT2 and ALT3. The matrix is a decision tool that helps select the most viable alternative from a water quality perspective. There are three variables for the

hydrologic criteria, two for the concentration criteria and one for the load criteria. All these variables are equally weighted. The goal was to score the four alternatives among themselves based upon their relative performances in meeting a set target. The proposed scores are from 1 to 4.

A non-parametric statistical approach was used to rank the alternatives. Several examples are provided to illustrate the method. In the examples a longer retention time is judged better and therefore has a lower rank.

First Example

Components:	D13R	ALT1	ALT2	ALT3
Numerical Variable Value	30	40	50	70
Rank Scores	4	3	2	1

Second Example

Components:	D13R	ALT1	ALT2	ALT3
Numerical Variable Value	30	40	70	70
Rank Scores	4	3	1.5	1.5

Third Example

Components:	D13R	ALT1	ALT2	ALT3
Numerical Variable Value	30	40	40	40
Rank Scores	4	2	2	2

Fourth Example

Components:	D13R	ALT1	ALT2	ALT3
Numerical Variable Value	40	40	40	40
Rank Scores	2.5	2.5	2.5	2.5

Under this scenario, the alternative with the lowest score is the best for the performance measure under consideration.

C.11.1.2 Results of the Matrix Analysis

In addition to the groundwater model data used in the development of the matrices, a significant amount of water quality modeling work and analyses needed to be completed before the matrices were developed. The results of these discussions are critical to understanding the summary information reported in the matrices.

C.11.1.2.1 Results of Quantitative Analysis

C.11.1.2.1.1 General Results

The results obtained from model runs are reported in

Table C-40 for each component.

TABLE C-40: WATER QUALITY INFORMATION FOR TP AND DISSOLVED OXYGEN AND BENEFITS PROVIDED BY WPA FEATURES

Component	WQ Parameter	Inflow Conc. Mg/l	Outflow Conc. Mg/l	% Conc. Reduc.	Inflow Load Kg/yr	Outflow Load Kg/yr	% Load Reduc.	Benefits
C-11 Res	TP	0.016	0.016*	0*	1224	1125	8**	Divert flows from S-9, send to C-9 Res. of Lakebelt Storage Area.
	DO	2.12	2.78	31.06	N/A	N/A	N/A	Substantial DO increase, positive impact.
C-9 Res	TP	0.039	0.037	5	5484	3993	27**	Used with C-11 Res. to divert water from S-9, send to Lakebelt Storage Area.
	DO	3.26	2.92	-10.20	N/A	N/A	N/A	Need aeration at outlet of impoundment

* Present TP concentration of 0.016 mg/l is considered very low. It is unlikely that further retention in the impoundment would result in concentration decrease. At this concentration level the model may not reached accurate result. Therefore it is assumed that there is no additional concentration decrease due to storage. The change of concentration is taken to be zero.

** The load reduction in the table is the reduction as water transits through the C-11 Impoundment. The ultimate benefit of the C-11 and C-9 impoundments under the PSP alternative is that both used together provide a 93% TP load reduction to WCA n3A compared to current condition. This reduction is even better with the PSP than ALTD13R. The results are discussed in details in the following paragraphs.

C.11.1.2.2 Results for Components with Major Regional Water Quality Impact

Some of the WPAs have more critical and quantifiable impacts on the regional system than others. The components with critical impact on the overall system under the PSP are analyzed in more detail in the following paragraphs.

C.11.1.2.2.1 C-9 and C-11 Impoundments

The operation of C-11 and C9 impoundments has an impact on the flows released to WCA 3A. Under D13R stormwater from the Western C-11 Basin is stored in a 4.0 ft deep impoundment for further release to the North Lakebelt Storage Area when the capacity of the impoundment is exceeded. Water could be routed to the C-9 Impoundment for water supply purposes when needed.

Under the WPA-PSP alternative, with the Lakebelt Storage Area not online, the C-11 and C-9 impoundments are combined to store water that would have been otherwise been released to WCA 3 or to tide. These two units used as storage reservoirs have a highly significant impact in diverting stormwater from WCA 3. The C-9 Impoundment can store water above its operation level in its associated ASR wells. The water stored in the C-11/C-9 impoundment system is used to meet water needs in the C-9, C-6, C-7, C-2 and C-4 canals and Biscayne Bay. The flows released through the S-9 pump Station are given in ***Table C-41***.

TABLE C-41: FLOWS TO WCA 3A THROUGH S-9

	WPA-PSP (ac-ft/yr)	**D13R1198 (ac-ft/yr)**	Existing Condition (ac-ft/yr)
Flow from S-9 to WCA 3	15,000	22,000	210,0077*

* Historical water volume for the period May 1989 to April 1999 at S-9.

TABLE C-42: LOADS TO WCA 3A THROUGH S-9

	WPA-PSP (kg/yr)	**D13R1198 (kg/yr)**	Existing Condition (kg/yr)
Load from S-9 to WCA 3	298	434	4146

TABLE C-43: LOAD REDUCTION OF WPA AND D13R SCENARIOS VERSUS EXISTING CONDITION (%)

	WPA-PSP	**D13R1198**	Existing Condition
Load Reduction	93	90	0

The above tables show that the WPA-PSP and D13R have a high diversion of flows and load from WCA 3A. WPA-PSP (the selected alternative) fares better than D13R1198 (the corrected version of Restudy alternative D13R0698) and, as a result, there is a tremendous benefit to using the C-11 and C-9 impoundments jointly as a

water management system because pollutant loads to WCA 3 are highly reduced by operating both together. The impact of the two reservoirs on improving water quality in WCA 3A is immeasurable.

Matrix Scoring

The matrix template proposed in ***Table C-38*** was used to score the alternatives according to the groundwater and water quality performance measures presented earlier this report. The results from the comprehensive matrix were used to obtain the overall matrix for water quality (see ***Table C-44***).

TABLE C-44: WATER QUALITY RANK SCORES FOR WPA ALTERNATIVES INCLUDING THE EFFECTS OF HYDROLOGY, TP REDUCTION, DO INCREASE AND LOAD REDUCTION THROUGH THE WPA

WPA Elements	D13R	ALT1	ALT2	ALT3	Selected Alternative	Comments
C11_RES	19.5	18.5	9	13	ALT2	ALT2 has a better performance, ALT3 is not too Different. D13R and ALT1 have same performance(Hydro -logy, Load)
C9_RES	14.5	16.5	17	13.0	ALT3	ALT3 is just little better than D13R (Hydrology, Load). Quantitative and qualitative analysis are not far apart. Alt1 and ALT2 have about same Performance.

Note: The table also includes the results of the qualitative ranking described below.

C.11.1.3 Results of Qualitative Analysis

Cumulative water quality rating scores were determined for each alternative. The values are the total qualitative ratings multiplied by the component area. Numbers in bold italics indicate the alternative with the highest score.

TABLE C-45: RESULTS OF THE QUALITATIVE MATRIX ANALYSIS

	D13R	ALT. 1	ALT. 2	ALT.3
C-11 Component	30400	***32946***	26232	29103
C-9 Component	***47500***	32414	29274	31998

C.11.1.4 Final Matrix

After all the WPA sub-teams had completed their evaluation of the alternatives, there was a meeting to select the alternative that was most appropriate for each of the components under study. The following table contains the selected alternative for each WPA component.

TABLE C-46: PRE-SELECTION OF PLAN WATER PRESERVE AREA FEASIBILITY STUDY 8/21/00

Component	PSP	Comments
C-11 Impoundment	Alt 1	Move mitigation to North/Northwest corner; improve seepage mgmt on east side without negatively impacting mitigation outside impoundment.
C-9 Impoundment	Alt 1	Increase ASR if needed; include FDOT mit; identify and include additional water supply demands.

C.11.2 General Model Information for WPA Alternatives Analysis

The following is the detailed description of models used to assess the Water Quality Performance of STAs and Reservoirs for the Water Preserve Areas and the Senate Bill 1672 Feasibility Studies.

C.11.2.1 Dr. William Walker's Models

Walker (1998) developed water quality models to determine the fate of TP for STAs and reservoirs. One of the models is used to simulate TP in STAs and the other calculates TP concentrations at the outlet of the reservoirs. Both are empirical models that are calibrated with data collected in STAs and reservoirs in Michigan, Florida, Washington D.C., Missouri, Illinois and Minnesota. The STA model is similar to the TP model used to evaluate the sizing of the ENR STA and the Everglades Construction Project (ECP) STAs. The reservoir model was originally developed for predicting water quality changes in the United States Army Corps of Engineers (USACE) reservoirs and adapted for use with wet detention systems receiving urban stormwater. Agreement between data sets and in different climatic regions was satisfactory to allow use of the model for water quality analysis in South Florida. The reservoir model assumes complete mix conditions and is used to simulate phosphorus concentration changes over (at least annual average) time periods. It handles rainfall phosphorus and seepage phosphorus as input variables, in addition to the traditional system inflow TP concentration.

<u>Equations Used for Predicting Phosphorus Retention in Stormwater Treatment Areas and Storage Reservoirs:</u>

C.11.2.1.1 Model Assumptions

Water Balances for STAs or Reservoirs:

Differential Equation:

$$d Q / d A = b = P - E + Us - Uo$$

Boundary Condition:

$$Q = Qi \ @ \ A = 0 \text{ (inflow to wetland)}$$

Solution for Outflow Volume:

$$Qo = Qi + b A$$

Phosphorus Balance for Stormwater Treatment Areas:

Differential Equation:

$$d (QC) / dA = P Cp + Us Cs - Ke Fw C - Uo C$$

Boundary Condition:

$$QC = Qi Ci \ @ \ A = 0$$

Solution for Outlet Concentration (Plug Flow Conditions):

$$Co = Cb + (Ci - Cb) (Qo / Qi) (-r / b)$$
$$r = P - E + Us + Fw Ke$$
$$b = P - E + Us - Uo$$
$$Cb = (P Cp + Us Cs) / r$$

Phosphorus Balance for Storage Reservoirs:

Differential Equation:

$$d (QC) / dA = P Cp + Us Cs - K2 Fw \ C 2 - Uo C$$

Boundary Condition:

$$Q C = Qi Ci \ @ \ A = 0$$

Solution for Outlet Concentration (Completely Mixed Conditions):

$$qo = Qo / A + Uo$$
$$K2 = 0.17 Fw qo / (qo + 13.3)$$
$$Pi = (Qi Ci / A + P Cp + Us Cs) / qo$$
$$N = K2 Pi \ Z / qo$$
$$Co = Pi (-1 + 4 N) 0.5 / (2 N)$$

Procedure for Obtaining Concentration for Known Areas

$Co = Cb + (Ci - Cb)*((Qi + A*b)/Qi)^{(-r/b)}$ Eq.1
(Bill Walker, 1999, Restudy Webpage)
$r = R - ET + Us + Fw *Ke$
$b = R - ET + Us - Uo$

Procedure for Deriving a STA Area for Known Concentrations

Area is the parameter of interest mostly when the inflow and target outflow concentrations are known. The area can be found by iteratively solving for the area term, A, in Eq. 1or by directly solving Eq.1 for the area. In the latter case the area is obtained by:

$A (Co) = Qi * [2.72 ^ ((-b/r)* \ln((Co-Cb)/(Ci-Cb)))-1]/b$
Variable Definitions:

C = Water Column Phosphorus Concentration (ppb)
Q = Flow (hm3/yr)
P = Rainfall (m/yr)
E = Evapotranspiration Rate (m/yr)
Cp = Rainfall Phosphorus Concentration, Bulk, Reflects Wet + Dry Deposition (ppb)
Ke = Effective Settling Rate (m/yr)
Fw = Fraction of Days with Water Elevation Above Ground Surface
Uo = Infiltration Rate (Seepage Out of STA) (m/yr)
Us = Exfiltration Rate (Seepage Into STA) (m/yr)
Cs = Inflow Seepage Concentration (ppb)
A = Wetland Surface Area (km2)
Z = Mean Water Depth (m)
Cb = Background Concentration (ppb)
i = Subscript Indicating Inlet Conditions
o = Subscript Denoting Outlet Conditions

C.11.2.2 The EUTROMOD Model

The EUTROMOD is an empirical model developed by Rechow et al. (1992). It assumes completely mixed conditions and calculates reservoir outlet concentrations based on mean residence time, mean water, and inlet nutrient concentrations. The EUTROMOD lake model has been calibrated with regional, multi-lake data sets, including Florida lakes. Regional data sets produce a lower prediction error. The regional models are based on annual nutrient loads and lake-wide, growing season median nutrient concentrations. This model is not used for short-term (e.g., monthly) lake response, spatial patterns, or dynamic responses to changing input loads and concentrations.

The EUTROMOD Florida Version is used in the report to estimate average reservoir concentrations of TP, TN and Chlorophyll a. The model can also be used to estimate growing season probabilities for blue-green algal dominance and anoxia in the hypolimnion. Model formulation and assumptions information are given below.

TABLE C-47: EUTROMOD MODEL VARIABLES AND EQUATIONS

Terms	Description	Units
C_i	= Concentration in	mg/L
Q_i	= Inflow rate	hm3/yr
Q_o	= Outflow rate	hm3/yr
A	= WPA reservoir surface area	km2
q_i	= Hydraulic loading rate from pumped inflow	m/yr
q_a	= Hydraulic loading rate based on average flow (Qi+Qo)/2	m/yr
t	= Hydraulic residence time - mean	yr
Z	= Mean water depth	m
V	= Reservoir volume	hm3
C_o	= Concentration out, calculated	mg/L
C_o(-1 s.e.)	= Concentration out minus 1 std. error	mg/L
C_o(+1s.e.)	= Concentration out plus 1 std. error	mg/L
	Model Equations:	
	$\log_{10}(TP) = \log_{10}[TP_i/(1+K_{TP}t)]$	
	$K_{TP} = 1.71t^{-0.21}Z^{1.01}TP_i^{0.40}$	
	$\log_{10}(TN) = \log_{10}[TN_i/(1+K_{TN}t)]$	
	$K_{TN} = 0.20t^{-0.89}Z^{1.56}TN_i^{0.33}$	
	$\log_{10}(CHLA) = 1.46+0.30\log_{10}(TP)+0.96\log_{10}(TN)$	

C.11.2.3 The DO Regression Model

Dissolved oxygen (DO) processes are not easily defined in reservoirs; however, regression models are generally used to define DO levels in reservoirs. Research has shown that the fate of DO is a strong function of the hydraulic loading rate to the reservoir, the inflow DO rate, and the ammonia concentration of the medium (Kadlec and Knight; 1996). A regression model proposed by Knight and Kadlec was used to evaluate DO processes in this feasibility analysis.

Additional information on the regression model can be found in the document mentioned in the reference section of this write-up.

Regression models are known to be appropriate to estimate DO output in wetlands. The equation used to determine outflow wetland DO concentration (Kadlec and Knight, 1996) is:

$$C_{DO_OUT} = 2.52 + 0.126 * C_{DO_IN} - 0.0241*q* C_{NH4\text{-}N_IN}$$

Where:
C_{DO_OUT} = Wetland outflow DO concentration in mg/l
C_{DO_IN} = Wetland inflow DO concentration in mg/l
q = Hydraulic Loading Rate cm/day
$C_{NH4\text{-}N_IN}$ = Inflow NH4-H Concentration.

C.11.2.3.1 Residence Time Estimations

Information on any of the tools used in the water quality analysis not mentioned in this write-up is referenced in the original water quality report.

HRT = (A*Z/(Qi + Q0)/2)*365

Or

HRT = (A*Z/Q0))*365

(Knight, 1996 "Treatments Wetlands)

HRT = Hydraulic Retention Time, days
A = Area in acres
Z = mean Depth, ft
Qi = mean inflow rate, ac-ft/yr
Qo = mean inflow rate, ac-ft/yr

C.11.2.3.2 Load Computations

In the evaluation of various alternatives, loads were calculated. Inflow loads were calculated using inflow discharges and concentrations. Outflow loads were computed using the concentrations predicted by the water quality models with the outflow discharges obtained from the groundwater models. The computation scheme is given below.

Load = C*Q

Where:

C = Concentration
Q = Discharge or flow data

C.11.2.4 Functional Assessment Model

C.11.2.4.1 General Description

An assessment of the capacity (ability) of the WPA components to improve water quality has been conducted, based upon the method outlined by the Comprehensive Conservation, Permitting, and Mitigation Strategy. An overview of the method and project can be found online at: www.sfwmd.gov/portal/pls/portal/docs/15261903.PDF. A more detailed description of the method is outlined in the report entitled "A Water Quality Functional Assessment of South Florida Wetlands," currently in preparation as a SFWMD technical publication (Zahina et al., 2000). The water quality functional assessment consists of two components, an analysis of the inherent capacity of wetlands to improve or maintain water quality and a pollution risk analysis.

C.11.2.4.2 Inherent Capacity of Wetlands To Improve Or Maintain Water Quality

One component of the water quality functional assessment analysis is the inherent capacity of wetlands to reduce, degrade, or offer long-term storage of a specific pollutant. This is based on the concept that not all wetlands are created equal, therefore they do not all have the same capacity to moderate pollution inputs. Some wetlands have conditions (such as hydroperiod, pH, vegetation type, and soil properties) that promote the function of pollution-mitigating mechanisms, while others have unfavorable conditions. Models were developed to describe the major pollution mitigating mechanisms in wetlands (e.g. denitrification, sorption to soil particles) with respect to physio-chemical characteristics. Databases with the appropriate input parameters and model output were used to screen WPA components for characteristics that support pollution-mitigating mechanisms. The rating products from the functional assessment are qualitative values of "low," "moderate," or "high." The following pollutants were considered: nitrogen, phosphorus, micronutrients, heavy metals, suspended particulates, pathogenic organisms, and pesticides. Pollution mitigating mechanisms considered in the analysis are as follows:

- Nitrogen: loss due to denitrification and long-term uptake/storage by the plant community
- Phosphorus: long term sorption to soil particles and long term uptake/storage by the plant community
- Micronutrients: long term sorption to soil particles and long term uptake/storage by the plant community
- Heavy metals: long term sorption to soil particles
- Suspended solids: settling out/retention

- Pathogenic organisms: settling out/retention
- Pesticides: retention and conditions necessary for degradation

The assessment was conducted for each alternative in the WPAFS with input data provided by several sources. Soil data was supplied by the Natural Resources Conservation Service's county soil survey database (NRCS 1995). This included pH, surface texture, presence of a spodic layer, and depths to a confining layer (soil thickness). Hydroperiod and mean depth of flooding were derived from sub-regional groundwater model output.

C.11.2.4.3 Inherent Capacity Analysis Summary

The inherent capacity of the WPA components to improve/protect water quality shows variation between alternatives due to changes in water management scenarios. Some areas are either too dry or too wet to support wetland vegetation, so indicate low or reduced capacity for function. Other areas have soil types (i.e. sandy, acidic) that do not support permanent binding of pollutants to soils or in insoluble complexes. These areas frequently indicate low function with respect to some pollution types.

Besides the inherent capacity for a component to function with respect to a pollution mitigation mechanism, another consideration is the total area of the component. The consideration of area is important in understanding the relationship between the basin and the size of the component. A small component size in a large basin has less available function than a larger component in a smaller basin, even though both components may have the same inherent capacity rating.

Table C-48 shows the cumulative rating scores for the different alternatives for each WPA component multiplied by the component area. Care must be taken to remember that these values are the sum of scores used to derive qualitative ratings, not an actual measurement of function. However, higher numbers indicate higher capacity for function and when multiplied by the component area, provide some means of comparison of the total functional capacity of a particular alternative. The numbers in bold italics in the table indicate the alternative with the highest score.

The results shown in ***Table C-48*** indicate that Alternative 2 had the lowest sum for all components, indicating it may be the least desirable alternative in terms of water quality function. Alternatives 3 and 1 provide the most total capacity for water quality function to the total project area. Alternative 1 has the most components with the highest scores for alternatives (three components of seven have the highest score for any alternative) and has a total sum comparable to D13R. Besides increases in functional capacity, higher scores resulted from an increase in the area of the component. The larger component sizes in some alternatives offer more area of functional capacity and less area in the basin contributing pollution. In terms of total capacity of all components, Alternative 3 shows the greatest

amount of capacity to function. Alternative 1 has the most components with the highest scores (alternatives other than D13R) with a total capacity comparable to Alternative 3 and may offer the most components with higher capacity to function.

Relative to D13R, improvements were seen in Alternatives 1 and 2 for most components. However, for the Hillsboro and C-9 components, no improvements were seen for any alternative. Alternatives 1, 2, and 3 did not perform as well as D13R for these components.

TABLE C-48: CUMULATIVE WATER QUALITY RATING SCORES FOR EACH ALTERNATIVE

	D13R	ALT 1	ALT 2	ALT 3
C-11 Component	30400	***32946***	26232	29103
C-9 Component	***47500***	32414	29274	31998

C.11.3 Inherent Capacity Rating Calculations For WPA Components

TABLE C-49: CHARACTERISTICS OF WPA COMPONENTS

	Soil Surface Texture[1]	Soil pH[2]	Spodic[3]	Soil Thickness[4]	D13R Hydroperiod[5]	Alternative 1 Hydroperiod[5]	Alternative 2 Hydroperiod[5]	Alternative 3 Hydroperiod[5]
C-11 Impoundment (E)	Muck	1	0	1	2	2	2	1
C-11 West	Muck	1	0	1	N/A	N/A	2	2
C-9 Impoundment (E)	Muck	1	0	1	2	2	2	2
C-9 West	Muck	1	0	1	N/A	N/A	2	2

1. Soil surface texture from the NRCS county soil surveys.
2. Soil pH from the NRCS county soil survey, converted to a value range: 0=acidic (pH<6), 1=circumneutral (pH>6 and <8)
3. Spodic indicates the presence of a spodic layer within 40 inches of the soil surface: 0=none.
4. Soil thickness indicates the depth to bedrock or a confining layer: 0=12 inches or less, 1= more than 12 inches but less than 40 inches, and 2= more than 40 inches.
5. Hydroperiod indicates duration of annual flooding: 0= less than 3 months, 1=between three and nine months, and 2=more than 9 months.

* Assumed value from target of wetland restoration.

235

TABLE C-50: PLANT COMMUNITIES EXPECTED FOR EACH ALTERNATIVE, BASED UPON SITE HYDROPATTERNS PREDICTED BY SUB-REGIONAL GROUNDWATER MODEL OUTPUT

	D13R Plant Community	Alternative 1 Plant Community	Alternative 2 Plant Community	Alternative 3 Plant Community
C-11 Impoundment (E)	Marsh	Marsh	Marsh	Wet/dry
C-11 West	N/A	N/A	Deep water	Slough
C-9 Impoundment (E)	Marsh	Marsh	Slough	Marsh
C-9 West	N/A	N/A	Slough	Lake

TABLE C-51: FUNCTIONAL ASSESSMENT RATINGS FOR CAPACITY FOR DENITRIFICATION

Name	D13R	Alternative 1	Alternative 2	Alternative 3
C-11 Impoundment	2	2	2	2
C-11 West	N/A	N/A	2	2
C-9 Impoundment	2	2	2	2
C-9 West	N/A	N/A	2	1

0=low or none, 1=moderate, and 2=high

TABLE C-52: FUNCTIONAL ASSESSMENT RATINGS FOR CAPACITY FOR LONG-TERM CHEMICAL BINDING OF PHOSPHORUS

Name	D13R	Alternative 1	Alternative 2	Alternative 3
C-11 Impoundment	1	1	1	1
C-11 West	N/A	N/A	1	1
C-9 Impoundment	1	1	1	1
C-9 West	N/A	N/A	1	1

0=low or none, 1=moderate, and 2=high

TABLE C-53: FUNCTIONAL ASSESSMENT RATINGS FOR CAPACITY FOR LONG-TERM CHEMICAL BINDING OF MICRONUTRIENTS

Name	D13R	Alternative 1	Alternative 2	Alternative 3
C-11 Impoundment	2	2	2	2
C-11 North	N/A	N/A	2	2
C-9 Impoundment	2	2	2	2
C-9 West	N/A	N/A	2	2

0=low or none, 1=moderate, and 2=high

TABLE C-54: FUNCTIONAL ASSESSMENT RATINGS FOR CAPACITY FOR LONG-TERM STORAGE OF NUTRIENTS BY THE PLANT COMMUNITY

Name	D13R	Alternative 1	Alternative 2	Alternative 3
C-11 Impoundment	2	2	2	2
C-11 North	N/A	N/A	0	1
C-9 Impoundment	2	2	1	2
C-9 West	N/A	N/A	1	0

0=low or none, 1=moderate, and 2=high

TABLE C-55: FUNCTIONAL ASSESSMENT RATINGS FOR CAPACITY FOR LONG-TERM CHEMICAL BINDING OF HEAVY METALS

Name	D13R	Alternative 1	Alternative 2	Alternative 3
C-11 Impoundment	2	2	2	2
C-11 North	N/A	N/A	2	2
C-9 Impoundment	2	2	2	2
C-9 West	N/A	N/A	2	2

0=low or none, 1=moderate, and 2=high

TABLE C-56: FUNCTIONAL ASSESSMENT RATINGS FOR CAPACITY FOR SETTLING OUT OF SUSPENDED SOLIDS

Name	D13R	Alternative 1	Alternative 2	Alternative 3
C-11 Impoundment	2	2	2	2
C-11 North	N/A	N/A	2	2
C-9 Impoundment	2	2	1	2
C-9 West	N/A	N/A	1	1

0=low or none, 1=moderate, and 2=high

TABLE C-57: FUNCTIONAL ASSESSMENT RATINGS FOR CAPACITY FOR REMOVAL OR DEGRADATION OF PATHOGENIC ORGANISMS

Name	D13R	Alternative 1	Alternative 2	Alternative 3
C-11 Impoundment	2	2	2	2
C-11 North	N/A	N/A	2	2
C-9 Impoundment	2	2	1	2
C-9 West	N/A	N/A	1	1

0=low or none, 1=moderate, and 2=high

TABLE C-58: FUNCTIONAL ASSESSMENT RATINGS FOR CAPACITY TO DEGRADE PESTICIDES

Name	D13R	Alternative 1	Alternative 2	Alternative 3
C-11 Impoundment	2	2	2	2
C-11 North	N/A	N/A	2	2
C-9 Impoundment	2	2	2	2
C-9 North	N/A	N/A	2	2

0=low or none, 1=moderate, and 2=high

TABLE C-59: FUNCTIONAL ASSESSMENT RATINGS FOR CAPACITY FOR NITROGEN REMOVAL OR LONG TERM STORAGE

Name	D13R	Alternative 1	Alternative 2	Alternative 3
C-11 Impoundment	4	4	4	4
C-11 North	N/A	N/A	2	3
C-9 Impoundment	4	4	3	4
C-9 North	N/A	N/A	3	1

Range: 0=low through 4=high

TABLE C-60: FUNCTIONAL ASSESSMENT RATINGS FOR CAPACITY FOR LONG TERM STORAGE OF PHOSPHORUS

Name	D13R	Alternative 1	Alternative 2	Alternative 3
C-11 Impoundment	3	3	3	3
C-11 North	N/A	N/A	1	2
C-9 Impoundment	3	3	2	3
C-9 North	N/A	N/A	2	1

Range: 0=low through 4=high

TABLE C-61: FUNCTIONAL ASSESSMENT RATINGS FOR CAPACITY FOR LONG TERM STORAGE OF MICRONUTRIENTS

Name	D13R	Alternative 1	Alternative 2	Alternative 3
C-11 Impoundment	4	4	4	4
C-11 North	N/A	N/A	2	3
C-9 Impoundment	4	4	3	4
C-9 North	N/A	N/A	3	2

Range: 0=low through 4=high

C.11.4 The Comprehensive Evaluation Matrix

WPA Feasibility Study Hydrologic Evaluation
Alternative Performance Analysis
Water Quality Performance Analysis

WPA Feasibility Study Hydrologic Evaluation
Alternative Performance Analysis
Water Quality Performance Analysis

TABLE C-62: C-11 IMPOUNDMENT

Objective	Weight (W)	Performance Measure		Performance Rating (R)				Score (WxR)			
				D13R	ALT 1	ALT 2	ALT 3	D13R	ALT1	ALT2	ALT3
Evaluation of the Hydrology of WPA and its effect on Water Quality (WQ)	**N/A**	**Hydrologic Criteria:**	**Target**					**11**	**10**	**3**	**6**
Prevent Dry-out of WRA	1	Frequency of Depths < 0.5 ft	Lower is Better Unit: Frequency					0	0	0	0
Allow WRAs to function in optimum Depth Range	1	Frequency of Depths > 2.0 ft for WRAs	Lower is Better Unit: Frequency					0	0	0	0
Prevent Dry-out of Reservoir	1	Frequency of Depths < 0.75 ft for Reservoirs	Lower is Better Unit: Frequency					3.5	3.5	1	2
Increase performance of Reservoir for WQ Constituents Reduction	1	Frequency of Depth > 3.0 ft for Reservoirs	Higher is Better Unit: Frequency					3.5	3.5	1	2
Allow water to stay in WRAs or Reservoir for Plant Assimilation or Sedimentation	1	Residence Time Unit: Days	Longer is Better					4	3	1	2
Evaluation of Concentration Changes in WPA	**N/A**	**Concentration Criteria:**	**Target**					**5**	**5**	**5**	**5**
Determine the ability of WPA to reduce Water Quality Constituents Concentrations	1	Concentration Reduction for TP Unit: Percentage	Higher is Better					2.5	2.5	2.5	2.5

239

Objective	Weight (W)	Performance Measure		Performance Rating (R)				Score (WxR)			
				D13R	ALT 1	ALT 2	ALT 3	D13R	ALT1	ALT2	ALT3
Determine the ability of WPA to increase DO Levels	1	Concentration Increase for DO Unit: ppb	Higher is Better					2.5	2.5	2.5	2.5
Evaluation of Constituent Mass Reduction In WPA	**N/A**	**Load Criteria**	**Target**					**3.5**	**3.5**	**1**	**2**
Measure Ability to reduce constituent loads in WPA	1	Load Reduction Unit: Percentage	Higher is Better					3.5	3.5	1	2
TOTAL								**19.5**	**18.5**	**9**	**13**

240

C.11.5 WPA Feasibility Study Hydrologic Evaluation

Alternative Performance Analysis
Water Quality Performance Analysis

TABLE C-63: C-9 IMPOUNDMENT

Objective	**Weight (W)**	**Performance Measure**		**Performance Rating (R)**				**Score (WxR)**			
				D13R	ALT 1	ALT 2	ALT3	D13R	ALT1	ALT2	ALT3
Evaluation of the Hydrology of WPA and its effect on Water Quality (WQ)	**N/A**	**Hydrologic Criteria:**	**Target**					**6**	**9**	**10.5**	**5.5**
Prevent Dry-out of WRA	1	Frequency of Depths < 0.5 ft	Lower is Better Unit: Frequency					1.5			
Allow WRAs to function in optimum Depth Range	1	Frequency of Depths > 2.0 ft for WRAs	Lower is Better Unit: Frequency					2.5			
Prevent Dry-out of Reservoir	1	Frequency of Depths < 0.75 ft for Reservoirs	Lower is Better Unit: Frequency						3	4	1.5
Increase performance of Reservoir for WQ Constituents Reduction	1	Frequency of Depth > 3.0 ft for Reservoirs	Higher is Better Unit: Frequency						4	2.5	1
Allow water to stay in WRAs or Reservoir for Plant Assimilation or Sedimentation	1	Residence Time Unit: Days	Longer is Better					1	4	2	3

Objective	Weight (W)	Performance Measure		Performance Rating (R)				Score (WxR)			
				D13R	ALT 1	ALT 2	ALT3	D13R	ALT1	ALT2	ALT3
Evaluation of Concentration Changes in WPA	**N/A**	**Concentration Criteria:**	**Target**					**5**	**6.5**	**3.5**	**5**
Determine the ability of WPA to reduce Water Quality Constituents Concentrations	1	Concentration Reduction for TP Unit: %	Higher is Better					2.5	4	1	2.5
Determine the ability of WPA to increase DO Levels	1	Concentration Increase for DO Unit: ppb	Higher is Better					2.5	2.5	2.5	2.5
Evaluation of Constituent Mass Reduction In WPA	**N/A**	**Load Criteria**	**Target**					**3.5**	**1**	**3.5**	**2**
Measure Ability to reduce constituent loads in WPA	1	Load Reduction Unit: Percentage	Higher is Better					3.5	1	3.5	2
TOTAL								**14.5**	**16.5**	**17.5**	**12.5**

242

C.11.6 References

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8. Status of water quality criteria compliance in the Everglades protection area.

C.12 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE (HTRW)

The SFWMD has conducted phase I and phase II site assessments on all of the project lands. Attachment E of this appendix is a copy of the joint USFWS, FDEP, SFWMD sampling protocol used to scope the environmental site investigations performed on prospective CERP restoration lands. Attachment F of this appendix is an internal SFWMD memorandum that summarizes the status of environmental site audits as of September 2005. Attachment G of this appendix is a list of the available site audit reports and ecological risk studies performed to assess the HTRW and ecological risk associated with the BCWPA project lands. Copies of these reports are not included in this PIR; however, they are available upon request.

As of January of 2012, the SFWMD has indicated that all of the project lands have been acquired and that corrective actions associated with prior releases of petroleum and other pollutants have been completed. There are several buildings and potentially septic systems still in use. These structures will be removed prior to

lands certification. The corrective actions identified for the Bishop/Nixon parcel within the WCA 3A/B SMA have not been completed since this parcel has been removed from the project footprint.

Studies to determine if corrective actions are necessary to address the elevated selenium concentrations found on 2000 acres of project lands are underway and are expected to be completed by Summer 2012. A discussion of residual agricultural chemicals is included in Section 7.11.

C.13 MITIGATION MEASURES TO OFFSET IMPACTS TO DEPARTMENT OF THE ARMY ESTABLISHED MITIGATION AREA

The SAP includes replacement compensation (i.e. a wetland mitigation plan) for the wetland mitigation sites within the C-9 and C-11 impoundment footprints that will be adversely impacted by project implementation. It should be noted that the Recommended Plan in the Draft Integrated PIR/EIS, Alternative A4, identified impacts to one of the Weston Increment III mitigation areas located within the C-11 Impoundment with replacement mitigation to be provided within the C-11 and C-9 impoundments through incorporation of fish and wildlife enhancement features. These enhancement features were described in the USFWS Planning Aid Report for the Water Preserve Areas Feasibility Study dated November 22, 1999. The Draft PIR/EIS identified no adverse impacts to the other mitigation sites within the C-11 and C-9 impoundments but rather suggested that project goals could be met while managing the impoundments for the same level of wetland function and value thus avoiding adverse impacts. Further assessment of the mitigation areas and project operations revealed that it would be difficult to sustain wetland function and value within the enhancement features and impoundment footprints while at the same time managing the impoundments for water storage. This required the PDT to develop a new mitigation plan eliminating all of the enhancement features identified in the Draft PIR/EIS except for the creation/restoration of marsh wetlands.

Costs for the revised mitigation plan are included in the cost estimate for the SAP. The proposed mitigation features will serve two functions for this project. They will provide wetland function and value to meet compensatory mitigation requirements while also providing storage requirements for the project to achieve its benefits. A Uniform Mitigation Assessment Methodology (UMAM) analysis was performed by the multi-agency team to assess loss of function and value to established wetland mitigation sites as a result of project implementation (***Table C-64***). Loss of wetland habitat within mitigation sites associated with construction of project and planned mitigation features including embankments and berms has been included in the UMAM analysis. The team also assessed the potential for functional gain of the wetland mitigation plan to determine if the plan is sufficient to offset the adverse

impacts to the wetland mitigation areas. The individual components of the revised wetland mitigation plan and UMAM analysis are described below. The individual UMAM score sheets for each assessment area (polygon) are included below.

C.13.1 Avoidance

As discussed in ***Section 6.2.1***, Alternative A4 adversely impacts the southern Weston Increment III and White Construction mitigation areas located in the C-11 Impoundment and the Sunset Lakes mitigation area (including Bregmann Tract) in the C-9 Impoundment. In order to avoid impacts to the higher quality 119.93-acre Weston Increment III mitigation area, the northern boundary of the C-11 Impoundment has been moved south (***Figure C-37***). Due to the construction of protection berms and levees there are some unavoidable impacts to this wetland mitigation area as well as to the 107.7-acre Weston Increment III mitigation site on the northern boundary of the project. The current design reflects the least amount of unavoidable adverse acreage impacts and associated functional loss to the existing Weston Increment III wetland mitigation sites while still maintaining comparable levels of proposed project benefits. Impacts to established wetland mitigation areas in the C-9 Impoundment have not been reduced.

C.13.2 Creation of A Northern Buffer Marsh

The SAP includes an approximate 475-acre buffer marsh along the northern perimeter of the project (***Figure C-37***). This area which is shown as Mitigation Area A has the provision for one foot of storage for enhancement of wetland hydroperiod. In order for the mitigation area to be hydrologically successful additional water (above and beyond what would be provided in a rainfall driven system) is needed. This water will be supplied by the impoundment. Although not used to justify federal participation in the project, the mitigation area's ability to store up to one foot of water will contribute to project benefits downstream by increasing storage volume. The buffer marsh includes the three existing DA mitigation areas in the C-11 Impoundment footprint (i.e., the two Weston Increment III sites and the White Construction site). Additionally, the plan will convert highly degraded wetlands dominated by exotic plant species (i.e., Brazilian pepper and Melaleuca) and drained as a result of adjacent development to freshwater marsh. Exotic plant species will be removed, the area will be graded to suitable wetland elevation and rehydrated as water is available from the C-11 Impoundment. The northern Weston Increment III mitigation area which has an existing functional UMAM FCI of 0.67 has been identified as a reference mitigation site for the buffer marsh area. An additional mitigation area, Mitigation Area B, is 13 acres and will be created through scrape down of uplands to wetland grade with replanting of native wetland species. This area is not connected to Mitigation Area A and will be a rainfall driven/seepage wetland. Creation of the buffer marsh including Mitigation Area B will provide approximately 66.51 FCUs or mitigation credits (***Table C-64***).

C.13.3 Enhancement of the FDOT Optional Mitigation Area

The SAP avoids hydrologic improvements to 339 acres of the existing FDOT 'Optional' Mitigation Area (***Figure C-38***) because of USFWS ecological risk concerns to trust species due to selenium tainted soils. The PDT has agreed to avoid the FDOT Optional Mitigation Area (not hydrate it) and pay a mitigation bank for the needed FCU credits. If the mitigation bank option is not available at the time the project is authorized, the FDOT Optional Mitigation Area tainted soils would be cleaned up and the area used as a part of the Project. Planned mitigation activities include construction of a low berm to retain water up to a two-foot depth in the southern cell (Mitigation Area C) and one-foot depth in the northern cell (Mitigation Area D) with associated water control and outflow structures. This would provide hydrologic improvements to approximately 339 acres of wetlands resulting in approximately 54.24 FCUs (***Table C-64***). An increase in water depth and duration would reduce the prolonged over draining of this wetland area and restore a more natural hydroperiod indicative of historic conditions. Along with restored hydroperiods, the surrounding wetland plant communities would provide a native seed source to the FDOT Optional Mitigation Areas site, which would promote natural plant community recruitment. The storage volume provided by Mitigation Areas C and D, though not used to justify federal participation in the project, will contribute to project benefits downstream. See Appendix H for a more detailed description of the FDOT Optional Mitigation Area under the Agricultural Chemicals Policy Section H.12.

C.13.4 Wetland Enhancement and Restoration within WCA 3A/3B SMA

There are two types of wetland mitigation activities proposed within WCA 3A/3B SMA: wetland enhancement as a result of hydroperiod restoration and supplemental native planting and wetland restoration as a result of scrape down/grading of uplands to restore former wetland habitat (***Figure C-39***). The northern portion of WCA 3A/3B SMA is of high ecological value and closely resembles the natural hydroperiods and vegetative communities of the adjacent WCA 3A. The remainder of the WCA 3A/3B SMA, however, has been disturbed and degraded as a result of adjacent development/construction practices including major canals and subsequent increased loss of water through seepage and infestation by exotic plant species. Using the northern portion of WCA 3A/3B SMA as a reference mitigation site, it is anticipated that removal of uplands, hydroperiod improvements, and/or supplemental plantings will enhance the degraded areas of the WCA 3A/3B SMA. It should be noted that since the SFWMD has an existing exotic plant management program in place for the WCA 3A/3B SMA, the USACE is not able to claim any mitigation credit for the exotic removal activity alone but rather for improvements to the community structure as a result of improved hydroperiod. This is consistent with USACE Regulatory mitigation policy and guidance.

Several wetland community structures exist within the WCA 3B SMA which were divided into separate polygons based on the dominant vegetation type, i.e. sawgrass or Melaleuca. Lands and available acreages for mitigation were identified for each vegetation polygon. Because a majority of these are existing low quality wetlands, enhancement has a very good chance of success. Due to the WCA 3B SMA proximity to WCA 3A/3B, and by improving the wetland function, quality of the vegetation community and water environment, these wetlands will have a high utilization by Everglades fauna. Specifically, water depths and duration will increase in the existing degraded wetlands to more closely resemble the desired, natural hydroperiods associated with the adjacent WCA 3A wetlands. The increased hydroperiod should prevent further soil oxidation, promote soil formation and provide hydrologic conditions more conducive to the sawgrass and wet prairie marsh communities, which will increase the wetland function and value for wading birds, animals, fish and invertebrates. As shown on the UMAM analysis is ***Table C-64***, mitigation activities within the SMA will provide approximately 240.42 FCUs.

TABLE C-64: UMAM EVALUATION FOR IMPACTS TO ESTABLISHED AND PROPOSED WETLAND MITIGATION AREAS

Wetland Polygon	Acres Impacted	Existing UMAM FCI	Future-With FCI	Delta	FCU Debits
Established Mitigation Areas					
C-11 Impoundment					
Weston Increment III Polygon 20	6.52	0.67	0	-0.67	-4.37
Weston Increment III Polygon 14A	2.68	0.57	0	-0.57	-1.53
White Construction Polygon 15	2.6	0.5	0.5	0	0
C-9 Impoundment					
FDOT Mitigation Site	19	0.4	0	-0.4	-7.6
Sunset Lakes Polygon 3	682.75	0.47	0	-0.47	-320.89
Bregmann Tract Polygon 4	98.25	0.27	0	-0.27	-26.53
Total	**811.8**				**-360.92**

249

WCA 3A/3B SMA	Acres	Existing UMAM	With-Project UMAM Reference	With-Project UMAM Adjusted	Delta	FCUs	Time lag	Risk	Net FCUs
Polygon 1	323.78	0.33	0.7	0.5	0.17	55.04	1	2	27.521
Polygon 3	666.52	0.63	0.7	0.65	0.02	13.33	1	1.25	10.664
Polygon 4A	55.03	0.33	0.7	0.525	0.195	10.73	1	1.25	8.584
Polygon 4B	365.53	0.37	0.7	0.55	0.18	65.8	1	1.25	52.64
Polygon 5	510.85	0.37	0.7	0.575	0.205	104.72	1	1.25	83.776
Polygon 6	355.23	0.57	0.7	0.65	0.08	28.42	1	1.25	22.736
Polygon 7	777.49	0.7	0.7	0.7	0	0	1	1	0
Upland (SMA 1)#3	5.8	0	0.7	0.7	0.7	4.06	1	1.25	3.248
Upland (SMA 2)#5	15.7	0	0.7	0.7	0.7	10.99	1	1.25	8.792
Upland #7	2.3	0	0.7	0.7	0.7	1.61	1	1.25	1.288
Upland (SMA 3)#8	4.7	0	0.7	0.7	0.7	3.29	1	1.25	2.632
Upland (SMA 4)#10	13.8	0	0.7	0.7	0.7	9.66	1	1.25	7.728
Upland (SMA 5)#12	8.3	0	0.7	0.7	0.7	5.81	1	1.25	4.648
Upland (SMA 6)#21	16.9	0	0.7	0.7	0.7	11.83	1	2	5.915
Upland # 22	0.7	0	0.7	0.7	0.7	0.49	1	2	0.245
Total	**3122.63**					**325.78**			**240.42**

C-11 Impoundment	Acres	Existing UMAM	With-Project UMAM Reference	With-Project UMAM Adjusted	Delta	FCUs	Time lag	Risk	Net FCUs
Polygon 15	4	0.5	0.67		0.17	0.68	1	1.5	0.45333
Polygon 16	10.5	0	0.67		0.67	7.04	1	1.5	4.69333
Polygon 17	30.2	0.33	0.67		0.34	10.27	1	1.5	6.84667
Polygon 19	51.5	0.37	0.67		0.3	15.45	1	1.5	10.3
Polygon 21	55.4	0.33	0.67		0.34	18.84	1	1.5	12.56
Backfill Borrow Pit	3.8	0.2	0.67		0.47	1.79	1	1.5	1.19333
Upland	13	0	0.67		0.67	8.71	1	1.5	5.80667
Backfill Canal	2.5	0.2	0.67		0.47	1.18	1	1.5	0.78667
Roads (upland)	10.8	0	0.67		0.67	7.24	1	1.5	4.82667
Polygon 18	95.2	0.37	0.67		0.3	28.56	1	1.5	19.04
Total	**276.9**					**99.76**			**66.51**
FDOT Optional Mitigation Site	**Acres**	**Existing UMAM**	**With-Project UMAM Reference**	**With-Project UMAM Adjusted**	**Delta**	**FCUs**	**Time lag**	**Risk**	**Net FCUs**
Polygon 8	339	0.4	0.67	0.6	0.2	67.8	1	1.25	54.24
Total	**339**					**67.8**			**54.24**
Net FCUs (SMA + C-11 + FDOT Mitigation Site)									361.17
FCU Debits (Existing Mitigation Sites)									-360.92
NET TOTAL									**0.25**

Note: The FDOT Optional (Chimney) Mitigation Site will not be included in the project footprint due to USFWS ecological risk concerns over selenium residues on the property which if hydrated could potentially have adverse effects to trust species via invertebrate and prey fish food sources. A mitigation bank payment for the needed FCU credits (54) is the preferred option. A mitigation land swap would be the second option. The FDOT (Chimney) lands would only be used if other options are not available upon project authorization.

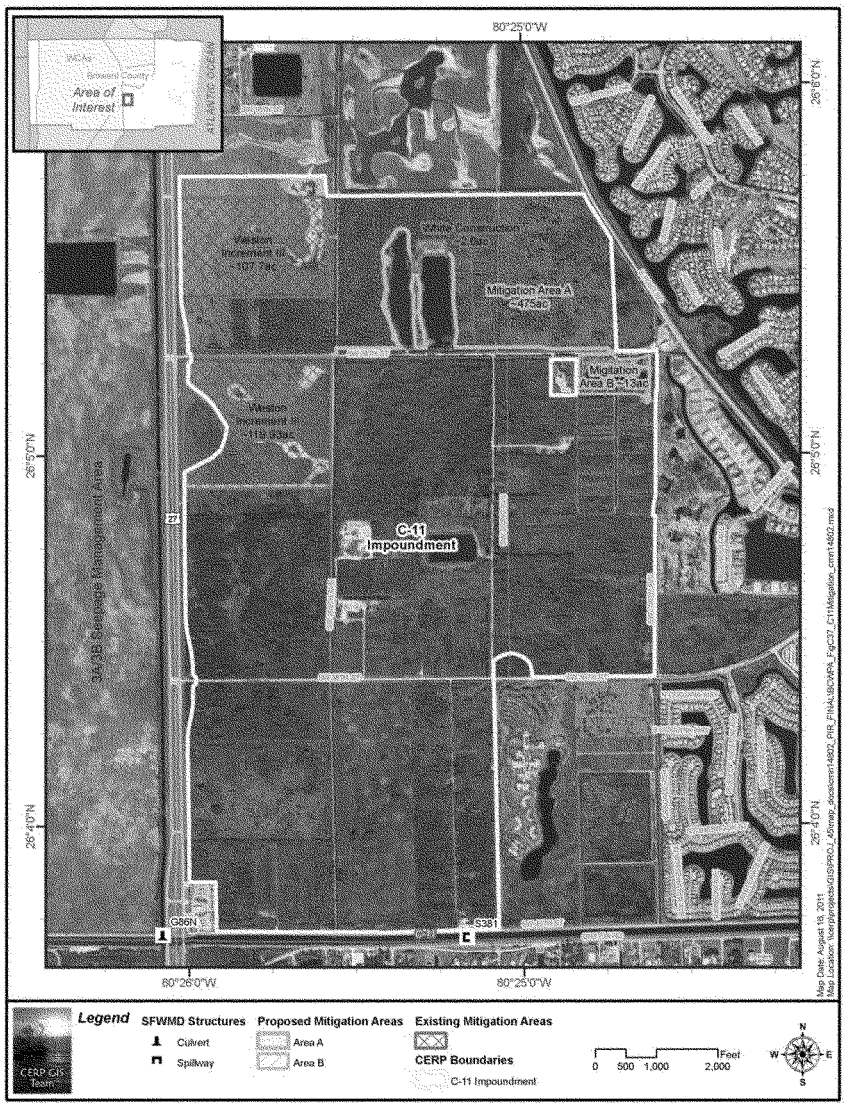

FIGURE C-37: EXISTING AND PROPOSED WETLAND MITIGATION WITHIN THE C-11 IMPOUNDMENT

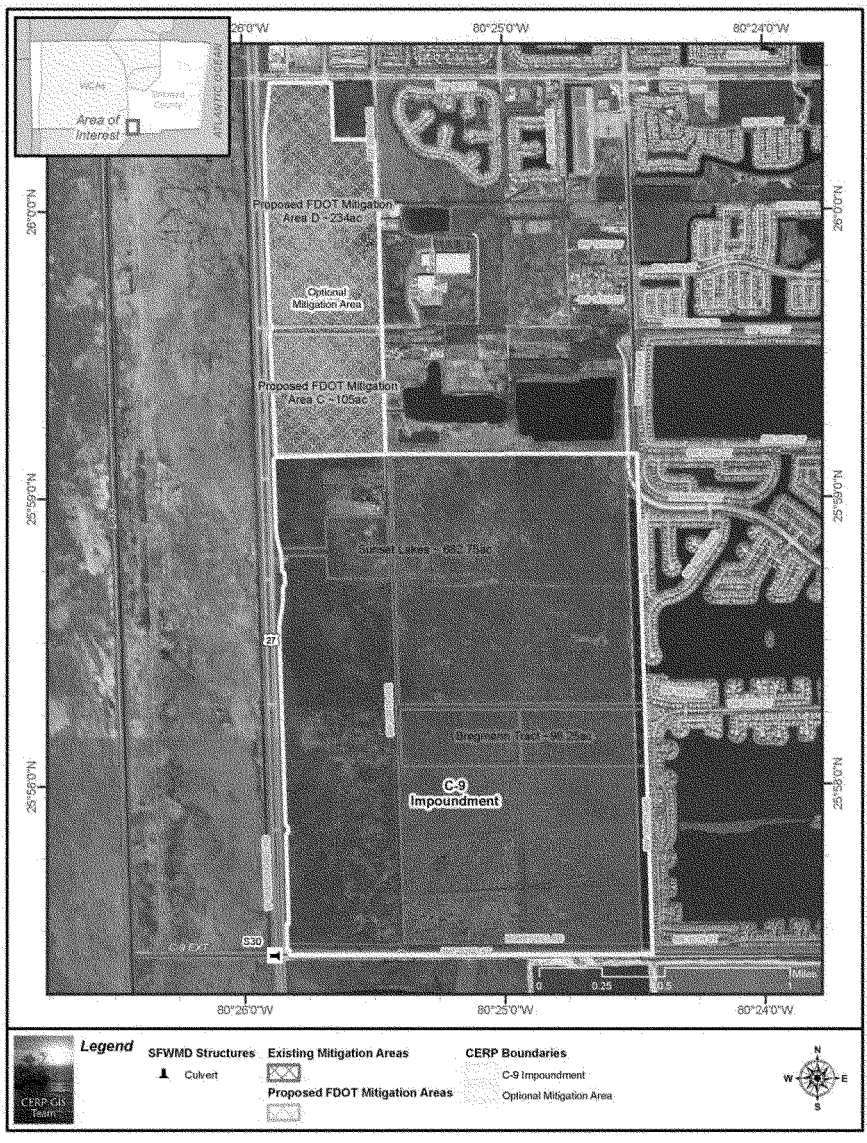

FIGURE C-38: EXISTING AND PROPOSED WETLAND MITIGATION WITHIN C-9 IMPOUNDMENT

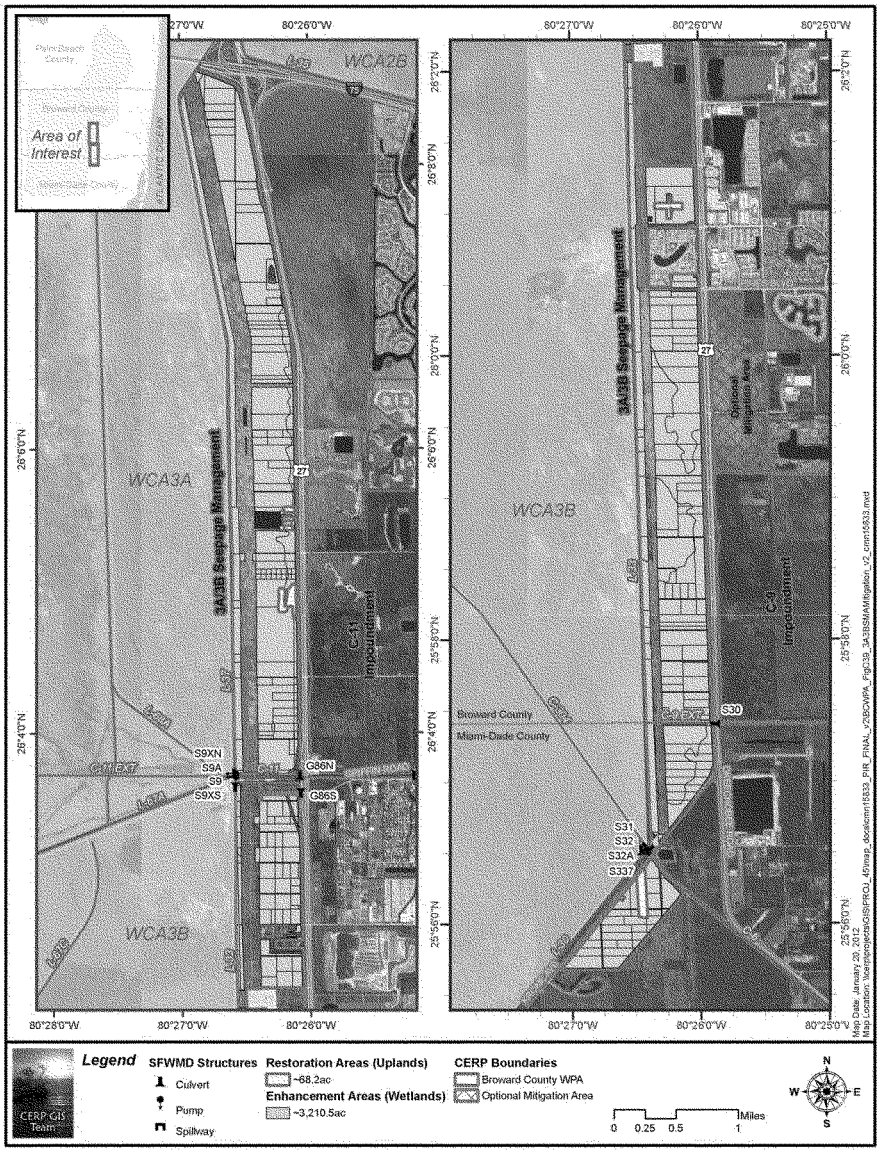

Figure C-39: Proposed Wetland Mitigation Within WCA 3A/3B SMA

C.13.5 Conclusions of Replacement Mitigation Plan

With the impoundment of water for prolonged durations in the C-11 and C-9 areas, it is anticipated that the quality of certain habitats will be reduced. Despite the assumption that future-with project effects are expected to be more beneficial to the ecological system than future-without project conditions, compensatory mitigation is required for any mitigation area established under a Department of the Army regulatory permit where environmental benefits are eliminated or reduced. This is required as part of the Record of Decision (ROD) for the C&SF Comprehensive Review Study, which was signed on July 1, 1999.

The result of the UMAM evaluation concludes that the selected alternative plan results in a loss of approximately 360.92 FCUs. The proposed wetland mitigation plan identified herein will result in a lift of approximately 361.17 FCUs as shown in ***Table C-64*** for a net gain of 0.25 FCUs.

The FDOT (Chimney) Mitigation Site will not be included in the project footprint due to USFWS ecological risk concerns over selenium residues on the property which, if hydrated, could potentially have adverse effects to trust species via invertebrate and prey fish food sources. In accordance with Section 2036(c) of the Water Resources Development Act (WRDA) of 2007, the Corps is giving first consideration to the use of a wetlands mitigation bank to offset losses of wetland functions caused by the project and for removal of the FDOT (Chimney) Mitigation Site from the project footprint. An appropriate mitigation bank within the project watershed will be used for the 54 FCUs needed for this area. In addition, if the proposed project mitigation does not realize the lift expected during the monitoring phase, additional credits may be purchased to compensate.

C.13.6 UMAM Score Sheets

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-11 Sub Area		Weston Increment III (south) (Polygon 14a)

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
643		Impact	119.93

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
C-11 Basin	Class III	N/A

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands SW 26th Street to the north; U.S. Highway 27 to the west; polygon 13 to the east; polygon 14b to the south.	
Assessment area description Freshwater wetland, marsh and wet prarie complex with pockets of deep water refugia created as via mitigation activities	
Significant nearby features SW 26th Street to the north and U.S. Highway 27 to the west.	Uniqueness (considering the relative rarity in relation to the regional landscape.) Mitigation area (Weston Increment III-South)
Functions Provides foraging habitat for birds (native and migratory), reptiles and small to medium sized mammals.	Mitigation for previous permit/other historic use Yes - Exsting Mitigation site
Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found) wading and aquatic dependent birds (native and migratory), fish, alligators, invertebrates, small and medium sized mammals	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area) Everglades Snail Kite, Woodstorks, Bald Eagle, Indigo snake
Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.): armadillo, feral hogs, butterflies & insects, racoon, rabbits, egrets and other wading birds, rodents, crayfish, other aquatic invertebrates, apple snails, reptiles, other birds	
Additional relevant factors:	
Assessment conducted by: USACE, SFWMD, USEPA, USFWS	Assessment date(s): 22-May-06

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-11 Sub Area		Weston Increment III (Polygon 14a)
Impact or Mitigation	Assessment conducted by:	Assessment date:
Impact	USACE, USEPA, USFWS, SFWMD	5/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 4	with: 0	**Existing Condition**: Assessment area is bordered by undeveloped lands infested with exotic plant species to the south and east and highway/roadways to the north and west. **Future With**: A small portion of the assessment area, approximately 2.68 acres, will be impacted by placement of fill for levee construction.
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 6	with: 0	**Existing Condition**: Site is a mitigation area which includes portions that have been scraped down to provide open water pockets which provides habitat. Species observed using open water areas include aquatic invertebrates including apple snails, frogs, wading birds. Portions of site not scraped are hydrologically stressed as indicated by encroachment of *Myrica cerifera* and *Baccharis* sp. This is likely from a lowering of the water table due to canal construction and development with the C-11 Sub Area. **Future With**: A small portion of the assessment area, approximately2.68 acres, will be impacted by placement of fill for levee construction.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 7	with: 0	**Existing Condition:** Community structure supports an Everglades marsh with open water areas. Vegetation includes *Eleocharis* sp., *Sagittaria* sp., and *Cladium* sp. Some exotics including *Melaleuca* sp. and *Schinus terebinthifolius* are present but very minor. Encroachment by scrub species due to lowering of water table. **Future With**: A small portion of the assessment area, approximately 2.68 acres, will be impacted by placement of fill for levee construction.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres: 0.57	with: 0

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres = -1.53

Delta = [with-current]
-0.57

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-11 Sub Area		White Construction (Polygon 15)

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
644	Emergent Aquatic Vegetation	Impact	4

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
	Class III	

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

White Construction Borrow pits to the west and east; undeveloped lands to the north and south.

Assessment area description

Littoral shelves with wetland vegetation.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Borrow pits to the west and east.	

Functions	Mitigation for previous permit/other historic use
Provides foraging habitat for birds (native and migratory) and reptiles.	Yes - Exsting Mitigation site for White Construction

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
wading and aquatic dependent birds (native and migratory), fish, alligators, and invertebrates	Everglades Snail Kite, Woodstorks, Bald Eagle

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

alligators, birds, invertebrates (including apple snails), marsh rabbit, racoon, deer

Additional relevant factors:

Total assessment area is 4 acres of which 2.6 acres was required as mitigation for Department of the Army Permit. Borrow pit operations and mitigation activities were abandoned after SFWMD purchased the lands.

Assessment conducted by:	Assessment date(s):
USACE, SFWMD, USEPA, USFWS	22-May-06

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-11 Sub Area		White Construction (Polygon 15)
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	5/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	**Existing Condition**: Assessment area is bordered by undeveloped lands infested with exotic plant species and borrow pits. **Future With**: Assessment area will be incorporated into Mitigation Area A, a 475-acre buffer marsh.	
w/o pres or current: 3	with: 5	
.500(6)(b)Water Environment (n/a for uplands)	**Existing Condition**: Site is highly disturbed and includes furrows and swales. Assessment area bounded by borrow pits which has significantly lowered the water table. **Future With**: Assessment area will be incorporated into Mitigation Area A. Hydrology of site will be controlled to maintain wetland function and value with low berms around entire mitigation area to allow up to 1 foot of storage.	
w/o pres or current: 6	with: 7	
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	**Existing Condition:** Vegetation dominated by exotics, namely *Schinus terebinthifolius*. Other woodyspecies include *Baccharis* sp. and scattered *Quercus* spp. Signs of planted littoral areas (previous mitigation activities) with *Pontederia cordata*, *Andropogon* sp., *Typha* sp., and *Acrostichum* sp. **Future With**: Mitigation activities include grading to elevation that can support a sustainable wetland and planting of native wetland species.	
w/o pres or current: 6	with: 8	

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres: 0.5	with: 0.67

Delta = [with-current]
0.17

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.5

For impact assessment areas
FL = delta x acres =

For mitigation assessment areas
RFG = FL/(t-factor x risk) = .45

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-11 Sub Area		Polygon #16

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
742	Borrow Area (Uplands)	Mitigation	10.5

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
	Class III	N/A

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

White Construction Borrow pits to the west and east; undeveloped lands to the north; and SW 26th Street to the south.

Assessment area description

Upland area between White Construction Borrow Pits.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Borrow pits to the west and east; and SW 26th Street to the south.	

Functions	Mitigation for previous permit/other historic use

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
No wildlife use anticipated	

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Additional relevant factors:

Site has been hydrologically altered and is significantly disturbed.

Assessment conducted by:	Assessment date(s):
USACE, SFWMD, USFWS, USEPA	22-May-06

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-11 Sub Area		Polygon 16
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	5/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

	w/o pres or current	with	
.500(6)(a) Location and Landscape Support	0	5	**Existing Condition**: Assessment area is highly disturbed upland that provides no wetland function and value. Site is sandwiched between two borrow pits. This area was heavily used by equipment during active borrow operations. **Future With**: Assessment area will be incorporated into Mitigation Area A, a 475-acre buffer marsh.
.500(6)(b)Water Environment (n/a for uplands)	NA	7	**Existing Condition**: NA. **Future With**: Assessment area will be incorporated into Mitigation Area A. Hydrology of site will be controlled to maintain wetland function and value with low berms around entire mitigation area to allow up to 1 foot of storage.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	0	8	**Existing Condition:** Assessment area is highly disturbed upland area between two existing borrow pits with rocky substrate and no vegetation. Assessment area provides no wetland function and value. **Future With**: Mitigation activities include grading to elevation that can support a sustainable wetland and planting of native wetland species.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0	0.67

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.67

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.5

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 4.69

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-11 Sub Area		Polygon 17

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
243	Abandoned Ornamental Nursery	Mitigation	30.2

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
	Class III	N/A

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

White Construction Borrow pits to the west; SW 26 Street to the east; mitigation area to the north; and undeveloped lands to the south.

Assessment area description

Old abandoned nursery site; site has been graded and has transitioned into an upland. Species observed: Brazilian pepper, scattered sawgrass, queen palms, melaleuca, and willow.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Borrow pits to the west; mitigation area to the north	

Functions	Mitigation for previous permit/other historic use

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
small and medium sized mammals	Eastern indigo snake

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

small and medium sized mammals (deer, racoons), birds, invertebrates

Additional relevant factors:

Site has been hydrologically altered due to previous use as nursery

Assessment conducted by:	Assessment date(s):
USACE, SFWMD, USEPA, USFWS	22-May-06

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-11 Sub Area		Polygon 17
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	5/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 4	with: 5	**Existing Condition**: Assessment area is bordered by mitigation area to the north providing adjacent cover and food sources. Bordered by White Construction borrow pites ot the west and undeveloped lands to the east. **Future With**: Assessment area will be incorporated into Mitigation Area A, a 475-acre buffer marsh.
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 3	with: 7	**Existing Condition**: Site is highly disturbed due to past use as a ornamental tree nursery. Hydrology has been severely impacted with onsite ditching and furrowing and drawn down of water table from adjacent borrow pit. Even with these disturbances, site still exists wetland hydrology and wetlands soils with low spots throughout assessment area. **Future With**: Assessment area will be incorporated into Mitigation Area A. Hydrology of site will be controlled to maintain wetland function and value with low berms around entire mitigation area to allow up to 1 foot of storage.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 3	with: 8	**Existing Condition:** Vegetation dominated by *ornamental tree species including palms with scattered pockets dominated by wetland vegetation throughout, namely Cladium jamaicense, Salix sp., and Ludwigia sp. (primrose willow)* **Future With**: Mitigation activities include grading to elevation that can support a sustainable wetland and planting of native wetland species.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres: 0.33	with: 0.67

Delta = [with-current]
0.34

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.5

For impact assessment areas
FL = delta x acres =

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 6.85

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-11 Sub Area		Polygon 18

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
617		Mitigation	95.2

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
C-11 Basin	Class III	N/A

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

SW 26 Street to the south; proposed church site to the east; mitigation area to the north; polygon 17 to the west; and levee to the northeast.

Assessment area description

Dominated by exotics, *Schinus terebinthifolius* and *Melaleuca quinquenervia*

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Mitigation area to the north and SW 26 Street to the south.	

Functions	Mitigation for previous permit/other historic use
Provides foraging habitat for birds (native and migratory), reptiles and small to medium sized mammals.	NA

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
wading and aquatic dependent birds (native and migratory), fish, alligators, invertebrates, small and medium sized mammals	Everglades Snail Kite, Woodstorks, Bald Eagle, Indigo snake

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

small and medium sized mammals (deer, racoons), birds, invertebrates, armadillo, feral hogs, butterflies and other insects

Additional relevant factors:

Site has been hydrologically altered

Assessment conducted by:	Assessment date(s):
USACE, SFWMD, USFWS, USEPA	22-May-06

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-11 Sub Area		Polygon 18
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	5/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

	w/o pres or current	with	
.500(6)(a) Location and Landscape Support	3	5	**Existing Condition**: Assessment area is bordered by mitigation area to the north providing adjacent cover and food sources. Bordered by previous ornamental tree nursery/now disturbed lands to the west and roadway to the south. **Future With**: Assessment area will be incorporated into Mitigation Area A, a 475-acre buffer marsh.
.500(6)(b)Water Environment (n/a for uplands)	4	7	**Existing Condition**: Site is highly disturbed and dominated by exotic plant species an indication of impaired hydrology. Hydrology is still sufficient to support wetland with strong hydric soils and dominance of wetland species in the understory. **Future With**: Assessment area will be incorporated into Mitigation Area A. Hydrology of site will be controlled to maintain wetland function and value with low berms around entire mitigation area to allow up to 1 foot of storage.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	4	8	**Existing Condition:** Vegetation dominated by *Schinus terebinthifolius* with understory of *Acrostichum* sp., *Cladium jamaicense*, *Myrica cerifera*, *Baccharis* sp., and *Osmunda regalis*. **Future With**: Mitigation activities include grading to elevation that can support a sustainable wetland and planting of native wetland species.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.37	0.67

Delta = [with-current]
0.3

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.5

For impact assessment areas
FL = delta x acres =

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 19.04

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-11		Polygon 19

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
617	Mixed Wetland Hardwood (Melaluca dominated)	Mitigation	51.5

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
C-11 Basin	Class III	N/A

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

SW 26 Street to the south; U.S. Highway 27 to the west; Weston Increment III mitigation area to the north; and undeveloped lands to the east.

Assessment area description

Species observed: Melalleuca, wax mrytle, willows, sawgrass and Brazilian pepper.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Weston Increment III to the north and SW 26 Street to the south; and U.S. Highway 27 to the west.	

Functions	Mitigation for previous permit/other historic use
Provides foraging habitat for birds (native and migratory), reptiles and small to medium sized mammals as well as roosting (for birds) and protective cover.	

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
wading and aquatic dependent birds (native and migratory), fish, alligators, invertebrates, small and medium sized mammals.	Everglades Snail Kite, Woodstorks, Bald Eagle, Indigo snake

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Wading birds and other birds, alligators, small and medium sized mammals (deer, racoons), nvertebrates

Additional relevant factors:

Site has been hydrologically altered

Assessment conducted by:	Assessment date(s):
USACE, SFWMD, USEPA, USFWS	22-May-06

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-11 Sub Area		Polygon 19
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	5/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 4	with: 5	**Existing Condition**: Assessment area is bordered by mitigation area to the north providing adjacent cover and food sources. Bordered by roadway to the south and recevies runoff. **Future With**: Assessment area will be incorporated into Mitigation Area A, a 475-acre buffer marsh.
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 3	with: 7	**Existing Condition**: Site is highly disturbed and infested by *Melaleuca* sp., indicative of impaired hydrology. **Future With**: Assessment area will be incorporated into Mitigation Area A. Hydrology of site will be controlled to maintain wetland function and value with low berms around entire mitigation area to allow up to 1 foot of storage.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 4	with: 8	**Existing Condition:** Vegetation dominated by *Melaleuca* sp. with understory of *Cladium jamaicense and Cerifera myrica*. **Future With**: Mitigation activities include grading to elevation that can support a sustainable wetland and planting of native wetland species.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.37	0.67

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.3

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.5

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 10.3

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-11 Sub Area		Weston Increment III (Polygon 20)

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
643		Impact	107.7

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
C-11 Basin	Class III	Area is an existing mitigation area protected under a Conservation Easement

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Existing mitigation area to the north but separated by low berm; U.S. Highway 27 to the west; undeveloped lands to the south and east with open connection

Assessment area description

Freshwater wetland, marsh and wet prarie complex with pockets of deep water refugia created as via mitigation activities

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
U.S. Highway 27 to the west; mitigation area to the north contiguous with assessment area although separated by low berm.	Mitigation area (Weston Increment III-North)

Functions	Mitigation for previous permit/other historic use
Provides foraging habitat for birds (native and migratory), reptiles and small to medium sized mammals.	Yes - Existing Mitigation site

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
wading and aquatic dependent birds (native and migratory), fish, alligators, invertebrates, small and medium sized mammals	Everglades Snail Kite, Woodstorks, Bald Eagle, Indigo snake

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

armadillo, feral hogs, butterflies & insects, racoon, rabbits, egrets and other wading birds, rodents, crayfish, other aquatic invertebrates, apple snails, reptiles, other birds

Additional relevant factors:

This assessment area is the reference wetland for the proposed mitigation activities within the C-11 Sub Area.

Assessment conducted by:	Assessment date(s):
USACE, SFWMD, USFWS, USEPA	22-May-06

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-11 Sub Area		Weston Increment III (Polygon 20)
Impact or Mitigation	Assessment conducted by:	Assessment date:
Impact	USACE, USEPA, USFWS, SFWMD	5/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 5	with: 0	**Existing Condition**: Assessment area is bordered by mitigation to the north, road to the west, and undeveloped lands infested with exotic plant species to the south and east. **Future With**: A small portion of the assessment area, approximately 6.52 acres, will be impacted by placement of fill for low berm construction.
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 7	with: 0	**Existing Condition**: Site is a mitigation area which includes portions that have been scraped down to provide open water pockets which provides habitat. Species observed using open water areas include aquatic invertebrates including apple snails, frogs, wading birds. **Future With**: A small portion of the assessment area, approximately 6.52 acres, will be impacted by placement of fill for low berm construction.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 8	with: 0	**Existing Condition:** Community structure supports an Everglades marsh with open water areas. Vegetation includes *Eleocharis* sp., *Sagittaria* sp., and *Cladium* sp. Some exotics including *Melaleuca* sp. and *Schinus terebinthifolius* are present but very minor. **Future With**: A small portion of the assessment area, approximately 6.52 acres, will be impacted by placement of fill for low berm construction.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.67	0

Delta = [with-current]
-0.67

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) =
Risk factor =

For impact assessment areas
FL = delta x acres = -4.37

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-11 Sub Area		Polygon 21

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
617	Mixed Wetland Hardwood (Melaluca dominated)	Mitigation	55.4

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
C-11 Basin	Class III	N/A

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

SW 26 Street to the south; Weston Increment III mitigation area and other undeveloped lands to the west; mitigation area to the north; and White Construction borrow pits to the east.

Assessment area description

Species observed: Melalleuca, rhyncospora, willows, sawgrass, bacchris and Brazilian pepper. Mucky soils.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Mitigation area to the north, Weston Incrment III to the west and White Construction borrow pits to the east.	

Functions	Mitigation for previous permit/other historic use
Provides foraging habitat for birds (native and migratory), reptiles and small to medium sized mammals. Provides protective cover and buffer to adjacent mitigation area.	

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
wading and aquatic dependent birds (native and migratory), fish, alligators, invertebrates, small and medium sized mammals	Everglades Snail Kite, Woodstorks, Bald Eagle, Indigo snake

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

wading and aquatic dependent birds (native and migratory), fish, alligators, invertebrates, small and medium sized mammals

Additional relevant factors:

Site has been hydrologically altered

Assessment conducted by:	Assessment date(s):
USACE, SFWMD, USFWS, USEPA	22-May-06

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-11 Sub Area		Polygon 21
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	5/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 4	with: 5	**Existing Condition**: Assessment area is bordered by mitigation area to the north providing adjacent cover and food sources. Bordered by White Construction borrow pites ot the west and undeveloped lands to the east. **Future With**: Assessment area will be incorporated into Mitigation Area A, a 475-acre buffer marsh.
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 4	with: 7	**Existing Condition**: Site is highly disturbed and dominated by exotic plant species, *Melaleuca* sp., and indication of impaired hydrology. Hydrology is still sufficient to support wetland with strong hydric soils. **Future With**: Assessment area will be incorporated into Mitigation Area A. Hydrology of site will be controlled to maintain wetland function and value with low berms around entire mitigation area to allow up to 1 foot of storage.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 2	with: 8	**Existing Condition:** Vegetation dominated by *Melaleuca sp. with understory of Cladium jamaicense*. **Future With**: Mitigation activities include grading to elevation that can support a sustainable wetland and planting of native wetland species.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres: 0.33	with: 0.67

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.34

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.5

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 12.56

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-11 Sub Area		Upland Area/Mitigation Area B

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
100	Uplands	Mitigation	13

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
C-11 Basin	Class III	N/A

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands Site surrounded by roadway to the north, undeveloped lands to the south and east, and borrow pit to the west.	
Assessment area description Previously developed upland site	
Significant nearby features Development to the east, roadway to the north, cell tower to the west, and abandoned ornamental tree nursery to the south.	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Functions Provid3es no wetland and value	Mitigation for previous permit/other historic use NA
Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found) No wildlife use anticipated	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area) NA
Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.): No wildlife use anticipated	
Additional relevant factors: Site has been hydrologically altered and is significantly disturbed.	
Assessment conducted by: USACE, SFWMD, USFWS, USEPA	Assessment date(s): 22-May-06

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-11 Sub Area		Uplands/Mitigation Area B
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	5/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

	w/o pres or current	with	
.500(6)(a) Location and Landscape Support	0	5	**Existing Condition**: Assessment area includes previously developed upland associated with rock mine that provides no wetland function and value. **Future With**: Assessment area will become Mitigation Area B, a 13-acre marsh and although not hydrologically connected to Mitigation Area A, adjacent allowing for avian movement back and forth.
.500(6)(b)Water Environment (n/a for uplands)	NA	7	**Existing Condition**: NA. **Future With**: Assessment area will become Mitigation Area B. Site will be a rainfall driven/seepage wetland.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	0	8	**Existing Condition:** Assessment area includes previously developed area with hard substrate/no vegetation and provides no community structure or vegetation. **Future With**: Mitigation activities include grading to elevation that can support a sustainable wetland and planting of native wetland species.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0	0.67

Delta = [with-current]
0.67

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.5

For impact assessment areas
FL = delta x acres =

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 5.81

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-9 Sub Area		Sunset Lakes (Polygon 3)

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
643		Impact	682.75

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e. OFW, AP, other local/state/federal designation of importance)
C-9 Basin	Class III	Area is an existing mitigation area and protected under a Conservation Easement

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Separated from adjacent development and mining to the east by levee and canal but hydrologically connected to undeveloped lands to the south and west via overland flow.

Assessment area description

Historic Everglades marsh wetland that was drained for agriculture and used as a pasture. Mitigation activities included ditch plugs and planting on native plant species to restore area to wetland marsh.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Sunset Lakes Residential Development and mining activities to the east.	Unique in that there are few large tracts of undeveloped, preserved lands in this area of Broward County

Functions	Mitigation for previous permit/other historic use
Provides foraging habitat for birds (native and migratory), reptiles and small to medium sized mammals.	Yes - Exsting Mitigation site

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
wading and aquatic dependent birds (native and migratory), fish, alligators, invertebrates, small and medium sized mammals	Everglades Snail Kite, Woodstorks, Bald Eagle, Indigo snake

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Deer, racoons, rabbits, snakes, rodents, butterflies and other insects, aquatic invertebrates in ditches.

Additional relevant factors:

Site has been hydrologically altered

Assessment conducted by:	Assessment date(s):
USACE, SFWMD, USEPA, USFWS	14-Sep-05

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-9 Sub Area		Sunset Lakes (Polygon 3)
Impact or Mitigation	Assessment conducted by:	Assessment date:
Impact	USACE, USEPA, USFWS, SFWMD	9/14/2005

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 4	with: 0	**Existing Condition**: Assessment area is bordered by levee, canal, and Sunset Lakes residential development and mining to the east; undeveloped lands (primarily melalueca infested to the west); and undeveloped lands to the south (Bregmann Tract - unimproved pasture). **Future With**: Wetland mitigation area will be converted to impoundment with no monitoring and maintenance of wetland function. This constitutes an adverse impact of all wetland function and value provided by the assessment area.
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 5	with: 0	**Existing Condition**: Hydrology not sufficient to sustain a viable marsh community. Plant species include obligate to facultative species. Site is former pasture with agricultural ditches. **Future With**: Wetland mitigation area will be converted to impoundment with no monitoring and maintenance of wetland function. This constitutes an adverse impact of all wetland function and value provided by the assessment area.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 5	with: 0	**Existing Condition**: Community structure is varied. Assessment area is former pasture which has been enhanced as mitigation to its historic former marsh condition (prior to being drained for pasture). Although mitigation activities of permit and mitigation were completed area includes a range of species including some planted native trees namely cypress with coverage by exotic plant species greater than 5%. **Future With**: Wetland mitigation area will be converted to impoundment with no monitoring and maintenance of wetland function. This constitutes an adverse impact of all wetland function and value provided by the assessment area.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres: 0.47	with: 0

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres = -320.89

Delta = [with-current]
-0.47

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-9 Sub Area		Bregmann Tract (Polygon 4)

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
643		Impact	98.25

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
C-9 Basin	Class III	Area is an existing mitigation area within a tract of land purchased with DOI federal grants for Everglades Restoration

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Separated from adjacent development and mining to the east by levee and canal but hydrologically connected to undeveloped lands to the north and west via overland flow.

Assessment area description

Historic Everglades marsh wetland that was drained for agriculture and used as a pasture. Mitigation activities included ditch plugs and planting on native plant species to restore area to wetland marsh.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Sunset Lakes Residential Development and mining activities to the east & Sunset Lakes Mitigation Area to the north	The land was purchased with federal grant from DOI to be used for Everglades Restoration.

Functions	Mitigation for previous permit/other historic use
Provides foraging habitat for birds (native and migratory), reptiles and small to medium sized mammals.	Yes - Exsting Mitigation site

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
wading and aquatic dependent birds (native and migratory), fish, alligators, invertebrates, small and medium sized mammals	Everglades Snail Kite, Woodstorks, Bald Eagle, Indigo snake

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Deer, racoons, rabbits, snakes, rodents, butterflies and other insects, aquatic invertebrates in ditches.

Additional relevant factors:

Site has been severely hydrologically altered

Assessment conducted by:	Assessment date(s):
USACE, SFWMD, USEPA, USFWS	14-Sep-05

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-9 Sub Area		Bregmann Tract (Polygon 4)
Impact or Mitigation	Assessment conducted by:	Assessment date:
Impact	USACE, USEPA, USFWS, SFWMD	9/14/2005

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 4	with: 0
Existing Condition: Assessment area is bordered by levee, canal, and Sunset Lakes residential development and mining to the east; undeveloped lands (primarily melalueca infested) to the west; undeveloped/ mitigation lands i.e., feshwater marsh/Sunset Lakes to the north. **Future With**: Wetland mitigation area will be converted to impoundment with no monitoring and maintenance of wetland function. This constitutes an adverse impact of all wetland function and value provided by the assessment area.		
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 2	with: 0
Existing Condition: Hydrology of the site is impacted by agricultural ditches throughout. Plant species are vary including obligate to upland species. Species are more indicative of uplands and include butterflies and insects. Hydrology is not appropriate to sustain a viable wetland community. **Future With**: Wetland mitigation area will be converted to impoundment with no monitoring and maintenance of wetland function. This constitutes an adverse impact of all wetland function and value provided by the assessment area.		
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 2	with: 0
Existing Condition: Community structure is varied. Assessment area is historic marsh which was ditched and drained for pasture. Marsh species present throughout along with pasture grasses and nuisance, invader species greater than 5 percent. Northern 100 acres of assessment area enhanced as marsh. **Future With**: Wetland mitigation area will be converted to impoundment with no monitoring and maintenance of wetland function. This constitutes an adverse impact of all wetland function and value provided by the assessment area.		

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres: 0.27	with: 0

Delta = [with-current]
-0.27

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) =
Risk factor =

For impact assessment areas
FL = delta x acres = -26.53

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Broward WPA: C-9 Sub Area		FDOT Chimney Site (Polygon 8)

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
643		Impact & Mitigation	358

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
C-9 Basin	Class III	Area is an existing mitigation area

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Separated from lands to the north by a berm, connected South Broward Drainage District Canal 8 to the east by 2 culverts, south boundary open to undeveloped lands and west boundary open which receives runoff from US Highway 27.

Assessment area description

Historic Everglades marsh wetland that was drained for agriculture and used as a pasture. SFWMD has implemented an aggressive exotic maintenance control program using the mitigation monies paid by the permittee (FDOT).

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
US Highway 27 runs along the western edge of the project	This parcel of land is part of the Everglades East Coast Buffer and provides an important buffer between the Everglades and development to the east

Functions	Mitigation for previous permit/other historic use
Provides foraging habitat for birds (native and migratory), reptiles and small to medium sized mammals.	Yes - Exsting Mitigation site

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
wading and aquatic dependent birds (native and migratory), fish, alligators, invertebrates, small and medium sized mammals	Everglades Snail Kite, Woodstorks, Bald Eagle, Indigo snake

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Deer, racoons, rabbits, snakes, rodents, butterflies and other insects

Additional relevant factors:

Site has been hydrologically altered

Assessment conducted by:	Assessment date(s):
USACE & SFWMD	28-Jul-06

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-9 Sub Area		FDOT Chimney Site (Polygon 8)
Impact or Mitigation	Assessment conducted by:	Assessment date:
Impact	USACE & SFWMD	7/28/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	**Existing Condition**: Assessment area is bordered by major highway to the west with no roadside berm, highway and development to the north with swale and berm separating assessement area, canal to the east, and undeveloped lands to the south. Site is connected to a canal on the east side through 2 culverts. The assessement area is bifurcated by a highway with no hydrologic connection between the 2 cells. **Future With**: A portion of the existing mitigation lands will be filled for low berm construction.	w/o pres or current: 4; with: 0
.500(6)(b)Water Environment (n/a for uplands)	**Existing Condition**: Hydrology not sufficient to sustain a viable marsh community or to keep exotic plant species under control. The north cell is connected to a canal to the east through 2 culverts which help to keep site drained. Assessment area receives runoff from highwayto the west due to absence of roadside swale or berm. South connection is presently open allowing sheetflow. **Future With**: A portion of the mitigation area will be filled for low berm construction.	w/o pres or current: 3; with: 0
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	**Existing Condition**: Community structure is varied, some areas Melaleuca has been effectively treated and in other areas it is a problem. Native species include *Rhyncospora* sp., *Centella* sp., *Pontederia cordata*, *Pluchea* sp., *Panicum hemitomon*, and *Myrica cerifera*. Melaleuca seedlings are present throughout. **Future With**: A portion of the mitigation area will be filled for low berm construction.	w/o pres or current: 5; with: 0

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.4	0

Delta = [with-current]
-0.4

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) =
Risk factor =

For impact assessment areas
FL = delta x acres =-7.6

For mitigation assessment areas
RFG = FL/(t-factor x risk) =

Form 62-345.900(2), F.A.C. [effective date]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA/C-9 Sub Area		FDOT Chimney Site (Polygon 8)
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE & SFWMD	7/28/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 4	with: 5	**Existing Condition**: Assessment area is bordered by major highway to the west with no roadside berm, highway and development to the north with swale and berm separating assessement area, canal to the east, and undeveloped lands to the south. Site is connected to a canal on the east side through 2 culverts. The assessement area is bifurcated by a highway with no hydrologic connection between the 2 cells. **Future With**: Adjacent areas to the west, north, and east will remain. The C-9 impoundment will be constructed to the south with hydrologic connection for envrionmental water supply. Additionally the site will be entirely bermed (low berm).
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 3	with: 7	**Existing Condition**: Hydrology not sufficient to sustain a viable marsh community or to keep exotic plant species under control. The north cell is connected to a canal to the east through 2 culverts which help to keep site drained. Assessment area receives runoff from highwayto the west due to absence of roadside swale or berm. South connection is presently open allowing sheetflow. **Future With**: A low berm to retain water and prevent roadside runoff will be constructed around perimeter of project with water control structures allowing water supply from the C-9 impoundment. An increase in water depth and duration will reduce the prolonged over draining of this wetland area and restore a more natural hydroperiod indicative of historic conditions.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 5	with: 8	**Existing Condition**: Community structure is varied, some areas Melaleuca has been effectively treated and in other areas it is a problem. Native species include *Rhyncospora* sp., *Centella* sp., *Pontederia cordata*, *Pluchea* sp., *Panicum hemitomon*, and *Myrica cerifera*. Melaleuca seedlings are present throughout. **Future With**: With improved hydroperiod and additional water exotics will be eliminated and the Everglades sawgrass marsh species predominately *Cladium jamaciense* is anticipated to return.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.4	0.67

Adjustments for existing exotic plant control
Adjusted UMAM score= 0.6
Adjusted mitigation delta = 0.2

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.27

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.25

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 54.24

Form 62-345.900(2), F.A.C. [effective date]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Water Conservation Area (WCA) 3A Seepage Management Area (SMA)		SMA 3A

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
610, 641, 643,424		Mitigation	1,961.10 acres

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
WCA 3	Class III	

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Seepage Mangement Area 3A is hydrologically connected to surrounding and downstream wetlands through several large pumping structures and gravity feed structures. A canal and levee system surrounds and links SMA 3A to downstream wetland areas.

Assessment area description

The area consists of 248 acres of meleleuca, 939 acres of sawgrass marsh and 206 acres of wet prairie

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
WCA 3A and 3B are to the west.	Part of the historic northern/central Everglades, containing tree islands, and the ridge and slough landscape.

Functions	Mitigation for previous permit/other historic use
Provides nesting and foraging habitat for birds (native and migratory), fish, amphibians, reptiles and small to medium sized mammals. Natural water storage.	None

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
wading and aquatic dependent birds (native and migratory), fish, alligators, invertebrates, small and medium sized mammals	Everglades Snail Kite, Woodstorks, Bald Eagle, Indigo snake, Florida Panther

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Everglades Snail Kite, Woodstorks, Bald Eagle, Egrets, Tri-colored Herons, Ibis, alligators, small mammals, birds and invertebrates

Additional relevant factors:

Eradication of melaleuca has taken place

Assessment conducted by:	Assessment date(s):
SFWMD, USACE, USEPA, USFWS	6/22/2006

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Water Conservation Area (WCA) 3B Seepage Management Area (SMA)		WCA 3B SMA

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
610, 641, 643,424		Mitigation	3335.17acres

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
WCA 3	Class III	

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Ssepage mangement Area 3B extends from southern border of SMA 3A at the South New River Canal and lies between L33 levee on the west and US 27 on its east.is hydrologically connected to surrounding and downstream wetlands through several large pumping strucures and gravity feed structures. A canal and levee system surrounds and links SMA 3B to downstream wetland areas.

Assessment area description

This area encompasses approximately 751 acres of wet prairie, 493.5 ac of shrubland, 11.65 ac of forested uplands, 1,286 acres of melaleuca

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
WCA 3B are to the west.	Part of the historic northern/central Everglades, containing tree islands, and the ridge and slough landscape.

Functions	Mitigation for previous permit/other historic use
Provides nesting and foraging habitat for birds (native and migratory), fish, amphibians, reptiles and small to medium sized mammals. Natural water storage.	None

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
wading and aquatic dependent birds (native and migratory), fish, alligators, invertebrates, small and medium sized mammals	Everglades Snail Kite, Woodstorks, Bald Eagle, Indigo snake, Florida Panther

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Everglades Snail Kite, Woodstorks, Bald Eagle, Egrets, Tri-colored Herons, Ibis, alligators, small mammals, birds and invertebrates

Additional relevant factors:

Eradication of melaleuca has taken place

Assessment conducted by:	Assessment date(s):
SFWMD,USACE, USFWS, USEPA	6/22/2006

Form 62-345.900(1), F.A.C. [effective date of 2/2/04]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA - WCA 3A/3B SMA		Polygon 1 - Wetland Enhancement; 360.78 acres
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	6/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 4	with: 4	**Existing Condition**: Assessment area is bordered by Krome Avenue to west and and East Coast Buffer (including Pensuco wetlands) to the east; isolated by Dade-Broward Levee. **Future with:** Berm and canal to be constructed around entire SMA for retaining water. Polygon 7 is reference wetland for mitigation activities.
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 5	with: 8	**Existing Condition**: Site has been hydrologically altered due to adjacent development including levees impeding sheetflow but assessment area has saturated soils and muck soils throughout. **Future with**: Site will be bermed allowing retainment of water. Water depths and duration will increase.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 1	with: 9	**Existing Conditions**: Community structure is dense *Melaleuca* sp with no understory. **Future with:** Site will be planted with appropriate Everglades flora and managed with exotic control with Polygon 7 as reference wetland. Mitigation lift adjusted to account for existing exotic plant management plan already in place.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.33	0.7

Adjustments for existing exotic plant control
Adjusted UMAM score = 0.5
Adjusted mitigation delta = 0.17

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.37

If mitigation
Time lag (t-factor) = 1
Risk factor = 2

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 30.67

Form 62-345.900(2), F.A.C. [effective date]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA - WCA 3A/3B SMA		Polygon 2 - Wetland Enhancement; 106.4 acres
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	6/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 2	with: 4	**Existing Condition**: Assessement area is bordered by Krome Avenue to west and rock mine to east. **Future with:** Polygon 7 is reference wetland for mitigation activities.
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 5	with: 8	**Existing Condition**: Site has been hydrologically altered due to adjacent development including levees impeding sheetflow but assessment area has saturated soils and muck soils throughout. **Future with**: Entire SMA will be bermed off allowing retainment of water. Water depths and duration will increase. Polygon 7 is reference wetland.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 5	with: 9	**Existing Conditions**: Commuinity structure is dense *Melaleuca* sp with understory of *Cladium jamaicense*. **Future with:** Site will be planted with appropriate Everglades flora and managed with exotic control with Polygon 7 as reference wetland. Mitigation lift adjusted to account for existing exotic plant management plan already in place.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres: 0.4	with: 0.7

Adjustments for existing exotic plant control
Adjusted UMAM score = 0.6
Adjusted mitigation delta = 0.2

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.3

If mitigation
Time lag (t-factor) = 1
Risk factor = 3

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 7.09

Form 62-345.900(2), F.A.C. [effective date]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA - WCA 3A/3B SMA		Polygon 3 - Wetland Enhancement; 666.52 acres
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	6/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 5	with: 4	**Existing Condition**: Assessement area is bordered by U.S. Highway 27 and canal to the east and WCA 3B to the west although separated by levee. **Future with:** Berm and canal to be constructed around entire SMA for retaining water. Polygon 7 is reference wetland for mitigation activities.
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 7	with: 8	**Existing Condition**: Site has been hydrologically altered due to adjacent development including levees impeding sheetflow but assessment area has saturated soils and muck soils throughout. **Future with**: Site will be bermed off allowing retainment of water. Water depths and duration will increase. Polygon 7 is reference wetland.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 7	with: 9	**Existing Conditions**: Community structure is dense *Melaleuca* sp with understory of *Cladium jamaicense*. **Future with:** Site will be planted with appropriate Everglades flora and managed with exotic control with Polygon 7 as reference wetland. Mitigation lift adjusted to account for existing exotic plant management plan already in place.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres: 0.63	with: 0.7

Adjustments for existing exotic plant control
Adjusted UMAM score = 0.65
Adjusted mitigation delta = 0.02

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.07

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.25

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 10.67

Form 62-345.900(2), F.A.C. [effective date]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA - WCA 3A/3B SMA		Polygon 4A - Wetland Enhancement; 55.03 acres
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	6/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 3	with: 4	**Existing Condition**: Assessement area is bordered by U.S. Highway 27 and Krome Avenue. **Future with:** Berm and canal to be constructed around entire SMA for retaining water. Polygon 7 is reference wetland for mitigation activities.
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 5	with: 8	**Existing Condition**: Site has been hydrologically altered due to adjacent development including levees impeding sheetflow but assessment area has saturated soils and muck soils throughout. **Future with**: Site will be bermed off allowing retainment of water. Water depths and duration will increase. Polygon 7 is reference wetland.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 2	with: 9	**Existing Conditions**: Assessment area includes sparse *Melaleuca* sp. with open understory supporting *Bacopa* sp and periphyton. **Future with:** Site will be planted with appropriate Everglades flora and managed with exotic control with Polygon 7 as reference wetland. Mitigation lift adjusted to account for existing exotic plant management plan already in place.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.33	0.7

Adjustments for existing exotic plant control
Adjusted UMAM score = 0.525
Adjusted mitigation delta = 0.20

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.37

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.25

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 8.58

Form 62-345.900(2), F.A.C. [effective date]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA - WCA 3A/3B SMA		Polygon 4B - Wetland Enhancement;365.53 acres
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	6/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

	w/o pres or current	with	
.500(6)(a) Location and Landscape Support	4	4	**Existing Condition**: Assessement area is bordered by U.S. Highway 27 to east and WCA 3B (and levee) to the west. Holly Lake Mobile Home Park is to the north. **Future with:** Berm and canal to be constructed around site for retaining water. Polygon 7 is reference wetland for mitigation activities.
.500(6)(b)Water Environment (n/a for uplands)	4	8	**Existing Condition**: Site has been hydrologically altered due to adjacent development including levees impeding sheetflow but assessment area has saturated soils and muck soils throughout. **Future with**: Entire SMA will be bermed off allowing retainment of water. Water depths and duration will increase. Polygon 7 is reference wetland.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	3	9	**Existing Conditions**: Assessment area includes sparse *Melaleuca* sp., *Cladium jamaicense*, and periphyton. **Future with:** Site will be planted with appropriate Everglades flora and managed with exotic control with Polygon 7 as reference wetland. Mitigation lift adjusted to account for existing exotic plant management plan already in place.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.37	0.7

Adjustments for existing exotic plant control
Adjusted UMAM score = 0.55
Adjusted mitigation delta = 0.18

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.33

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.25

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 52.64

Form 62-345.900(2), F.A.C. [effective date]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA - WCA 3A/3B SMA		Polygon 5 - Wetland Enhancement; 510.85 acres
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	6/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 4	with: 4
Existing Condition. Assessement area is bordered by U.S. Highway 27 to east, WCA 3B (and levee) to the west, C-11 Canal to the north. **Future With:** Berm and canal to be constructed around site for retaining water. Polygon 7 is reference wetland for mitigation activities.		
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 3	with: 8
Existing Condition: Site has been hydrologically altered due to adjacent development including levees impeding sheetflo. Assessment area drys out in areas during the dry season and is slightly wetter during the wet season. **Future with**: Site will be bermed off allowing retainment of water. Water depths and duration will increase. Polygon 7 is reference wetland.		
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 4	with: 9
Existing Conditions: Site includes new growth of *Melaleuca* sp., *Andropogon* sp., *Baccharis* sp., *Rhynchospora* sp., *Centella* sp., *and Hypericum* sp. **Future with:** Site will be planted with appropriate Everglades flora and managed with exotic control with Polygon 7 as reference wetland. Mitigation lift adjusted to account for existing exotic plant management plan already in place.		

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.37	0.7

Adjustments for existing exotic plant control
Adjusted UMAM score = 0.575
Adjusted mitigation delta = 0.21

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.33

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.25

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 83.78

Form 62-345.900(2), F.A.C. [effective date]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA - WCA 3A/3B SMA		Polygon 6 - Wetland Enhancement; 355.23 acres
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	6/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 4	with: 4	**Existing Condition**: Assessement area is bordered by U.S. Highway 27 to east, WCA 3A (and levee) to the west, C-11 Canal to the south. **Future With:** Berm and canal to be constructed around entire SMA for retaining water. Polygon 7 is reference wetland for mitigation activities.
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 6	with: 8	**Existing Condition**: Site has been hydrologically altered due to adjacent development including levees impeding sheetflow. Soils are spongy and signs of nutrient loading from C-11 Canal. Assessment area drys out in areas during the dry season and is slightly wetter during the wet season. **Future with**: Site will be bermed off allowing retainment of water along east and west with no changes to water quality influence from C-11 canal. Water depths and duration will increase. Polygon 7 is reference wetland.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 7	with: 9	**Existing Conditions**: Vegetation includes *Cladium jamaicense*, *Typha* sp., *Pontederia cordata*, *Panicum hemitomon*, and periphyton. **Future with:** Site will be planted with appropriate Everglades flora and managed with exotic control with Polygon 7 as reference wetland. Mitigation lift adjusted to account for existing exotic plant management plan already in place.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.57	0.7

Adjustments for existing exotic plant control
Adjusted UMAM score = 0.65
Adjusted mitigation delta = 0.08

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.13

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.25

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 22.74

Form 62-345.900(2), F.A.C. [effective date]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA - WCA 3A/3B SMA		Polygon 7 - Reference Wetland; 777.49 acres
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	6/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	**Existing Condition**: Assessement area is bordered by U.S. Highway 27 to east, WCA 3A (and levee) to the west. **Future With:** Berm and canal to be constructed around entire SMA with no change to location/landscape. Polygon 7 is reference wetland for mitigation activities.	w/o pres or current: 4; with: 4
.500(6)(b)Water Environment (n/a for uplands)	**Existing Condition**: Hydrology indicative of sustainable Everglades ecosytem although site is bounded by levee preventing sheetflow from the west. **Future with**: Polygon 7 is reference wetland as site is highly functional and no lift anticipated.	w/o pres or current: 8; with: 8
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	**Existing Conditions**: Vegetation includes typical Everglades marsh wet prairie complex dominated by *Cladium jamaicense*, *Rynchospora* sp., *Eleocharis cellulosa*, and periphyton. **Future with:** No ecological lift is anticipated. Polygon 7 is reference wetland.	w/o pres or current: 9; with: 9

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.7	0.7

Adjustments for existing exotic plant control
Adjusted UMAM score =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = FL/(t-factor x risk) =

Form 62-345.900(2), F.A.C. [effective date]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA - WCA 3A/3B SMA		Polygon 8 - Wetland Enhancement; 12.64 acres
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	6/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

	w/o pres or current	with	
.500(6)(a) Location and Landscape Support	3	4	**Existing Condition**: Assessment area is bordered by Dade-Broward Levee and U.S. Highway 27 and isolated and separated from larger section of the SMA. **Future with:** Berm and canal to be constructed around entire SMA for retaining water. Polygon 7 is reference wetland for mitigation activities.
.500(6)(b)Water Environment (n/a for uplands)	4	8	**Existing Condition**: Site has been hydrologically altered due to adjacent development and levees which impede sheetflow. Soils within assessment area are saturated; hydroperiod appears to be too dry during the dry season and too wet from retaining water during the wet season. **Future with**: Entire SMA will be bermed. Water depths and duration will increase with hydroperiod that can sustain Everglades flora community.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	1	9	**Existing Conditions**: Community structure is dense *Melaleuca* sp. with no understory. **Future with:** Site will be planted with appropriate Everglades flora and managed with exotic control with Polygon 7 as reference wetland. Mitigation lift adjusted to account for existing exotic plant management plan already in place.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.27	0.7

Adjustments for existing exotic plant control
Adjusted UMAM score = 0.6
Adjusted mitigation delta = 0.34

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.5

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.25

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 3.44

Form 62-345.900(2), F.A.C. [effective date]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
BCWPA - WCA 3A/3B SMA		Upland Polygons (68.2 acres)
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	USACE, USEPA, USFWS, SFWMD	6/22/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

	w/o pres or current	with	
.500(6)(a) Location and Landscape Support	0	4	**Existing Condition**: Assessement area includes upland with prior development with no wetland function provided i.e., tree nurseries, berm, and staging area associated with borrow pit. **Future With:** Berm and canal to be constructed around entire SMA for retaining water. Polygon 7 is reference wetland for mitigation activities.
.500(6)(b)Water Environment (n/a for uplands)	NA	8	**Existing Condition**: NA **Future with**: Site will be graded to elevations consistent with adjacent wetland areas. Entire SMA will be bermed for retaing water and improving hydroperiods. Polygon 7 is reference wetland.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	0	9	**Existing Conditions**: Site is upland, prior developed area with no communtiy structure that provides any wetland function and value. **Future with:** Site will be planted with appropriate Everglades flora and managed with exotic control with Polygon 7 as reference wetland. Mitigation lift adjusted to account for existing exotic plant management plan already in place. Upland assessment areas have no existing exotic plant management program in place so no adjustments are needed.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0	0.7

Adjustments for existing exotic plant control
Adjusted UMAM score =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
0.7

If mitigation
Time lag (t-factor) = 1
Risk factor = 1.25 (for all upland polygons except for two which have risk of 2)

For mitigation assessment areas
RFG = FL/(t-factor x risk) = 34.5

Form 62-345.900(2), F.A.C. [effective date]

C.14 ATTACHMENT A - BCWPA ENVIRONMENTAL BENEFITS MODEL LIST OF ACRONYMS

C.14.1 Broward County Water Preserve Areas Environmental Benefits Model Appendix C List of Acronyms

AAHUs	Average Annual Habitat Units (unit of measurement of habitat value increases or worth in a given year)
AC	Acres
A-Series	refers to the BCWPA A Alternatives (A1, A2, A3, A4)
ATR	Agency Technical Review
BCWPA	Broward County Water Preserve Areas
BPJ	Best Professional Judgment
C	Carbon
C-9	Canal Number Nine
C-9 West	Canal Nine West Drainage Basin
C-11	Canal Number Eleven
C-11 West	Canal Eleven West Drainage Basin
C&SF	Central and Southern Florida Project (drainage plan for south Florida)
CERP	Comprehensive Everglades Restoration Plan
CERPZone	A digital storage program for CERP information
CESAJ-PD	Corps of Engineers Jacksonville District – Planning Division
D13R	The Restudy Selected Plan
DO	Dissolved Oxygen (Refers to oxygen level in a water body)
EBM	Environmental Benefits Model
EC	Engineering Circular (USACE guidance is contained in these)
e.g.	Exempli gratia (meaning: for example)
Etc	Et cetera (meaning: and so forth)
Et al	Et alii (means: and others)
EIS	Environmental Impact Statement
ENP	Everglades National Park
EPA	Everglades Protection Area
ER	Engineering Regulation (Corps guidance is contained in these)
FDEP	Florida Department of Environmental Protection
Ft	foot – English unit of linear measurement
F-Series	refers to the BCWPA F Alternatives (F1, F2, F3, F4)
FWC	Florida Fish and Wildlife Conservation Commission
FWP	Future With Project (describes a future scenario with the proposed project)

FWO	Future without project (describes a future scenario without the proposed project)
GIS	Geographic Information Systems
HA	Hectares (unit of land area = 10,000 square meters)
HSI	Habitat Suitability Index (functioning value of a habitat)
HU	Habitat Unit (refers to a unit – acre/hectare – used to measure geographical function to set a value on the unit)
IG	Interim Goals
IR	Indicator Region (geographical regions within the Everglades that are devised to delineate species health)
Kac	1,000 acres
Kacft/yr	kilo-acre-feet per year
KM	kilometers (measurement equal to 3.28 feet)
mt	metric ton
N	Nitrogen
NAI	Next Added Increment
NESRS	Northeast Shark River Slough
NSM	Natural System Model (a hydrologic model that develops Everglades natural system output conditions)
P	Phosphorous
PEER	People who are equal in such respects as age, education, etc.
Pg	Page (generally precedes a number referring to a page number)
PIR	Project Implementation Report
PMs	Performance Measures (also referred to as Planning Models)
Pp	refers to page number
Ppb	Parts Per Billion (measurement of constituents in soil, water, air, etc.)
PS	pump station
RDO	Rain Driven Operations
RECOVER	Restoration Coordination & Verification (RECOVER is an arm of CERP responsible for linking science with system-wide planning, evaluation and assessment tasks)
REMAP	*Regional Environmental Monitoring and Assessment Program* (describe, diagnose, and predict the status of ecosystem conditions)
R&S	Ridge and Slough (habitat type within the Everglades)
Restudy	C&SF Project Comprehensive Review Study

S-9	Structure Nine (this structure is a pump station)
S-31	Structure Thirty-One (this is a spillway)
S-141	Structure One Hundred and forty one (this is a culvert)
SFER	South Florida Everglades Report
SFWMD	South Florida Water Management District (CERP sponsor)
SFWMM	South Florida Water Management Model (2 miles by 2 mile hydrographic model)
SI	Sub-index
SMA	Seepage Management Area
SME	Subject Matter Expert
SOW	Scope of Work
Spp	Species (refers to a plant or animal species)
Sq Mi	Square Miles (unit of measurement)
SRS	Shark River Slough (refers to geographical area of the Everglades
SRS-ENP	Shark River Slough – Everglades National Park
Stddev	standard deviation
Subteam	refers to the BCWPA environmental benefits model multi-agency, multi-discipline subteam
TP	Total Phosphorus (refers to all phosphorus organic, inorganic)
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service
Yr	year
WCA	Water Conservation Area
WSE	Water Supply and Environment
95B	The Base condition for the year 1995

C.14.2 Glossary of Terms

Adaptive Management: A science and performance based approach to ecosystem management in situations where management anticipates actions to be taken as testable explanations, or propositions so the best course of action can be decided through monitoring, integrative assessment and synthesis.

Attributes: An efficient subset of all potential biological elements or components of natural systems that are representative of the overall ecological conditions of the system. Attributes (also known as indicators or endpoints) are selected to represent

the knowns or hypothesized effects of stressors, and the elements of the systems that have important human values (e.g., endangered species, sports fishing, etc.)

Ecosystem Benefits: Positive, non-monetary effects of an ecosystem restoration plan on ecological resources.

Conceptual Ecological Model: simple non-quantitative models developed to demonstrate how the Everglades ecosystem are stressed and to identify the source of this stress, and to be used as a guideline for establishing performance measures (PMs) for stressors and attributes identified in the process.

Drivers/Sources: The major external forces that have large-scale influences on natural systems. Drivers can be natural forces (e.g., sea level rise and hydrology) or anthropogenic (e.g., water management practices impacts on hydrology).

Ecological Effects: The biological responses caused by the stressors.

Habitat Unit: A predictive measure of the ecosystem benefits of an ecosystem restoration plan that combines an estimation of the quality of a given resource and the spatial extent over which that quality is expected to occur.

Indexing: The process of setting quantitative or qualitative performance measure (PM) output to a 0 to 1 scale.

Indicator: See definition of Attribute. An attribute used to monitor, assess, or manage natural resources.

Institutional Significance: The importance of an environmental resources is acknowledged in the laws, adopted plans and other policy statements of public agencies, tribes or private groups.

Lift: The difference between predicted ecological benefits of an ecosystem restoration alternative and the predicted ecological benefits of the future-without-project condition.

Performance Measure: The specific feature(s) or each attribute to be monitored to determine how well that attribute is responding to projects designed to correct the adverse effects of the stressors (i.e., to determine the success of the project).

Public Significance: Some segment of the general public recognizes the importance of an environmental resource as evidenced by people engaged in activities that reflect an interest or concern for that particular resources.

Stressors: The physical or chemical changes that occur within natural systems that are brought about by the drivers, causing significant changes in the biological components (structure and function),patterns and relationships in natural systems.

Technical Significance: A resource qualifies as significant based on its technical merits, which are based on scientific knowledge or judgment of critical resource characteristics.

C.15 ATTACHMENT B - BCWPA ENVIRONMENTAL BENEFITS MODEL APPENDIX C REFERENCES

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C.16 ATTACHMENT C - RECOVER EVERGLADES SNAIL KITE INFORMATION

Appendix - Interim Goals Indicator 3.12

Indicator 3.12 - Snail Kite

What is the desired restoration condition?

The desired restoration condition for the Everglade snail kite is to restore and maintain a network of snail kite foraging habitats and promote habitat that supports primary prey (apple snails) recruitment throughout the South Florida ecosystem.

Why is this indicator important and why is it a good indicator of CERP restoration?

The goal of improving habitat for snail kites and their prey is consistent with the Comprehensive Everglades Restoration Plan (CERP) goals to improve the functional quality of native habitats and improve native plant and animal species abundance and diversity (USACE and SFWMD 1999). Long-term snail kite population trends appear to correspond with the record of wetland drainage in South Florida (Bennetts et al., 1994). Snail kite habitats are affected by the primary stressors that the CERP will affect: hydrology and water quality.

Therefore, the snail kite population is likely to be sensitive to the CERP and their monitoring has been proposed as a useful adaptive assessment, status report, and compliance monitoring function (CROGEE 2003). Snail kite habitat is an important indicator of a natural predrainage Everglades landscape for the following reasons:

• Snail kites are obligate wetlands species (i.e., they must live and feed within wetlands), which rely on a mosaic of native freshwater marsh habitats characteristic of much of the Everglades. Snail kites feed in the Everglades' marshes and along the shorelines of several lakes, in particular, Lake Okeechobee. Wet prairies and aquatic sloughs dominated by a suitable distribution of *Eleocharis* spp. and *Panicum* sp. are necessary for snail kite foraging, while areas with woody shrubs, such as tree islands, are optimal nesting locations (Kitchens et al., 2002). These features are characteristic of the pre-drainage Everglades and much of the habitat that the CERP strives to restore.

• The species' primary current and historic distribution is almost entirely within the area to be affected by the CERP. The distribution of snail kites is within five distinct watersheds throughout the state, but its two principal watersheds are the Greater Everglades (Kissimmee-Okeechobee-Everglades) and Upper St. John's Basin (Kitchens et al., 2002). The large spatial extent of marsh and shoreline habitats within the Greater Everglades, particularly the Water Conservation Areas and Lake Okeechobee, encompass the majority of habitat for snail kites.

• Recovery of threatened and endangered species is a task outlined by federal regulations and deemed worthy by the public. Recovery of listed species is a critical element of the South Florida Ecosystem Restoration Initiative as established by the South Florida Ecosystem

Restoration Task Force. The U.S. Fish and Wildlife Service's South Florida Multi-Species Recovery Plan's (USFWS, 1999) recommendations for snail kite recovery and restoration of the ecological communities they inhabit are consistent with CERP goals for restoration of native habitat within the Everglades.

The snail kite has experienced population fluctuations associated with hydrologic influences, both man-induced and natural (Sykes, 1983a; Beissinger and Takekawa, 1983; Beissinger, 1986), but the amount of fluctuation is debated. However, the abundance of its exclusive prey, apple snails (*Pomacea paludosa*), has been definitively linked to water regime (Kushlan, 1975, Sykes 1979, 1983a) and the Everglades watershed has experienced, and continues to experience, substantial degradation including increased number and severity of untimely drydowns in many areas (Weaver and Brown 1993). Drainage of Florida's interior wetlands has reduced the extent and quality of habitat for both the apple snail and the snail kite (Sykes, 1983b). Apple snail populations, and therefore snail kite habitat suitability, are particularly affected by severe and untimely drydowns (Darby et al., 1997). Conversely, continuous high water levels have resulted in the loss of wet prairies, which are optimal for snail kite foraging and nesting.

Apple snails are more common in wet prairies that include emergent vegetation, such as *Rhynchospora* spp., *Panicum* sp., and *Eleocharis* sp., than in adjacent sloughs with sparse, floating and submerged vegetation such as *Utricularia* spp. and *Nymphaea* sp. (Darby, 2003). Emergent vegetation allows the snails to easily access the water surface for respiration, where they are visible and accessible to foraging snail kites. On the other end of the extreme, in dry years, the snail kites depend on water bodies that normally are suboptimal for feeding, such as canals, impoundments, and small isolated wetlands, remote from regularly used sites (Beissinger and Takekawa, 1983; Bennetts et al., 1988; Takekawa and Beissinger, 1989). These secondary or refuge habitats, considered vital to the continued survival of this species in Florida, are being lost at a rapid pace. Therefore, an increase in area and heterogeneous distribution of natural foraging habitats through restoration may be essential to the long-term survival persistence of the species when faced with natural, yet severe habitat disturbances, such as drought.

Snail kite research (Bennetts and Kitchens, 1997) also suggests that maintaining deep, impounded pools, like those exhibited in southern and eastern Water Conservation Area 3A under current water management operations, will eventually result in degradation of snail kite nesting habitat due to the loss of woody vegetation and degradation of foraging habitat due to the loss of wet prairie communities. Continuous flooding of wetlands for more than four of five years is particularly associated with degradation of snail kite foraging habitat (DOI, 2001; Bennetts et al., 1998). In Water Conservation Area 3A, snail kites have increasingly moved their nesting activity to areas of higher elevations and shorter hydroperiods as lower elevation habitat areas have been degraded by high water levels sustained by water management practices (Bennetts et al., 1998). As this shift continues, the area of suitable nesting habitats within Water Conservation Area 3A may decline and snail kites may be forced to move to other areas of suitable habitat (Kitchens et al., 2002).

Kitchens et al. (2002) examined the relationship between 15 vegetation studies and snail kite nesting and foraging habitat and concluded that all studies documented detrimental habitat alterations as a result of excessive depths and hydroperiods. Central and Southern Florida

Project operations have disrupted natural hydrologic patterns, reducing hydroperiods in some areas and increasing them in others (Weaver and Brown, 1993). These hydrologic changes are identified as a stressor on the snail kite as an attribute of the *Greater Everglades Ecosystem Conceptual Ecological Model* (Ogden et al., in prep.). CERP implementation should help to reverse these trends and support increasing areas of snail kite foraging habitat. In addition, excessive nutrient inputs promote dense growth of exotic and invasive native plants, particularly, cattail, water lettuce (*Pistia stratiotes*), water hyacinth (*Eichhornia crassipes*), and hydrilla (*Hydrilla verticillata*). Dense growth of these plants can reduce the ability of snail kites to locate apple snails. Expected water quality improvements, as a result of the CERP, should help promote the maintenance of a more natural, oligotrophic system.

How is the interim goal for this indicator predicted?

During the Central and Southern Florida Project Comprehensive Review Study, commonly referred to as the Restudy, hydrologic evaluations for the snail kite were based on Across Trophic Level Systems Simulation (ATLSS) modeling. Since then, species experts have advised the U.S. Fish and Wildlife Service and the Restoration Coordination and Verification Team (RECOVER) Evaluation Team that the ATLSS models are no longer considered suitable for this kind of analysis (Robert Bennetts, U.S. Geological Service, personal communication, February 13, 2003). As a result, U.S. Fish and Wildlife Service staff developed two new performance measures based on relationships between hydrologic variables and snail kite habitat suitability. Apple snail reproductive habitat and snail kite foraging habitat will be predicted using hydrologic output from the South Florida Water Management Model (SFWMM).

Apple Snail Reproductive Habitat

Because snail kites feed almost exclusively on apple snails, their survival depends directly on the hydrologic functioning of wetlands (Bennetts et al., 1998). Apple snails require water levels above ground surface in order to produce egg clusters, and newly hatched snails are less able to survive dry periods that are adult-sized snails (Darby et al., 1997; Darby, 2003). A peak in apple snail egg cluster production in March – April was documented, suggesting that dry outs below ground level prior to or during this peak can substantially reduce apple snail populations through reduced egg cluster production and reduced hatchling survival (Darby et al., 1997; Darby, 2003). Therefore, the apple snail reproductive habitat indicator will use output from the SFWMM to evaluate the number of years in which water levels fall below ground surface prior to May 1. Predicted water levels for April 30 of each year of the 36-year record of record will be averaged across each indicator region and compared to the average ground surface for each indicator region. The number of drydowns will be quantified for five-year increments throughout CERP implementation. For the Lake Okeechobee littoral zone, the number of years in which predicted lake levels fall below 11 feet (approximately 95 percent of the littoral zone dry) will be counted. Fewer drydowns before May 1 than predicted by the Natural System Model (NSM) are desirable. The indicator will be applied to the Lake Okeechobee littoral zone and the following indicator regions (established by the RECOVER Evaluation Team): 100-102, 110-133, 140-146, 160, and 170 (RECOVER 2004) (Figure 3.12.1).

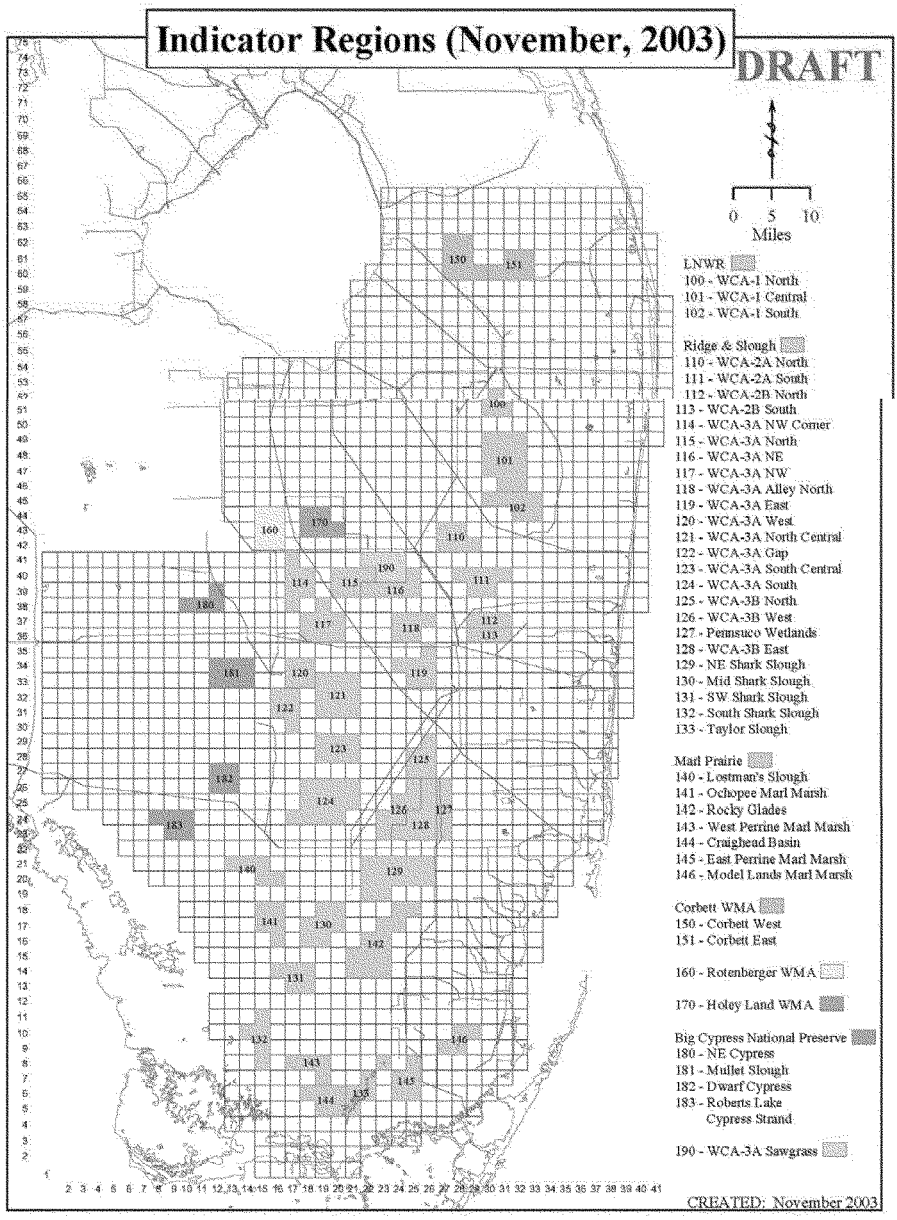

Figure 3.12.1. Indicator regions established by the RECOVER Evaluation Team

Snail Kite Foraging Habitat

Based on Bennetts et al. (1998) and Bennetts (personal communication 2003), optimal snail kite foraging habitat supporting emergent wet prairie vegetation is maintained in areas where water levels fall below ground surface between 1-in-3 and 1-in-5 years (156-260 weeks average flood duration). Although suitable emergent marsh vegetation may occur in areas where drydowns are more frequent, apple snail abundance in these areas is reduced, reducing foraging habitat value. Based on this, areas with 1-in 2 to 1-in-3 year drydowns (104-156 weeks average flood duration) are considered marginal. As hydroperiods increase, emergent marsh vegetation begins to shift to submergent slough communities. Bennetts et al. (1998) documents these shifts in areas with 1-in-5 to 1-in-6 year drydowns (260-312 weeks average flood duration). These hydroperiod classes correspond with the hydrologic requirements of emergent marsh vegetation reported in the scientific literature as reviewed in two recent publications (Wetzel, 2001; SFWMD, 1995). Output from the SFWMM will be used to predict the average duration of flooding events (weeks per year) over the 36-year period of record. Indicator regions with average flood durations from 156 to 260 weeks will be considered optimal, indicator regions with average flood durations from 104 to 155 week or 261 to 312 weeks will be considered marginal. This indicator will be applied to the following indicator regions (established by the RECOVER Regional Evaluation Team): 100-102, 110-133, 140-146, 160 and 170 (Figure 3.12.1) (RECOVER 2004). For snail kite foraging habitat in the Lake Okeechobee littoral zone, the existing Lake Okeechobee littoral zone indicators will provide an appropriate evaluation of habitat.

What are the predictions for five-year increments?

Results for apple snail reproduction and snail kite habitat predictive indicators are presented in Table 3.12.1. The model runs presented are NSM version 4.5, 1995, 2050 (without project), 2010, 2015, and D13R. The apple snail reproduction indicator counts the number of dryouts prior to May 1. If the number of dryouts is less than or equal to the NSM value and less than 10, the indicator region is scored as suitable (S); otherwise it is rated unsuitable (U) as snail kite habitat. The snail kite habitat indicator characterizes snail kite foraging habitat based on duration of inundation, with values from 156 to 260 weeks rated optimal (O), 104 to 155 or 261 to 312 weeks rated marginal (M), and other inundation durations rated unsuitable (U). An indicator region is considered usable habitat if it scores at least a marginal rating for both measures.

Table 3.12.1. Summary of snail kite indicator predictions by indicator region

Indicator Region		Indicator	NSM 4.5	1995	2050	2010	2015	D13R
100	North Water Conservation Area 1	Apple Snail Reproduction	9	20 U	24 U	21 U	20 U	21 U
		Snail Kite Habitat	126 M	47 U	42 U	43 U	43 U	43 U
101	Central Water Conservation Area 1	Apple Snail Reproduction	11	5 S	10 S	6 S	6 S	6 S
		Snail Kite Habitat	86 U	141 M	76 U	139 M	140 M	139 M
102	South Water Conservation Area 1	Apple Snail Reproduction	14	1 S	8 S	2 S	1 S	1 S
		Snail Kite Habitat	74 U	266 M	126 M	263 M	265 M	264 M
110	Water Conservation Area 2A North	Apple Snail Reproduction	16	14 S	18 U	14 S	13 S	13 S
		Snail Kite Habitat	72 U	79 U	80 U	82 U	82 U	82 U

Indicator Region		Indicator	NSM 4.5	1995	2050	2010	2015	D13R
111	Water Conservation Area 2A South	Apple Snail Reproduction	13	15 U	13 S	13 S	13 S	13 S
		Snail Kite Habitat	86 U	84 U	96 U	95 U	102 U	95 U
112	Water Conservation Area 2B North	Apple Snail Reproduction	13	15 U	13 S	13 S	13 S	13 S
		Snail Kite Habitat	98 U	73 U	95 U	70 U	70 U	67 U
113	Water Conservation Area 2B South	Apple Snail Reproduction	12	12 S	8 S	13 U	14 U	11 S
		Snail Kite Habitat	92 U	95 U	121 M	93 U	82 U	83 U
114	Water Conservation Area 3A Northwest Corner	Apple Snail Reproduction	14	25 U	16 U	14 S	13 S	13 S
		Snail Kite Habitat	90 U	41 U	80 U	81 U	92 U	93 U
115	Water Conservation Area 3A North	Apple Snail Reproduction	17	21 U	19 U	17 S	16 S	19 U
		Snail Kite Habitat	69 U	41 U	61 U	64 U	64 U	59 U
116	Water Conservation Area 3A Northeast	Apple Snail Reproduction	18	25 U	12 S	18 S	17 S	19 U
		Snail Kite Habitat	60 U	37 U	96 U	68 U	60 U	58 U
117	Water Conservation Area 3A Northwest	Apple Snail Reproduction	14	18 U	17 U	17 U	16 U	14 S
		Snail Kite Habitat	90 U	60 U	63 U	65 U	68 U	80 U
118	Water Conservation Area 3A Alley North	Apple Snail Reproduction	15	7 S	15 S	15 S	15 S	15 S
		Snail Kite Habitat	71 U	116 M	67 U	72 U	69 U	66 U
119	Water Conservation Area 3A East	Apple Snail Reproduction	18	1 S	11 S	13 S	12 S	6 S
		Snail Kite Habitat	64 U	262 M	106 M	98 U	114 M	126 M
120	Water Conservation Area 3A West	Apple Snail Reproduction	14	17 U	18 U	7 S	6 S	5 S
		Snail Kite Habitat	84 U	78 U	69 U	153 M	173 O	196 O
121	Water Conservation Area 3A North Central	Apple Snail Reproduction	15	12 S	16 U	10 S	7 S	6 S
		Snail Kite Habitat	78 U	113 M	74 U	115 M	140 M	140 M
122	Water Conservation Area 3A Gap	Apple Snail Reproduction	16	19 U	20 U	12 S	11 S	10 S
		Snail Kite Habitat	79 U	57 U	50 U	93 U	127 M	140 M
123	Water Conservation Area 3A South Central	Apple Snail Reproduction	16	8 S	17 U	15 S	13 S	12 S
		Snail Kite Habitat	63 U	117 M	66 U	76 U	88 U	107 M
124	Water Conservation Area 3A South	Apple Snail Reproduction	14	1 S	12 S	12 S	11 S	10 S
		Snail Kite Habitat	98 U	265 M	107 M	115 M	126 M	139 M
125	Water Conservation Area 3B North	Apple Snail Reproduction	19	7 S	17 S	7 S	7 S	4 S
		Snail Kite Habitat	60 U	154 M	76 U	117 M	139 M	171 O
126	Water Conservation Area 3B West	Apple Snail Reproduction	14	6 S	12 S	11 S	9 S	2 S
		Snail Kite Habitat	100 U	153 M	98 U	107 M	126 M	398 U
127	Pennsuco	Apple Snail Reproduction	10	19 U	20 U	12 S	11 S	4 S
		Snail Kite Habitat	139 M	57 U	49 U	93 U	101 U	187 O
128	Water Conservation Area 3B East	Apple Snail Reproduction	11	12 U	15 U	12 U	11 S	3 S
		Snail Kite Habitat	117M	90 U	57 U	96 U	105 M	314 U
129	Northeast Shark River Slough	Apple Snail Reproduction	0	17 U	15 U	12 U	11 U	3 S
		Snail Kite Habitat	533 U	74 U	79 U	90 U	105 M	395 U
130	Mid-Shark River Slough	Apple Snail Reproduction	0	11 U	9 S	9 S	8 S	2 S
		Snail Kite Habitat	400 U	124 U	126 U	137 M	126 M	397 U
131	Southwest Shark River Slough	Apple Snail Reproduction	3	17	11	11	11	5
		Snail Kite Habitat	223 O	67 U	97 U	140 M	97 U	104 M
132	South Shark River Slough	Apple Snail Reproduction	6	21 U	13 U	14 U	14 U	9 S
		Snail Kite Habitat	141 M	55 U	85 U	80 U	81 U	114 M
133	Taylor Slough	Apple Snail Reproduction	27	28 U	28 U	28 U	28 U	28 U
		Snail Kite Habitat	39 U	36 U	35 U	35 U	35 U	36 U
160	Rotenberger Wildlife Management Area	Apple Snail Reproduction	22	29 U	22 U	22 U	22 U	22 U
		Snail Kite Habitat	41 U	28 U	41 U	51 U	51 U	51 U
170	Holey Land Wildlife Management Area	Apple Snail Reproduction	15	7 S	5 S	16 U	15 U	16 U
		Snail Kite Habitat	78 U	140 M	221 O	77 U	77 U	77 U
190	Water Conservation Area 3A sawgrass	Apple Snail Reproduction	15	28 U	9 S	16 U	18 U	19 U
		Snail Kite Habitat	na	na	na	na	na	na

Snail kite habitat suitability appears to improve beginning in 2010, especially in the Shark Slough and Loxahatchee indicator regions (Figure 3.12.2). This pattern is maintained and optimal snail kite habitat is predicted for Water Conservation Area 3B West and North, and Pennsuco indicator regions in the D13R simulation. Apple snail reproduction potential gradually improves over 1995 results in the 2010, 2015, and D13R simulations (Figure 3.12.3). These improvements reflect substantially improved conditions for apple snails over the 2050 simulation. Overall, we expect increased suitability for snail kites in southern Water Conservation Area 3A and Shark River Slough as hydrologic restoration progresses. It is difficult to identify a true restored condition for snail kites, especially since few pre-drainage data are available. However, it is reasonable to expect that a fully restored system would provide a substantial mosaic of wet prairie habitat. One might expect that a fully restored system should, over a 31-year period, include approximately 50 percent of the Greater Everglades landscape, including the Lake Okeechobee littoral zone, which would be marginal or optimal for snail kites.

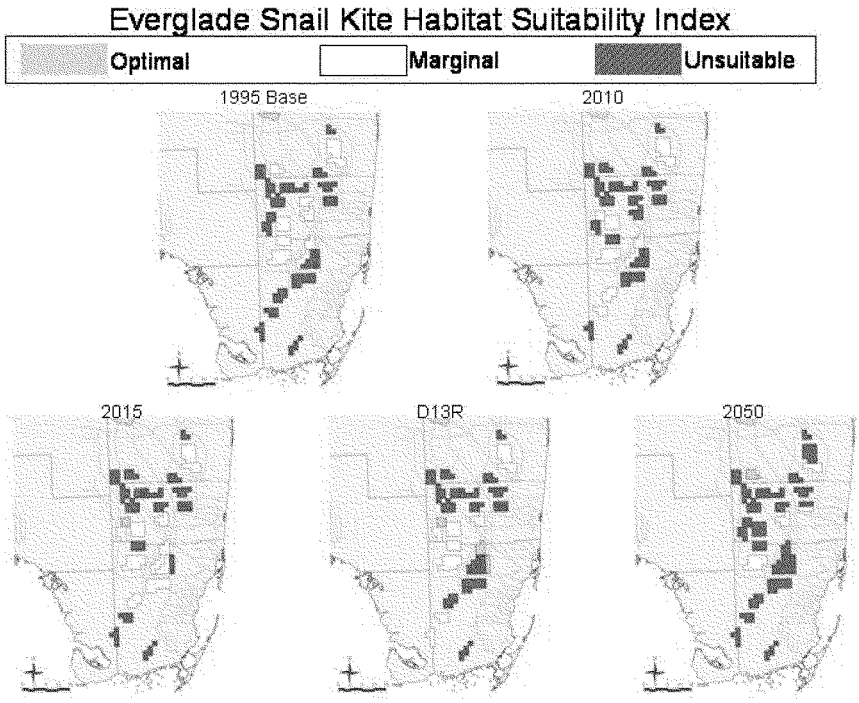

Figure 3.12.2. Snail kite habitat suitability index based on average inundation duration projected for NSM version 4.5, 1995 Base, 2050 Base, 2010, 2015, and D13R model runs.

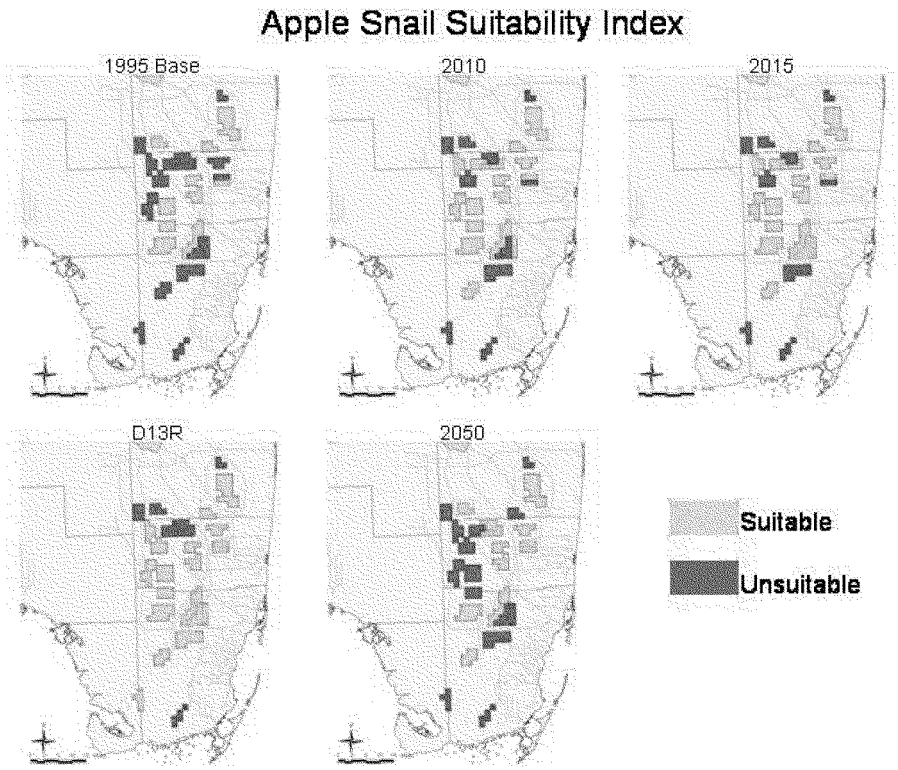

Figure 3.12.3. Apple snail suitability index based on average inundation duration projected for NSM 4.5, 1995 Base, 2050 Base, 2010, 2015, and D13R model runs.

How will we track whether the interim goals established for this indicator have been achieved?

Numbers of successful snail kite nests should be monitored in Water Conservation Areas 1A, 2A, 2B, 3A, 3B, Lake Okeechobee, Everglades National Park, Big Cypress, the upper St. Johns River, East Lake Tohopekaliga, West Lake Tohopekaliga, and Lake Kissimmee. Sampling of snail kite nests will be conducted during the breeding season, March to June, as this time period coincides with peak nesting activity (Bennetts and Kitchens, 1997). Consecutive surveys will be conducted within the wetland units shown in Figure 3.12.1 from March to June at 2-3 week intervals. Nests will be checked with a telescoping mirror pole to determine reproductive status of the nest. Water depth will also be measured at nests using a staff gauge. Sampling design will also include measuring global positioning system (GPS) locations of the nest, nesting substrate, and nest height. A nest is considered successful when at least one young reaches 24 days of age post-hatching (Steenhof and Kochert, 1982).

What additional work is needed to improve this interim goal?

The snail kite and apple snail suitability indices are preliminary methods and still under development. It is important to realize that these predictions are a product of average topography and water levels across large spatial areas. As such, the actual indicator regions, classified as suitable or unsuitable, are likely to contain both suitable and unsuitable habitat.

The indicators used for this round of predictions utilize output from the NSM. The NSM is currently under significant revision. When revised, the NSM will certainly change our interim goals for snail kites.

With the development and refinement of ecological models, future interim goal prediction methodology may include population size, growth rates, and spatial distribution of the snail kite population. For example, the ATLSS Model includes a snail kite spatially-explicit suitability index (SESI) that will be useful for predicting the distribution of snail kite habitat. The Everkite model, developed by Wolf Mooij, Netherlands Institute of Ecology, is a spatially-explicit individual-based snail kite model that also has potential for future goal predictions (Mooij et al., 2002). However, the current version of the model is not recommended for predicting actual population numbers. Efforts should be made to improve the predictive ability of the Everkite and ATLSS SESI models; thus, making the models useful for setting interim goals. Future interim goals predictions for snail kites should incorporate data from the ATLSS SESI snail kite model, Everkite simulations, and models that predict vegetation succession.

In addition, when the CERP Master Implementation Sequencing Plan is complete, the effect of constructing CERP features, or "footprint" effect, should be factored into interim goals predictions. Methods for predicting "footprint" effects of CERP projects on individual species have been developed (USFWS, 2004).

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C.17 ATTACHMENT D - BCWPA ENVIRONMENTAL BENEFITS MODEL ATR CERTIFICATION

Statement of ATR Team Member Qualifications
Todd Swannack, ERDC-EL-EE-W, Research Biologist
Todd Swannack serves as a Research Biologist for Wetlands and Coastal Ecology Branch of the Environmental Laboratory in the Engineer Research and Development Center, Vicksburg, MS. Todd has 13 years experience as a biologist, including 8 years experience in ecological modeling. He co-authored the textbook: *Ecological Modeling: a commonsense approach to theory and practice* and has published several modeling articles in the peer-reviewed literature. He consistently reviews documents for the journal *Ecological Modelling* and was named Outstanding Reviewer of the Year (2010) for the journal. He serves on the adjunct graduate faculty at Texas State University-San Marcos in the Department of Biology. Todd received his Bachelors and Ph.D. from Texas A & M University and a Masters from Texas State University-San Marcos.

Final Comments for Revised Model Documentation
The models presented in the manuscript are well-developed and are quite useful for the analyzing the ecological effects of the BWCPA project. The models were developed and quantified using assumptions that are based on well-accepted ecological theories. The hydrodynamics were developed using the South Florida Water Management Model (SFWMM), which is a well-documented, state-of-the-art hydrodynamics model. The performance measures chosen reflect the considerable knowledge of the model development team. These measures should be able to accurately monitor ecosystem condition after the project is implemented. The performance measure models used linear functions to explain relationships among many system components. Linear functions are the appropriate functional forms for the equations used in these models. Linear functions are appropriate for ecological models when trying to project trends in long term dynamics and when the general relationship between two variables is understood

I have thoroughly reviewed the document *Model Certification Documentation for the Broward County Water Preserves Area (BCWPA) Final Integrated Project Implementation Report (PIR), Environmental Impact Statement (EIS) and Technical Appendices*. The models are technically sound and I was unable to find any flaws in the logic used to develop the models or any mathematical errors in the calculations. The model documentation is well organized and well written. The modeling team addressed all of my comments, implemented the majority of my changes or provided logical and valid reasons for not doing so. After considering the modeling team's reasoning, I fully agree with their decisions. The models and accompanying documentation now appear complete and I fully support the models for use on this project.

Sincerely,

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

REPLY TO
ATTENTION OF

CECW-P 1 February 2011

MEMORANDUM FOR Director, National Ecosystem Restoration Planning Center of Expertise (ECO-PCX)

SUBJECT: Broward County Water Preserve Areas (WPA), Broward County, Florida. Ecosystem Planning Models – Approval for Use

Three ecosystem planning models used to quantify project benefits are approved for use for the subject project. Adequate technical reviews have been accomplished and the model meets the certification criteria contained in EC 1105-2-412. This approval is based on the decision of the HQUSACE Model Certification Panel which considered the National Ecosystem Planning Center of Expertise (ECO-PCX) assessments of the models. Below are specific assessments.

a. Ridge and Slough Model. This model has been published in peer reviewed journals and used in many projects for plan formulation and plan outputs and justification. The Ridge and Slough Model relies on a variety of performance indicators to measure and project outputs. This model is well documented, published, and tested, and is approved for use.

b. Snail Kite Habitat Quality Model. This model is part of the suite of habitat models used in South Florida restoration efforts. It focuses on vegetative changes which can either expand or reduce optimum forage habitat for an endangered raptor which only eats snails found in that vegetation. Like the Ridge and Slough Model, this model has been well documented and tested by planning and operations efforts in the ecosystem and is approved for use.

c. Cattail Spread Rate Reduction Model. Of the three models used for the Broward County WPA project, the Cattail model triggered the most review comments due to the sensitivity of Phosphorus loading issues in the aquatic ecosystem in Florida and the potential wide error bands around projections of Phosphorus reduction from project and system operations. The modeling team added backup information to address the model review comments. As a result, the Cattail Spread Rate Reduction Model is approved for use.

APPLICABILITY: Approval of these three models is limited to the subject project.

EXPIRES: 28 February 2018

HARRY E. KITCH, P.E.
Deputy Chief, Planning and Policy Division
Directorate of Civil Work

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C.18 ATTACHMENT E - PROTOCOL FOR ASSESSMENT, REMEDIATION AND POST-REMEDIATION MONITORING FOR ENVIRONMENTAL CONTAMINANTS ON EVERGLADES RESTORATION PROJECTS

3/14/08 FINAL VERSION

ATTACHMENT 1

A. Contamination Assessment

1. *Phase I Environmental Site Assessment*

The Phase I Environmental Site Assessment (Phase I) is performed in accordance with the American Society of Testing and Materials (ASTM) Standard Practice E1527-00, "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process." The purpose of the Phase I is to identify the presence or likely presence of any hazardous substance or petroleum product on the property. Phase I should provide all available information on current and past land use, and consists of the following elements:

a. Site Inspection

The site inspection usually consists of walking, driving, and/or flying over the property to visually ascertain the presence of features or indicators of past land uses and possible environmental contaminants. A checklist of such indicators includes, but is not limited to, dumps, drums, construction debris, fills, unusual chemical odors, above ground and underground storage tanks, chemical storage buildings, asbestos evidence, "stressed" vegetation or bare ground, "sterile" water bodies, oiled roads, stained or discolored ground or stream banks, oil slicks, air strips, maintenance areas, pipelines, transformers or other electrical equipment, oil and gas drilling, and mining activities.

b. Historical Considerations

The historical review should include interviews with current owners, previous owners, and neighbors to obtain an accurate history of past land uses, farming practices, pesticide usage, etc. Aerial photographs should be reviewed for evidence of row crops and other agricultural, commercial or industrial activities. At a minimum, the historical review should include reliable information on (1) farming practices (e.g., row crops, sugarcane, citrus, sod farm, ornamentals, grazing), (2) exact location of these practices on the property, and (3) farming chronology. For example, row cropping on a portion of the property during the period from the 1940s to the mid-1980s is strong suggestive evidence for the presence of organochlorine (OC) pesticides at that location.

c. Review of Environmental Databases

An extensive review of environmental databases (Comprehensive Environmental

Response, Compensation, and Liability Information System; Resource Conservation and Recovery Information System; National Priorities List; Emergency Response Notification System; state Above Ground and Underground Storage Tank records; Solid Waste Facility and Landfill Report; Florida State Hazardous Waste Site list; Facility Index System/Identification Initiative Program Summary Report; Formerly Used Defense Sites; and local mosquito control districts) should be conducted.

Information gleaned from the Phase I assessment is used to determine the necessity of a Phase II assessment.

2. *Phase II Environmental Site Assessment*

Should information from the Phase I or other credible sources (i.e., previous investigations) indicate the presence of contamination or that the potential for contamination exists, a Phase II Environmental Site Assessment (Phase II) should be initiated. Coordination between FWS and the agency performing the assessment is important starting at this point and throughout the rest of the process. Coordination will be facilitated by providing FWS with a Phase II Scope of Work (SOW) or proposal for review. The proposal should describe in detail the sampling plan (number, media, and location of samples), sample collection methods, analytical parameters, quality control/quality assurance (QA/QC) plan, standards and/or ecological screening criteria to be used for comparison, contingency for expanded sampling, and screening level risk assessment procedures, if applicable. The environmental laboratory to perform chemical analyses should be EPA certified, maintain a rigorous QA/QC program, and achieve laboratory detection limits consistent with state and federally approved ecological screening values and water/soil quality standards. More detail on sampling procedures and analytical requirements is provided in the following section. The selection of a credible laboratory is one of the highest priorities in the site assessment process.

The purpose of the Phase II is to identify sources and locations of contamination, specify contaminants of potential concern (both human health and ecological), and provide recommendations for additional sampling, testing, or risk assessment; and corresponding corrective actions. The focus of the Phase II is generally on facilities and potential point sources on the property, which includes: mixing/loading areas, storage sheds, vehicle turn-around areas, airstrips, cattle dip tanks, pumping stations, and burn areas.

In addition, sampling may be conducted in other areas, such as canals and agricultural fields, in order to identify contaminants that have a more widespread distribution or to establish background levels of contaminants. Media sampled may include soils, sediments, groundwater and occasionally surface water. The most commonly encountered types of contaminants at agricultural sites include pesticides, petroleum hydrocarbons, and various metals.

Chemical concentrations in the various sampled media should be compared with the appropriate ecological screening values to determine if remediation and/or additional sampling or assessment is required. Ecological screening values to be used include the following: (1) Florida Department of Environmental Protection (FDEP) Sediment Quality Assessment Guidelines (SQAGs); (2) Florida Surface Water Quality Standards; or (3) USEPA Ambient

Water Quality Criteria, among others. Ecological screening values are discussed in more detail in the next section.

Generally, any point sources identified can be remediated based on the results of the Phase II, with some additional delineation work. If remediation of the point source(s) removes all ecological concerns (i.e., all contaminant concentrations are reduced below screening values), no further assessment work is required on the site. However, if the results of the Phase I and/or Phase II indicate that widespread contamination at levels of ecological concern may be present, then more extensive sampling in the agricultural fields may be required (see next section).

3. *Agricultural Field Sampling and Screening Level Ecological Risk Assessment (SLERA)*

Generally, contaminant information obtained during a standard Phase I/Phase II Environmental Site Assessment (Phase I/II) is not detailed or comprehensive enough to be suitable for use in an ecological risk assessment (ERA). The methods described in this section are designed to provide detailed information on the distribution and concentrations of contaminants of concern (COCs) identified in the Phase I/II, for use in food chain models to predict risks to FWS's trust resources. A major purpose of this section is to determine whether concentrations of contaminants in the farmed areas are uniformly distributed in the fields, or are present as "hot spots[1]" that can be remediated. The method allows for sampling coverage of a large area while keeping assessment costs at manageable levels. If there is sufficient evidence to expect that pesticide contamination is likely at a site, it may be advantageous to conduct this sampling protocol concurrently with the Phase II assessment.

Sample site selection should be biased to maximize detection of agrochemicals in cultivated soils by sampling the entire cultivated area when possible. Random sampling on properties characterized by mixed land use is not likely to provide the greatest degree of representation regarding contamination commonly associated with agricultural production (i.e., insecticides, herbicides, fungicides, fertilizers, etc.). Prior to developing a sampling strategy, each property's land use should be reviewed in terms of spatial and temporal variables, placing the greatest sampling priority on those areas which were intensively managed for agricultural production (e.g., cultivated fields). Conversely, a lesser priority should be given to rangelands and abandoned or vacant lots which have limited or no historical agricultural land uses. Some exceptions to this rationale would include commercial and industrial land uses which are sparsely distributed within the geographic areas currently under consideration for incorporation into CERP projects. In most cases, the use of random sampling is limited to those properties demonstrating homogeneous land use across the majority of the property.

a. Sample Collection

Soil samples will be collected using a stainless steel spoon or hand auger from 0-6 inches below land surface. This interval represents the biologically relevant depth for interaction with surface water and biological receptors. It is important that care is taken not to include sample material from more than 6 inches deep, as this may result in dilution and underestimation of contaminant concentrations. Between samples, sampling equipment

should be decontaminated using standard procedures to prevent cross-contamination between samples. (Decontamination between subsamples (see below) will not be necessary because subsamples will be mixed together to form a composite.) Immediately following collection, samples should be placed on ice and submitted as soon as possible to the laboratory for analysis.

[1] Hot spots are referred to isolated areas of elevated contaminant concentrations.

At all properties except citrus groves, discrete soil samples and subsamples for compositing (see below) should be composed of five aliquots of equal volumes collected from the center point located at the nominal sampling location, and from four additional points located 5 feet from the center point in each of the cardinal directions. The sample should be thoroughly homogenized in a stainless steel mixing bowl. These "close proximity composite samples" are intended to reduce the effects of small scale soil heterogeneity.

At properties used for citrus farming, discrete soil samples should be composed of three equal-volume subsamples; one subsample each from (1) the drip line of the tree nearest to the nominal sampling point; (2) the nearest drainage swale to the tree; and (3) the nearest crown of the road between rows of the trees. The sample is, therefore, expected to be representative of the average concentration of the areas most likely to be affected by the application of agricultural chemicals used in citrus farming. The sample should be thoroughly homogenized in a stainless steel mixing bowl.

Before being placed in the sample jar, all soil samples (discrete and composites) should be thoroughly homogenized until they appear completely uniform in texture and color. Analytical laboratories should be instructed that samples received from the field should be thoroughly homogenized again in the jar before an aliquot is removed for extraction.

b. Analytical Parameters

If it has been determined during the Phase I/II that a property has a history of agricultural activity prior to 1985, then each soil analysis should include, at a minimum, organochlorine pesticides (EPA Method 8081), metals (including mercury and copper), and total organic carbon (TOC). If the history of the property or more recent use suggests that other contaminants may be present, then the list of analytes should be expanded as appropriate. The best available detection limits should be requested of the analytical laboratory, but at a minimum, detection limits (practical quantitation limits) for each chemical should be as low as the corresponding screening value (see below). That is not possible in all cases; however, since some screening benchmarks are lower than quantitation limits defined by the Florida Department of Environmental Protection. As a general rule, TOC analysis should be done for all soil and sediment samples. TOC is essential for food chain modeling and interpretation of individual sample results, bioassay results, etc.

c. Discrete Sampling for Small Properties (<500 acres)

Discrete sampling will be required for agricultural areas less than 500 acres in size. Discrete sample sites should be established at regular intervals across the property, at a density of at least one sample per 10-20 acres. The actual sampling density will depend on the size of the property, analytical cost per sample, likelihood of contamination, and other factors, and will be specified in the proposed sampling plan and agreed to by consensus between the SFWMD and FWS. A minimum of 10 samples will be necessary for most properties. Some exceptions to this minimum sample size will occur where parcels are small (<100 acres) or demonstrate a combination of land uses (i.e., residential "ranchettes," small scale livestock/garden/nursery properties, rock mining pits, etc.) where only a small percentage of the overall area was cultivated. Careful consideration should be given prior to using a sample size smaller than 10. As sample size decreases, statistical variation tends to increase, thereby increasing the size of confidence intervals used to determine the 95 percent UCL of the mean for any given analyte. Higher UCL values may increase the probability that samples will exceed ecological screening values, thereby necessitating expanded sampling, risk assessment, and subsequent clean up. Also, higher UCL values will generate correspondingly higher Hazard Quotients (HQ) in food chain modeling exercises associated with Ecological Risk Assessments (ERA).

Within this framework, actual sample location is at the discretion of the project manager. This agricultural field sampling is in addition to, and separate from, Phase II sampling that may be focusing on facilities with a high likelihood of contamination, such as pump stations, storage sheds, mixing/loading areas, airstrips, vehicle turn-arounds, cattle dip tanks, etc. The exact location of each sample should be recorded using GPS.

d. Composite Sampling for Large Properties (>500 acres-1000 acres)

In large properties, discrete sampling at short intervals would be at best cost prohibitive, if not impracticable. Reducing the sample density, however, can lead to under-representation of large portions of the property, as well as elevated likelihood of missing hot spots. In order to address this problem, composite sampling is used. Composite sampling is a compromise, under which large numbers of discrete samples are collected, but composited prior to laboratory analyses. The following composite sampling strategy has been developed jointly by FWS and SFWMD.

Using aerial photographs, a 50-acre grid pattern will be established on each property or agricultural area greater than 500 acres in size. The grids should be located and confirmed in the field using GPS. For properties between 500 acres and 1,000 acres, all of the 50 acre grids will be sampled. For example, for a 1000-acre parcel, all 20 of the 50-acre grids would be sampled.

Each of the 50-acre grids will be subdivided into ten 5-acre subgrids. One close proximity composite soil sample will be collected from each of the 5-acre subgrids in the 50-acre grid. The location of each subsample should be exactly determined using GPS. The ten sub-samples are then composited into one sample and thoroughly mixed. This

composite sample, representing the entire 50-acre grid, is then submitted to the laboratory for analysis and/or testing. (For copper, discrete samples will be maintained separate (i.e., not composited) and analyzed individually.)

e. Composite Sampling for Very Large Properties (>1000 acres)

For very large properties, where complete composite sample coverage is not possible due to budget constraints, a pre-arranged fraction of the 50-acre grids should be selected. For example, a 5000-acre parcel would be divided into 100, 50-acre grids. Perhaps half (50) of these grids would be selected for sampling. The number of grids to be selected will be predetermined for each site by consensus between the SFWMD and FWS, based on site-specific factors. Grids will be selected for sampling using a stratified random approach.

For stratified random sampling, the agricultural area will be divided into a number of equally-sized supergrids, each consisting of group of adjacent 50-acre grids. From each supergrid, the pre-arranged fraction of grids will be selected randomly for sampling. For this purpose, a random number generator will be used to select 50-acre grids from each supergrid for sampling. The stratified random approach is recommended over a purely random approach. In random sampling there is always a chance of clustering, as well as over- and under-representation of segments of the agricultural area. The stratified random approach will assure that all segments of the agricultural area are equally represented.

f. Screening-Level Ecological Risk Assessment

Following the collection of Phase II data and sampling of the cultivated areas, each site will be evaluated using a SLERA. The SLERA is intended to identify contaminants of potential ecological concern (COPECs) and provide screening-level conclusions regarding the potential for risk to the ecological receptors at the site. The conclusions of the SLERA will primarily indicate which COPECs are likely to show a low potential for elevated risk and those that may require further evaluation either through the collection of additional data for use in an expanded ecological risk assessment or through remediation.

Screening is conducted for two general sets of ecological receptors and the screening values are used to identify areas that may require further attention for each receptor. For the aquatic community receptor, the FDEP's Sediment Quality Assessment Guidelines (SQAGs) for Florida Inland Waters (MacDonald et al. 2003) should be used as screening values whenever possible. The SQAGs were developed for assessing sediment quality in Florida waters, based on the probability of effects on sediment-dwelling organisms. For each contaminant there are two SQAGs: Threshold Effect Concentration (TEC) and Probable Effect Concentration (PEC). TECs were formulated to define concentrations of contaminants below which adverse effects on sediment-dwelling organisms are unlikely to occur. PECs were developed to define ranges of concentrations above which adverse effects are likely to occur.

In most cases the TEC will serve as the initial screening value, especially when using a

composite sampling design. Use of PECs as screening values may be justified under some circumstances for certain contaminants. For some contaminants, SQAGs have not yet been developed. The U.S. Environmental Protection Agency's Ecotox Thresholds, the National Oceanic and Atmospheric Administration's Effects Range Low and Effects Range Median, or other ecologically-based guidelines should be used when SQAGs are not available. For some chemicals such as metals, information on natural background levels may have to be considered. Human health-based guidelines for cleanup of contaminated sites, such as FDEP's Soil Cleanup Target Levels, should not be used for this purpose. Chemicals exceeding either the TEC or the PEC, or their equivalent benchmark where SQAGs are not available, will be identified as COPECs and will be further discussed in the SLERA.

When more than one chemical is present in the sediments, the risk associated with exposure of the aquatic community to the mixture may be greater than to a single chemical. Risks associated with exposure to multiple chemicals in any one chemical group (e.g., metals, organochlorine pesticides, etc.) are generally considered to be additive. In order to account for the potential effects of multiple chemicals, a PEC-quotient (PEC-q) approach will be utilized, when more than one chemical in a group is detected on a site. The PEC-q for each chemical is calculated by dividing the chemical concentration by the PEC for that chemical. The mean of the PEC-q's for all of the chemicals in the group will then be calculated. If the mean PEC-q is greater than 0.5, the combined effects of the multiple chemicals in the sediment may be toxic and should be further evaluated. Specific tests and methods to be used for further risk-based evaluation are discussed in the following sections.

Since TECs/PECs are specific to benthic macroinvertebrates, screening is also conducted for aquatic-feeding wildlife (birds and mammals) that are FWS trust wildlife species (i.e. MBTA and ESA species). Generally, the bald eagle (*Haliaeetus leucocephalus*), white pelican (*Pelecanus erythrorhynchos*), snail kite (Rostrhamus sociabilis), osprey (*Pandion haliaetus*), clapper rail (*Rallus longirostris*), great blue heron (*Ardea herodias*), and wood stork (*Mycteria americana*) are federal trust species that have been used as representative target species in exposure and risk calculations.

For wildlife, the screening-level risk is expressed by calculating a screening-level hazard quotient (HQ), which is simply the ratio of the modeled exposure (numerator) and TRV (denominator). Screening-level HQs for wildlife species are calculated using the site-specific reasonable maximum exposure (numerator) compared to a TRV based on the No Observed Adverse Effects Level (NOAEL)(denominator). Exposures are generally calculated using the fugacity-based foodweb exposure model that was developed jointly by FWS and SFWMD (Goodrich 2002 and NewFields 2006), but other exposure models can be used if needed and approved by FWS. A screening-level HQ greater than one indicates that the chemical should be retained as a COPEC for further risk analysis in the SLERA and potentially as a basis for risk management actions.

g. Sites Which Exceed the PEC and/or with Wildlife HQs Greater than 1.0

Sediments with concentrations of contaminants above the PEC potentially represent significant and immediate hazards to exposed aquatic life. If any of the 50-acre composite samples, described above, exceeds the PEC or other appropriate probable effect-level screening value, it will be necessary to return to that 50-acre grid and obtain individual samples from each of the ten aliquot locations. These samples should be taken as close as possible to the original sample locations. These discrete samples should then be submitted to the laboratory for analysis.

The purpose of this follow-up sampling is to determine the spatial distribution of contaminants within the 50-acre grid; i.e., do the data indicate the presence of one or more isolated hot spots, or widespread contamination above the PEC? If only one or a few of the individual (5-acre) samples are elevated, SFWMD may choose to attempt to remediate these areas in order to reduce the average contaminant levels of the 50-acre grid to below PEC. This will require additional sampling in order to confirm that the sub-grids in question were indeed responsible for the PEC exceedance, and to delineate the extent of the hotspot(s). Due to possible small scale variability in contaminant concentrations, one sample is not sufficient as a basis for remediation decisions. As discussed in Section C (Remediation), the SFWMD may chose to conduct a more detailed analysis, including geostatistical analyses, to attempt to identify areas in need of remediation.

Conversely, follow-up sampling may indicate that large portions of the site contain elevated levels of contaminants. Remediation of widespread contamination over such a large area may not be practical. In such a case, further testing and completion of an ecological risk assessment (ERA) will be necessary in order to refine our understanding of the hazards to federal trust resources associated with contaminants on the site. These tests and assessments should include: (1) desorption studies, (2) sediment bioassays, and (3) ERA with food chain modeling. In addition, if any of the contaminants have a tendency to accumulate in aquatic organisms or biomagnify in the food chain, such as organochlorine pesticides, PCBs, PCDDs/PCDFs, and some metals, bioaccumulation studies are recommended. Specific tests and methods to be used are discussed in the following sections.

As stated above, follow-up sampling of discrete locations within a 50-acre grid is intended to determine the spatial distribution of contaminants within the grid, and should not constitute an attempt to confirm or refute the original composite result. If widely disparate results are obtained upon follow-up (discrete) sampling compared with the original composite, this suggests either small-scale variability in the COPEC concentrations or that some error has occurred in sampling, homogenization, or laboratory analysis. In these cases, the original composite result will represent the 50-acre grid in question, barring some evidence to the contrary suggesting that the follow-up result is actually more representative of contaminant concentrations in the grid.

In order to avoid the above situation, consideration will be given on a project-by-project basis, that discrete samples collected in the field, following homogenization, be split into two jars. One sample jar will be used for producing the composite by mixing with the

other samples representing a particular 50-acre grid; the other jar of each pair would be stored at 4 degrees centigrade for possible future analyses. If screening levels for any analytes of interest are exceeded in the composite sample analyses, then all 10 of the subsample aliquots used to make that sample will be reanalyzed for the observed compounds to identify more precisely the location of the observed contaminants. Use of this methodology may be problematic for very large properties due to limited storage space.

h. Sites Which Exceed Only the TEC

In general, a few scattered exceedances of a TEC by an individual contaminant at a site, when there are no PECs exceeded, is not considered to be a significant cause for concern. However, if enough samples exceed the TEC, such that the mean (estimated by the 95 percent upper confidence limit (UCL) of the mean) for the entire site (i.e., the mean of all discrete samples for a small site, or the mean of all 50-acre composites for a large site) is above the TEC, widespread ecological effects are possible. To evaluate this, the mean and the 95 percent UCL of the mean should be calculated for each COPEC. In most cases, if the 95 percent UCL for all contaminants is below the TEC, the SLERA will indicate that the potential for unacceptable risk is low and no further action will be necessary. However, if the 95 percent UCL for any contaminant exceeds the TEC, then the additional testing and an ERA (as described above for PEC exceedances) or corrective activities may be necessary. These tests and assessments should include: (1) desorption studies, (2) sediment bioassays, (3) ERA with food chain modeling, and (4) bioaccumulation studies for lipophilic contaminants. In addition, if TECs are exceeded by more than one contaminant in the same grid(s), further evaluation will be necessary to address possible synergistic or additive effects of these co-contaminants. Bioassays may be useful in this case to identify potential toxicity from multiple contaminants that would not be predicted by using individual screening values.

i. Evaluation of False Negatives where Composite Samples are Used

[Note: The following procedure for the evaluation of potential false negatives has been added to this MOA at the request of the Florida Department of Environmental Protection (FDEP) and is not required by FWS. This procedure is included in this MOA in order to provide a complete documentation of the sampling and assessment protocol followed by SFWMD.]

The primary disadvantage of composite samples is the possibility of masking hot spots by diluting the elevated discrete samples with cleaner aliquots. This masking can be viewed as a form of a "false negative," i.e., the probability of yielding clean composite results, while certain portions of the grid may exceed ecological benchmarks. In order to minimize the above disadvantage, the following procedure is included.

A representative percentage of "clean" grids (i.e., COPEC concentrations within the grid are all below the SQAG-TEC values) will be selected for further evaluation. The percentage of grids selected for further evaluation will depend upon the variability of the

data and the total number of composite samples which were analyzed. When selecting the subset of non-exceeding grids, the following should be considered: (1) the non-exceeding grids targeted for discrete sampling shall not be clustered; and (2) the number of non-exceeding grids targeted for discrete sampling shall be at least 20% of the total number of "clean" grids but not greater than 10.

All of the individual discrete aliquots making up the ten-point composite samples within the selected grids will subsequently be analyzed for the COPECs only. The results for the discrete samples for selected clean grids will be tabulated, along with the results for individual discrete samples that are analyzed for exceeding grids (per the procedure outlined in section h. below). Both the composite sample and discrete sample values for each grid should be tabulated.

For each grid, the percentage of discrete samples exceeding the ecological benchmark will be calculated. The grids will then be sorted based on ascending COPEC composite concentration. The average aliquot exceedence rate for each grid is then computed by obtaining the average percentage of aliquots exceeding the benchmark in that grid and in all grids with lower composite concentrations.

The average aliquot exceedance rates are then used to determine the composite sample concentration above which the individual sample results exceed the composite value by a pre-determined percentage (e.g., 5%). The largest composite value corresponding to the pre-determined exceedence rate will be defined as the trigger level. If the trigger level is less than the PEC for the given chemical, it shall be used in all subsequent analyses as the substitute for the PEC.

Using this approach, the probability of missing hot spots in clean grids can be maintained below a pre-determined level (e.g. 5%). Trigger levels for individual chemicals that have already been established in certain types of agricultural areas may be used in other similar agricultural areas. In such instances, supplementary area-specific false negative sampling and analyses are not required.

4. Expanded Ecological Risk Assessment

In cases where clear decisions regarding the potential for risk cannot be reached or where remediation to remove potential risks based on screening-level results is impractical, further testing and completion of an ERA will be necessary in order to refine our understanding of the hazards to federal trust resources associated with contaminants on the site. These tests and assessments should include: (1) desorption studies, (2) sediment toxicity tests, and (3) ERA with food chain modeling. In addition, if any of the contaminants have a tendency to accumulate in aquatic organisms or biomagnify in the food chain, such as organochlorine pesticides, PCBs, PCDDs/PCDFs, and some metals, bioaccumulation studies are recommended. The details of the ERA should be agreed upon by SFWMD and FWS prior to the initiation of work.

a. Desorption Studies

Contaminated soils inundated during the process of wetland restoration may release soil bound pollutants into the pore and surface waters. Soil or sediment characteristics governing pollutant desorption (e.g., total organic carbon, grain size, pH) will vary among locations. In addition, weathering or aging of some contaminants may alter their bioavailability from that predicted in the published literature. This necessitates site-specific desorption studies to accurately assess pollutant availability to aquatic organisms. Pollutant desorption is assessed on soils from the location using ASTM method E-1195-01, "Method for Determining a Sorption Constant (Koc) for an Organic Chemical in Soil and Sediments." This method simulates flooding of site soils and measures release of contaminants from the soil over time. Filtered pore water samples are collected and analyzed for COCs after 3, 7, 14, and 21 days contact time. These results are used to determine a site-specific organic carbon partitioning coefficient (Koc), an estimate of pollutant partitioning between sediments and water. This value can be used in food chain models for predicting aquatic and terrestrial organism exposure to pollutants.

Soils used in the desorption study should represent, as near as possible, the maximum detected concentration of the contaminant on the site, in order to ensure that measurable levels of the particular COC are released into the water. Bulk soil samples collected for this purpose must be thoroughly mixed. To ensure uniform contaminant concentrations, samples should be collected and analyzed from several locations within the bulk soil sample (e.g., top, middle, and bottom of the container). In order to be useful, the water analysis results must show evidence that steady-state concentrations have been reached within the 21-day duration of the test. Contaminant concentrations in water obtained during the desorption study may be compared with Florida Surface Water Quality Standards.

b. Sediment Toxicity Testing

Toxicity testing with representative aquatic invertebrates and vertebrates allows prediction of soil bound pollutant toxicity to aquatic organisms if the location is converted to a wetland. For properties requiring an ecological risk assessment, the following sediment toxicity tests should be conducted: 10-day flow through sediment bioassay with two invertebrate species (e.g., *Hyalella azteca* and *Chironomus tentans*), and 7-day flow through sediment bioassay with one fish species such as the fathead minnow (*Pimephales promelas*) or other suitable species.

"Standard Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates (ASTM E-1706-95)," "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates (USEPA/600-R-99/064)," and "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms (USEPA/600/4-91/002)" provide standard methods to assess soil-associated pollutant effects upon aquatic organisms.

Endpoints measured in these tests are survival and growth. Any statistically significant impacts upon these endpoints in any test are considered direct evidence of potential

impairment of the prospective benthic/aquatic community in the restored wetland.

As with the other sediment studies, bulk soil samples collected for this purpose must be thoroughly mixed, and uniformity of contaminant concentrations should be confirmed by sampling from several locations within the bulk soil simple. Soils used in the sediment toxicity tests should represent, as near as possible, the maximum detected concentration of the contaminant on the site.

c. Bioaccumulation Studies

Factors affecting pollutant accumulation by aquatic organisms can vary among locations. Accurate prediction of pollutant bioaccumulation at a location requires site-specific bioaccumulation studies, using species representative of those that may exist on the location once flooded. For properties requiring an ecological risk assessment, 28-day bioaccumulation studies should be performed with a representative benthic macro invertebrate (e.g., *Lumbriculus variegatus*) and fish (e.g., *Pimephales promelas*).

Methods described in "Great Lakes Dredged Material Testing and Evaluation Manual (USEPA and USACE, 1998)" and "Standard Guide for Determination of the Bioaccumulation of Sediment-Associated Contaminants by Benthic Invertebrates (ASTM E-1688)" should be used to determine the bioaccumulation potential of soil-associated pollutants. These results are considered as site-specific measures of the degree to which sediment-associated chemicals may accumulate in biota. Results can be used to generate input variables for food-chain modeling.

Soils used in the bioaccumulation studies should represent, as near as possible, the maximum detected concentration of the contaminant on the site, in order to ensure that measurable levels of the particular COC are released into the water and taken up by the organisms. Bulk soil samples collected for this purpose must be thoroughly mixed. To ensure uniform contaminant concentrations, samples should be collected and analyzed from several locations within the bulk soil sample (e.g., top, middle, and bottom of the container). In order to be useful, the concentration of contaminant(s) in the test organisms must show evidence that steady-state conditions have been reached within the 28-day duration of the test.

d. Exposure and Risk Analysis Using Aquatic Food Chain Models

In the absence of direct measures of effects, it is necessary to estimate or predict the risk of adverse effects upon FWS's trust resources and other organisms that may utilize the created wetland, reservoir, or STA. Food chain models allow prediction of effects on higher level organisms by combining data from the site-specific desorption and bioaccumulation studies with information on dietary composition, consumption rates, body weights, etc. and literature toxicity data. The FWS and SFWMD have jointly developed a food web model for this purpose (Goodrich 2002 and NewFields 2006), and this model is the preferred tool for risk analysis. However, alternative approaches for modeling exposure may be used if they are more applicable to site conditions. FWS must

approve the use alternative models, and reports should present details of the model components and input variables.

FWS's trust resources include migratory birds and federally listed threatened or endangered species. Typically, representative Trust species such as the bald eagle (*Haliaeetus leucocephalus*), white pelican (*Pelecanus erythrorhynchos*), snail kite (*Rostrhamus sociabilis*), osprey (*Pandion haliaetus*), clapper rail (*Rallus longirostris*), and wood stork (*Mycteria americana*) have been used in the analysis. Where bioaccumulating pollutants are present, a maximally exposed piscivorous bird must always be included. Generic fish species (omnivorous and higher level predatory fish) may be used as aquatic focal species. At a minimum, the food chain model should assess risk to the following groups (trophic levels) of target organisms: benthic invertebrates (detritivores), omnivorous fish, first order carnivorous fish (trophic level 3), second order carnivorous fish (trophic level 4), omnivorous bird, first order carnivorous bird, second order carnivorous bird, and all threatened or endangered species that may utilize the site after flooding. The following potential routes of exposure should be included in the model: direct exposure to contaminated water/sediments, sediment ingestion, water ingestion, and food ingestion. The following transfer mechanisms and processes should be included; desorption from sediment to water, bioconcentration from water, bioaccumulation through ingestion of contaminated prey, and biomagnification.

Once the target species exposure to pollutants has been modeled, the potential risk to the species should be assessed by comparing the modeled exposure to a toxicity reference value (TRV). For purposes of this program, the most relevant endpoints for assessing risk are effects upon (1) survival and (2) reproduction. In the absence of toxicity tests performed with the specific target species, TRVs for the pollutant(s) of interest must be obtained from the literature. Where possible, the ideal TRV will have been generated using a similar exposure route for a taxonomically related species. Uncertainties arising from the use of TRVs based on different exposure routes or unrelated species should be discussed in the risk assessment. In general, the most sensitive TRV should be utilized to assess risk to the target species.

As discussed in previous sections, risk is expressed by calculating an HQ, which is simply the ratio of the modeled exposure (numerator) and TRV (denominator). HQs above one indicate a potential for adverse effects to occur in a species under a given exposure scenario. The higher the HQ above one, the greater the risk that adverse effects will occur. HQs below one generally indicate that adverse effects are unlikely. HQs that are greatly different from one provide the greatest level of certainty in their interpretation.

Where appropriate, a probabilistic risk analysis may also be used as a tool for assessing risk at sites where the food chain model is also used in an expanded risk analysis. The details of any probabilistic risk assessment should be discussed and agreed upon by SFWMD and FWS on a site-specific basis prior to initiating any such analysis.

5. *Final Reports*

a. Phase I/II Environmental Site Assessment and SLERA Report

Upon completion of all sampling, chemical analyses, and screening-level food chain modeling, a Phase I/II and SLERA report should be prepared which identifies all potential hazards to ecological receptors and provides recommendations for additional risk-based data collection and assessment. The Phase I/II/SLERA will also provide all analytical data and corresponding global positioning system (GPS) coordinates for all collected samples in the report. These data and coordinates will also be provided to FWS in an electronic spreadsheet form (Excel). Finally, the Phase I/II/SLERA may also provide general recommendations for corrective actions and/or management of the project that will reduce the hazards to acceptable levels.

Given the spatial resolution of the data collected for the Phase I/II and the sometimes limited timeframe available for completion of the Phase I/II, SFWMD recognizes that accurate delineation of areas that may require remediation may not possible without further investigation. The Phase I/II will be used to provide a general estimation of the amount of remediation necessary to reduce the potential for risk at a site. More detailed delineation of areas of elevated COPEC concentrations that may occur subsequent to the Phase I/II will be presented in separate reports.

FWS will review the report and provide concurrence or make recommendations for changes or additions. Any recommendations for changes or additions will be handled as addenda to the report.

b. Ecological Risk Assessment Report

If additional risk assessment activities are required, an Ecological Risk Assessment (ERA) report will be provided as a separate document. Following the completion of the expanded ERA, SFWMD will provide FWS with a draft of the ERA report for review. The draft ERA report will include the complete results of all desorption studies, sediment toxicity testing, bioaccumulation studies, and food chain modeling. In addition, it should include a complete and clear description of all methods, assumptions, and inputs used in the laboratory studies and food chain modeling. The report should provide detailed conclusions regarding risks to all trophic groups and species of concern for the entire site or any portion thereof. FWS will review the draft report and make recommendations for changes or additions. Following the resolution of any FWS concerns, a final ERA report will be provided to FWS.

C.19 Summary of Environmental Conditions, 2005 SFWMD Memorandum

C.18.1.1.1 MEMORANDUM

C.18.1.1.1.1 TO: **Maxine Cheesman, Director**

C.18.1.1.1.2 **Land Support Division**

FROM: Robert Taylor, Lead Environmental Engineer
Environmental Engineering Unit, Land Management & Ops Support Division

DATE: September 14, 2005

SUBJECT: Environmental Evaluation Summary Document
3A/3B Seepage Management Areas and
C-9/C-11 Impoundment Areas located in
Broward and Dade Counties, Florida

Attached is a copy of the Environmental Evaluation Summary Document Report (EESD) conducted by BEM Systems, Inc for the above referenced project. The project area consists of 407 parcels that comprise an area of approximately 14.2 square miles that is located within Sections 33 & 34, Township 49 South, Range 39 East, Sections 3, 4, 9, 10, 14, 15, 22, 23, 26, 27, & 34, Township 50 South, Range 39 East, Sections 3, 10, 15, 22, 26, 27, 34 & 35, Township 51 South, Range 39 East and Sections 3, 9 & 10, Township 52 South, Range 39 East of Broward and Miami-Dade Counties, Florida respectively.

This evaluation was conducted to summarize the environmental status of the individual parcels that comprise the project area and identify those properties that pose an unacceptable ecological risk or that will require additional assessment or corrective action prior to their inclusion into the proposed project area.

The 3A/3B Seepage Management Areas and C-9/C-11 Impoundment Areas restoration project is proposed to restore the natural hydro pattern within the project area located along the east and west sides of U.S. Highway 27 in Broward and Dade Counties. The northern portion of the project area extends to U.S. Highway 27 and Interstate 75/595 interchange in Broward County and the southern portion of the project area is located along the northern boundary of Thompson Park located east of Krome Avenue in Miami - Dade County.

Project restoration efforts may include earthwork, excavation and filling of canals and/or ditches, as well as the construction of pump stations to move surface water throughout the project area.

The scope of work for the summary document included a review and update of existing environmental assessments conducted by District staff and outside environmental consultants. The scope of work for this evaluation also included a review of historic aerial photographs, regulatory file review, aerial inspection (helicopter) of the land tracts and limited site reconnaissance. The purpose of this assessment was to document the presence, or absence, of soil/groundwater contamination or contaminated media associated with the previous and current activities conducted at each parcel. This evaluation was performed in general accordance with American Society for Testing and Materials Standard Guide for Environmental Site Assessments: This method has been used as a guide to insure appropriate inquiry into the environmental characteristics and condition of the site consistent with good commercial and customary engineering and environmental practices, to the extent practical for such a large initiative.

The results of the summary document indicated that the landuse within the project area consisted of the following: undeveloped marsh, small foliage nurseries, construction yards, an asphalt plant, rock mines, pasture utilized for cattle grazing, residential use, a large unregulated solid waste dump site, shooting range and a former U.S. Government defense site. No intensive row crop activities were documented within the project area other than small-scale landscape foliage. Additionally, as a point of reference, the Jones' trailer park located on Tracts 9312-001 and 9312-010 within Cell 16 and the Florida Power and Light electrical substation located on Tract 12102-020 of Cell 12 are not included within the project foot-print. The District has no current plans to acquire these tracts. The current project plan calls for a dike or levee to surround the trailer park to control surface water. A Phase I/II EA of the trailer park and electrical substation was not completed as part of this environmental evaluation. In the event that these properties would be included at a later date, extensive Phase I/II EA would be necessary to evaluate the potential ecological risk pose by both properties.

Based upon the findings of environmental summary report, 49 of the 407 land tracts require some additional assessment or corrective actions. A detail list of the necessary additional assessment or corrective action is outline in **Table 1** of the attached report. The corrective actions recommended for these 49 land tracts vary from a follow-up regulatory file review to the implementation of comprehensive corrective actions. The following is a list of those sites that will require significant assessment or corrective actions. Other sites that will require a lesser extent of assessment or corrective action are also summarized on **Table 1** attached to this memo. The estimated costs associated with the recommended additional assessment activities and corrective actions are provided in **Table 2** of this memorandum.

Nixon/Bishop

The most significant environmental concern identified within the project area is associated with the Nixon/Bishop properties. This area is currently utilized as an unregulated landfill and shooting range that is located on Tracts 12102-012, 12102-013 and 12102-014 within Cell 12. It is possible that some of the landfilling activities have encroached onto other surrounding land tracts. Extensive Phase I/II investigation has been completed on this property by the District contracted environmental consultants. The findings of these assessments have documented the presence of a large quantity of solid waste and subsurface debris in the order of magnitude of several hundred thousand cubic yards of material. In addition, soil and groundwater analytical data has reported concentrations of metals, pesticides and petroleum compounds in exceedance of the FDEP cleanup criteria.

The District has estimated the cost to cleanup the area would be in the order of magnitude of more than $3 million to $10 million dollars. The District is considering remedial alternatives that would consist of isolating the landfill from the proposed project area by designing a constructed wetland that would include isolation berms, a leachate collection trench and the installation of a membrane liner for a cost of approximately $300,000 to $600,000. This cost estimate does not include maintenance costs or long term groundwater monitoring.

The District, as of the date of this report, has not acquired the property. The Land Acquisition staff and the District Project Manager for this restoration project are aware of the potential environmental risk and liability associated with these land tracts.

Weekley Property

The Weekley Property consists of Tracts 9201-061, 9201-072, 9201-075, 9201-076, 9201-080 and 9201-087 located within Cell 11, that include a former asphalt plant, equipment storage yard, petroleum distribution system, areas of landscape foliage and a rock mine. As part of the acquisition, a comprehensive Phase I/II Environmental Assessment was completed on the site. The Phase I/II identified significant assessment and corrective actions that were necessary at the site prior to its use for restoration purposes. The acquisition agreement indicated that Mr. Weekley (the owner) is responsible for implementing the necessary corrective actions that were identified in the Phase I/II assessments.

The major concerns associated with this site include several large asphalt piles, large piles of soil and concrete, presence of large quantities of solid waste, petroleum storage tanks, and soil and groundwater impacts. The owner is currently in the process of removing the asphalt material and debris from the site. The District recently sold the asphalt plant and, the equipment should be removed from the site by October 4 2005. Additionally, Mr. Weekley has retained an environmental consultant (CRB) to address the outstanding issues identified in the Phase I/II assessment on the various tracts. Mr. Weekley's environmental consultant is responsible for conducting these additional activities in accordance with FDEP protocol in order to obtain "No Further Action" status

from FDEP and USFWS for the assessment/corrective actions. The District is monitoring the progress of the additional assessment and corrective actions as well as the removal of the asphalt, soil and concrete piles at the Weekley property. Upon completion of the corrective action, a progress memo will be developed by the EEU and submitted to USFWS for review and comments.

White Construction

As part of the pre-acquisition Phase I/II EA, petroleum-impacted soils were identified on the White Construction site (Tract 9200-951, Cell 11). The impacted soil appeared to be associated with the storage and maintenance of large earth moving equipment as well as the presence of petroleum storage systems. White Construction has retained CRB to remove and dispose of the impacted soils. The removal and disposal activities are currently underway. Upon completion of the corrective action, CRB will develop a corrective action report for the District's review and comment. The corrective actions at White Construction property should be conducted in accordance with FDEP protocol in order to obtain "No Further Action" status from FDEP and USFWS.

Smith Property

As part of the pre-acquisition Phase I/II EA, petroleum-impacted soils were identified on the Smith Property (Tract 9201-086, Cell 11). The impacted soil appeared to be associated with the storage and maintenance of large earth moving equipment. The property owner has retained CRB to remove and dispose of the impacted soils. The removal and disposal activities are currently underway. Upon completion of the corrective action, CRB will develop a corrective action report for the District's review and comment. The corrective actions at the Smith property should be conducted in accordance with FDEP protocol in order to obtain "No Further Action" status from FDEP and USFWS.

Former U.S. Government Defense Site

Tract 9200-001 located in Cell 19 is an approximate 640-acre site that is listed as a formerly utilized defense site by the U.S. Army Corps of Engineers. The site was reportedly under the U.S. Military control for training purposes from August 1944 through January 1947. The site was utilized for the past 25 years as pasture for livestock. The U.S. Army Corps of Engineers conducted a site inspection of the property in January 1996. In addition, file reviews and interviews were conducted to assess for the historic use of ordnance at the site. The results of U.S. Army Corps 1996 investigation indicated that the site was considered to be "uncontaminated" since no evidence of its actual use as a bombing range or target range was identified in the file review and the fact that no ordnance was found during the site inspections. However, based on new protocol, the U.S. Army Corps has indicated that they will be revaluating this site in FY2006. It is recommended that any Contractors and District staff working at the property be made aware of the potential risk associated with the historic use of the site.

Tract 9311-049 (Coast to Coast Nursery Site)

Tract 9311-049 located in Cell 23 is approximately 17-acres and contains an approximate 8-acre foliage nursery. This property has not been acquired by the District, but is within the project foot print. A Phase I/II EA has not been completed for the site. Review of the aerial photographs of the site indicates that this property is an active nursery with onsite storage for what appears to be chemicals and equipment. The nursery also appears to be currently storing materials or equipment on the eastern adjacent District-owned Tract 311-055. Miami-Dade County has an on-going enforcement case against the property owner for wetland violations. In addition, a review of historic aerial photographs has indicated that the western portion of the site may have been historically utilized for livestock. Numerous structures and other unidentifiable features were identified on the historic aerial photographs at the locations of the present day landscape foliage fields. The historic landuse of these structures and the disposal of the construction/demolition materials are unknown. Based on the historic and current site activities, a comprehensive Phase II EA is necessary to evaluate the site prior to acquisition.

Griffin Brothers Nursery Site

Tract 201-071 is a former foliage nursery and equipment maintenance area that is located within Cell 11. All the buildings and structures have been removed from the property. The site is currently vacant. The results of a Phase I/II EA conducted as part of the pre-acquisition of the property identified impacted soils. A copy of the Phase I/II EA was submitted to the USFWS for review and comments. Based on the USFWS comments, additional soil assessment and possible corrective actions were necessary for this site. The USFWS comments regarding sediment sampling was addressed by ECT in December 1999. To date, the only remaining outstanding item was for the proper closure of seven ASTs. The ASTs have been removed from the site, however, it is unknown if the property owner's consultant conducted a tank closure assessment in accordance with FDEP protocol for petroleum system closures. CRB has not provided the District with a copy of an FDEP "No Further Action" letter for the closure of the petroleum systems.

Pig Farm 311-051

Tract 311-051 located in Cell 23 is 10-acres that formerly contained an approximate 7-acre pig farm. The results of the pre-acquisition Phase I/II identified soil impacted with residual pesticides and metals. An ecological assessment indicated that, soils located in the pig pen runoff swale area containing concentrations of DDX compounds (DDE, DDT, DDD), required corrective action to reduce the potential for impact to the USFWS Trust Resource Species. The District has issued a work order for the excavation and proper disposal of the pesticide impacted soil. The USFWS has concurred with the results of the site assessment and ecological assessment reports. In addition, the USFWS has concurred with the proposed corrective actions for the site. Upon

completion of the soil removal, a report that documents the corrective measure will be submitted to the District and USFWS. No additional corrective actions are necessary at this site other than the removal of concrete pads associated with the former building structures and the closure of a water collection pit.

Unassessed Foliage Areas

There are nine land tracts that consist of former foliage nurseries located within the project area that have **not** been assessed for an evaluation of potential impacts associated with agrochemical use at the sites. These former foliage areas include: Tracts 12101-036 (Cell 12), 9200-908 (Cell 11), 9200-919 (Cell 18), 9201-062 (Cell 11), 9201-109 (Cell 11), 9201-110 (Cell 11), 9201-128 (Cell 11), 9312-024 (Cell 16) and 9312-026 (Cell 16). Based upon a review of historical aerial photographs, these foliage areas were established in the 1980's and 1990's. Previous assessments conducted in similar foliage areas located within the vicinity of these land tracts have resulted in findings that indicate the potential for concentrations of metals and pesticides to exceed the regulatory cleanup values.

Unassessed Livestock Pens

There are three land tracts within the project area that formerly utilized livestock pens that have **not** been assessed for an evaluation of potential impacts associated with agrochemical use. These former livestock pens were located on Tracts: 9200-902 (Cell 19), 9200-901 (Cell 18), and 9200-963 (Cell 11). Previous assessments conducted at livestock pens have resulted in findings that indicate the potential for concentrations of metals and pesticides to exceed the regulatory cleanup values.

Small-scale Corrective Actions

There are three land tracts within the project area that are recommended for small-scale corrective action. The tracts that require corrective action include: 9201-047 (Cell 11), 9201-096 (Cell 11), and 9312-023 (Cell 16). Previous assessments conducted at these sites have identified areas of selenium and pesticide impacted soil that warranted excavation. In addition, an area of solid waste disposal is located on the southern section of Tract 9201-096 that warrants removal.

Florida Power and Light (FPL) Utility Easement

FPL utilizes more than 30 land tracts within the project area for easement of the electrical transmission lines. Based upon the updated assessment, the only concern associated with these properties is the potential for illegal dumping of solid waste. Observation of the FPL land tracts indicated that gates were in general not locked and the roads are accessible from U.S. Highway 27 and Krome Avenue. Therefore, some of the FPL land tracts contain solid waste that includes: large piles of tires, construction debris, metal machinery and appliances. The District should coordinate with FPL to limit

access to these properties. FPL should be responsible for the removal of all solid waste from their right-a-way.

Septic Tanks / Well abandonment/Asbestos Surveys

There are a number of tracts with buildings and structures that require the preparation of an asbestos survey, abandonment of septic tanks or removal of abandoned structures. The extent of the required additional assessment for these sites varies since several of the land tracts had multi-purpose landuse. It is estimated that there are approximately 25 to 35 tracts that will require some type of additional activities associated with the abandonment of septic systems and wells, as well as, the completion of an asbestos survey prior to demolition.

Solid Waste Dumping

The potential exists that solid waste could be located on parcels where access was restricted. In addition, due to the presence of roads that permit access to the project area, illegal dumping of solid waste in the vicinity of the C-9 impoundment area, C-11 impoundment area may continue due to unauthorized access.

The Environmental Engineering Unit will await your direction as to appropriate timeframe to implement the required corrective actions that are deemed the District's responsibility for the land tracts that comprise this project area. It is important to note that the completion of the required corrective actions would

render the property suitable for the future projected landuse.

Should you have any question, or require additional information, please contact me at extension 2264.

RT/mem

Attachments

EESD Report
Table 1 - Summary of Land Tracts Requiring Additional Assessment
Table 2 - Summary of Estimated Costs for Additional Assessment/Corrective Action

c. Max Day (w/o EESD report)
Lawrence Gerry (w/o EESD report)
Jeff Needle
Mike Hind (w/o EESD report)
Jenni Hiscock (w/o EESD report)
Fred Davis (w/o EESD report)
Jim Bridgeman (w/o EESD report)

Phil Kochan (w/o EESD report)
Bob Kukleski (w/o EESD report)

C.20 List of Environmental Audits and Ecological Risk Documents Prepared for Project Land Assessments

(Electronic copies of these documents are available from the USACE Jacksonville District upon request.)

Phase II Environmental Site Assessment, Weekley Property Broward County, Florida Tracts #201-061, 201-072, 201-075, 201-076, 201-080 & 201-087, BEM Systems, Inc., September 2002.

Phase II Environmental Site Assessment East Coast Buffer Canal 11 26 Condemnation Properties Broward County, Florida, BEM Systems, Inc., November 2002

Phase I Environmental Site Assessment, Grafalas Global Property Broward County, Florida Tract #201-058, BEM Systems, Inc., March 2003.

SFWMD Memorandum from Robert Taylor to Maxime Cheeseman, Environmental Evaluation Summary Document, 3A/3B Seepage Management Areas and C-9/C-11 Impoundment Areas located in Broward and Dade Counties, Florida. September 14, 2005.

Environmental Evaluation Assessment Report 3A/3B Seepage Management Areas and C-9/C-11 Impoundment Areas Broward and Dade Counties, BEM Systems, Inc., September 27, 2005

Site Assessment and Corrective Action Report, Parcel 311-051, Cell 23 Dade County, Florida. December 2005.

Phase II Assessment of Cell 16 Diversion Impoundment and Reservoir. Langan Engineering and Environmental Services, February 8, 2005.

File Review and Site Inspection Tracts 9200-930, 9201-066, 9201-111, 9201-119 and 12102-031 3A/3B/C9/C11 Impoundment and Seepage Areas Broward and Dade Counties, Florida. BEM Systems, Inc., December 16, 2005

Soil Assessment Report ,Tract 9200-931, C-9 Project Area Broward County, Florida, BEM Systems, Inc., December 30, 2005.

Groundwater Sampling Report Former Vietnamese Buddhist Temple Property – Tract 9200-921 3A/3B/C9/C11 Impoundment and Seepage Areas Broward and Dade Counties, Florida, BEM Systems, Inc., December 20, 2005.

Closure Assessment Report, Tract W9201-071 (Former Griffin Brothers Property) East Coast Buffer C-11 Project Area, Broward County, Florida, FDEP Facility #9802277, BEM Systems, Inc., December 2005.

Phase I Environmental Site Assessment East Coast Buffer Canal 11, 26 Condemnation Properties Broward County, Florida, BEM Systems, Inc., September 2002.

CRB Project No. BMG 638-02; Source Removal Report for the White Construction Property (Parcel 200-951) located in Weston, Broward County, Florida. Letter from CRB Environmental Services to R. Taylor., August 9, 2006.

Letter from PSI Inc., to Robert Taylor, SFWMD, Liquid Asphalt Disposal Report, November 8, 2006.

Above Ground Storage Tank Closure Report, Former Weekley Asphalt Paving Facility, PSI, Inc., December 5, 2006.

Soil Source Removal, Former Weekley Asphalt Paving Facility, Canal Operable Unit-1 (OU-1)m 20855 S.W. 36TH Street, Weston, Broward County, Florida FDEP ID #06-9801974 CRB Geological & Environmental Services, Inc., June 11, 2007.

Additional Selenium Sampling Results, 3A/3B/C-9/C-11 Water Preservation Areas Environmental Risk Assessment Services, Contract #OT060917, Work Order #1. Shaw Environmental, June 4, 2007.

East Coast Buffer Regional Selenium Project Report, ECT Inc., May 2010

Additional Assessment for East Coast Buffer Regional Selenium Report, ECT Inc., May 2011.

APPENDIX D

REAL ESTATE PLAN

TABLE OF CONTENTS

D.0 REAL ESTATE PLAN D-1
D.1 STATEMENT OF PURPOSE OF THE REAL ESTATE PLAN (REP) D-1
D.2 PROJECT AUTHORIZATION D-2
D.3 FEDERAL AGRICULTURE IMPROVEMENT AND REFORM ACT OF 1996 (FARM BILL) AND FEDERAL GRANT LANGUAGE AND OTHER FEDERAL GRANT FUNDING D-7
D.3.1 FRAMEWORK AGREEMENT D-8
D.3.2 DEPARTMENT OF INTERIOR (FEDERAL GRANTS) D-8
D.3.2.1 DEPARTMENT OF INTERIOR GRANT NUMBER FARM BILL-1 ..... D-8
D.3.2.1.1 DEPARTMENT OF INTERIOR GRANT NUMBER LWCF-1, LAND AND WATER CONSERVATION ACT FUNDS D-10
D.3.2.2 DEPARTMENT OF INTERIOR GRANT SUMMARY D-12
D.4 PROJECT LOCATION AND DESCRIPTION D-12
D.5 SELECTED PLAN DESCRIPTION D-12
D.5.1 SELECTED PLAN FEATURES AND ACTIONS D-12
D.5.1.1 C-11 IMPOUNDMENT D-13
D.5.1.1.1 IMPOUNDMENT D-15
D.5.1.1.2 PUMP STATIONS D-16
D.5.1.1.3 GATED CULVERTS D-17
D.5.1.1.4 WEIRS AND OTHER SPILLOVER WATER CONTROL STRUCTURES D-18
D.5.1.1.5 NON WATER CONTROL STRUCTURES D-19
D.5.1.1.6 EXISTING FEATURES D-20
D.5.1.1.7 SEEPAGE CANALS D-21
D.5.1.1.8 EMBANKMENTS, LEVEE, AND LEVEE/BERMS D-23
D.5.1.1.9 REAL ESTATE REQUIRED AND COST FOR C-11 IMPOUNDMENT, MITIGATION AREA A AND MITIGATION AREA B D-25
D.5.1.2 WATER CONSERVATION AREA 3A/3B SEEPAGE MANAGEMENT AREA D-26
D.5.1.2.1 HOLLY LAKES MOBILE HOME PARK D-28
D.5.1.2.2 PUMP STATIONS D-29
D.5.1.2.3 GATED SPILLWAYS AND CULVERTS D-29
S-515 GATED CULVERTS D-29
D.5.1.2.4 WEIRS AND OTHER WATER CONTROL STRUCTURES D-29
D.5.1.2.5 NON-CONTROL STRUCTURES D-30
D.5.1.2.6 EXISTING FEATURES D-31
D.5.1.2.7 CANALS D-33
D.5.1.2.8 EMBANKMENTS, LEVEES AND LEVEE/BERMS D-35
D.5.1.2.9 FISH AND WILDLIFE DESIGN FEATURES D-38
D.5.1.2.10 REAL ESTATE REQUIRED AND COST FOR THE WATER CONSERVATION AREA 3A/3B SEEPAGE MANAGEMENT AREA D-39
D.5.1.3 C-9 IMPOUNDMENT D-40
D.5.1.3.1 IMPOUNDMENT D-42
D.5.1.3.2 PUMP STATIONS D-42
D.5.1.3.3 GATED CULVERTS AND SPILLWAYS D-43
D.5.1.3.4 WEIRS AND OTHER WATER CONTROL STRUCTURES D-44
D.5.1.3.5 EXISTING FEATURES D-44

D.5.1.3.6 CANALS D-45
REAL ESTATE REQUIRED AND COST FOR C-9 IMPOUNDMENT, MITIGATION AREA C AND MITIGATION AREA D D-46
D.6 UNIFORM RELOCATION ASSISTANCE ACT, PL 91-646 ..... D-47
D.6.1 C-11 IMPOUNDMENT D-47
D.6.2 WCA 3A/3B SMA D-47
D.6.3 C-9 IMPOUNDMENT D-47
D.7 ANALYSIS OF ESTATES REQUIRED FOR PROJECT D-47
D.7.1 C-11 IMPOUNDMENT D-49
D.7.2 C-9 IMPOUNDMENT D-52
D.7.3 WCA 3A/3B SEEPAGE MANAGEMENT AREA D-54
D.8 PROPOSED ESTATES D-59
D.8.1 STANDARD ESTATE – FEE D-59
D.8.2 NON-STANDARD ESTATE FLOWAGE EASEMENT (PERMANENT FLOODING) FLORIDA POWER & LIGHT COMPANY LANDS D-59
D.8.3 STANDARD TEMPORARY WORK AREA EASEMENT D-60
D.8.4 TEMPORARY ACCESS ROAD EASEMENT D-60
D.8.5 NON-STANDARD PERPETUAL FLOWAGE EASEMENT (SUNSET LAKES ASSOCIATES, LTD.) D-60
D.9 FACILITY, UTILITY RELOCATIONS D-62
D.9.1 FLORIDA POWER & LIGHT COMPANY D-62
D.9.2 COMMUNICATION LINES AND TOWERS – BELLSOUTH/AT&T, WILTEL COMMUNICATIONS, EPIK COMMUNICATIONS, BROADWING COMMUNICATIONS AND NORTHSTART COMMUNICATIONS D-64
D.9.3 WATER AND SEWER LINES D-66
D.10 TEMPORARY WORK AREAS D-67
D.11 INDUCED FLOODING D-67
D.12 EXISTING FEDERAL PROJECTS D-69
D.13 FEDERALLY OWNED LANDS D-69
D.14 NAVIGATIONAL SERVITUDE AND OTHER LANDS D-69
D.15 ACCESS TO PROJECT AREA D-69
D.16 BORROW, STAGING AND DISPOSAL SITES D-70
D.17 MINERAL AND TIMBER ACTIVITIES D-70
D.18 NON-FEDERAL AUTHORITY TO PARTICIPATE IN THE PROJECT D-71
D.19 ZONING ORDINANCES D-74
D.20 ACQUISITION SCHEDULES D-74
D.21 HAZARDOUS TOXIC OR RADIOLOCICAL WASTE (HTRW)/ RESIDUAL AGRICULTURAL CHEMICALS D-74
D.22 PROJECT SUPPORT D-78
D.23 MITIGATION D-78
D.24 CERTIFICATION AND CREDITING FOR ACTUAL AND INCIDENTAL COSTS ACQUIRED UNDER THE DEPARTMENT OF INTERIOR GRANTS D-78
D.25 BASELINE COST ESTIMATES AND MCACES COST ESTIMATES D-79
D.26 MCACES COST ESTIMATES D-89

LIST OF FIGURES

Figure D-1: Project Location Map D-92
Figure D-2: The Selected Plan D-93

LIST OF TABLES

Table D-1: MCACES Cost Estimate for BCWPA Project D-87
Table D-2: Baseline Cost Estimate for BCWPA Project D-88
Table D-3: MCACES Cost Estimate for C-11 Impoundment D-89
Table D-4: MCACES Cost Estimate for WCA 3A/3B Seepage Management Area D-90
Table D-5: MCACES Cost Estimate for C-9 Impoundment D-91

D.0 REAL ESTATE PLAN

D.1 STATEMENT OF PURPOSE OF THE REAL ESTATE PLAN (REP)

The scope of this real estate plan for the Project Implementation Report (PIR) identifies the land, easements, rights of way, relocations, borrow and disposal (LERRD) issues and status of real estate activities for the Recommended Plan. The information presented in this appendix is based on available information provided by the Project Delivery Team (PDT) members. It presents an estimate of the project LERRD requirements and a description of the nature and scope of the non-Federal sponsor's responsibility and estimate of the LERRD. The purpose of this Real Estate Plan (REP) is to present the overall real estate requirements, costs, acquisition schedules, and other real estate requirements necessary for the Central and Southern Florida (C&SF), Comprehensive Everglades Restoration Plan (CERP), Broward County Water Preserve Areas (BCWPA) Project. This REP is tentative in nature and both the final real property acquisition lines and estimates of value are subject to change after approval of the decision document to which this Plan is appended.

In the April 2007 Project Implementation Report for Broward County Water Preserve Areas, guidance contained in the July 2007 draft of the Six Program-Wide Guidance Memorandum Section 2.3.2 entitled "Use Actual Acquisition Costs in Plan Formulation, Cost Estimating, and Crediting" was utilized to calculate the Real Estate cost estimates using South Florida Water Management District's actual acquisition costs. This report takes into consideration for crediting purposes the Congressional Authority, the Programmatic Regulations, the draft Six Program-Wide Guidance Memoranda, dated July 2007 and the CECW-SAD memorandum dated July 30, 2009 which modified Section 2.3.2 of the draft Six Program-Wide Guidance Memoranda.

In accordance with CECW-SAD memorandum dated July 30, 2009 signed by the Director of Civil Works, U.S. Army Corps of Engineers the current guidance for the CERP, Land Valuation and Crediting is as follows:

a. Consistent with long-standing USACE practice, and as supported by the unique land credit provision for CERP contained in Section 601 (e)(5)(A) of WRDA 2000, tracts acquired by the SFWMD that are acquired and provided in furtherance of a CERP project should be valued and credited as individual tracts regardless of whether the acquisition was prior to or after execution of the PPA for that project. This general principle would not apply where the SFWMD acquired contiguous tracts that are required for a CERP project but it acquired such tracts prior to the PPA for a reason and use other than for implementation of the CERP project. A determination that a tract was acquired "in furtherance of a CERP project" should be supported by documentation existing at the time of acquisition.

b. The unique statutory land credit provision for CERP projects is clear that the non-Federal sponsor will be afforded credit for the value of lands, or interests in lands, that it provides in accordance with a PIR "regardless of the date of acquisition." *See* Section 601 (e)(5)(A) of WRDA 2000. To effectuate the clear intent of Congress reflected in this credit provision, land use restrictions imposed in furtherance of a CERP project after acquisition of a tract by the SFWMD should not be considered in valuing that tract for crediting purposes.

c. For the same reasons as expressed in subparagraph b. above, demolition of improvements after a tract was acquired in furtherance of a CERP project should not change the approach to value from that applicable at the time of acquisition. Accordingly, the tract should be valued for crediting purposes as it was improved when acquired by the SFWMD. To accomplish this result, the contributory value of the improvements, as of the date of the SFWMD's acquisition, should be added to the market value of the land on the date it is provided for the project as appraised in accordance with its highest and best use on the date of acquisition.

3. Incidental Costs. The SFWMD has requested that it be afforded credit for the costs incurred by other non-Federal governmental entities incidental to acquisition of project lands by such entities. The wording of Section 601 (e)(5)(A) is clear that credit may be afforded only for "incidental costs for land acquired by a non-Federal sponsor." Credit may be afforded for traditional incidental acquisition costs that are incurred by SFWMD (such as appraisal costs, mapping costs, or relocation assistance benefits) as well as costs actually incurred by SFWMD in obtaining the required real property rights from other non-Federal governmental entities. However, to be eligible for credit to be afforded to the SFWMD for incidental acquisition costs, SFWMD must have, in fact, incurred those costs.

For the "determination that a tract was acquired "in furtherance of a CERP project" should be supported by documentation existing at the time of acquisition." Set forth in paragraph a. above, the Jacksonville District and SFWMD agreed that lands acquired after April 30, 1999, the date of publication of the Comprehensive Everglades Restoration Plan, is the date when lands were acquired for a CERP Project. Each of the components for the Broward County WPA were among the 10 initial authorized projects in WRDA 2000, Section 601(b)(2)(C).

D.2 PROJECT AUTHORIZATION

Along with the C&SF Comprehensive Review Study, the BCWPA Project PIR is authorized by Section 309(l) of the Water Resources Development Act (WRDA) of 1992 (Public Law 102-580) which states:

"(1) CENTRAL AND SOUTHERN FLORIDA. -- The Chief of Engineers shall review the report of the Chief of Engineers on central and southern Florida, published as House Document 643; 80th Congress, 2nd Session, and other pertinent reports, with a view to determining whether modifications to the existing project are advisable at the present time due to significantly changed physical, biological, demographic, or economic conditions, with particular reference to modifying the project or its operation for improving the quality of the environment, improving protection of the aquifer, and improving the integrity, capability, and conservation of urban water supplies affected by the project or its operation."

This study is also authorized by two resolutions of the Committee on Transportation and Infrastructure, United States House of Representatives, dated September 24, 1992. The first resolution states:

"Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Board of Engineers for Rivers and Harbors, is requested to review the report of the Chief of Engineers on Central and Southern Florida, published as House Document 643, Eightieth Congress, Second Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of environmental quality, water supply and other purposes."

The second resolution states:

"Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Board of Engineers for Rivers and Harbors, is requested to review the report of the Chief of Engineers on Central and Southern Florida, published as House Document 643, Eightieth Congress, Second Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of environmental quality, water supply and other purposes for Florida Bay, including a comprehensive, coordinated ecosystem study with hydrodynamic modeling of Florida Bay and its connections to the Everglades, the Gulf of Mexico, and the Florida Keys Coral Reef ecosystem."

The WRDA 1996 was enacted on October 12, 1996. Section 528 of the Act (Public Law 104-303) entitled "Everglades and South Florida Ecosystem Restoration" authorizes a number of ecosystem restoration activities and also provides specific direction and guidance for the CERP.

(b) RESTORATION ACTIVITIES-

(1) COMPREHENSIVE PLAN-

(A) DEVELOPMENT-

(i) PURPOSE- The Secretary shall develop, as expeditiously as practicable, a proposed Comprehensive Plan for the purpose of restoring, preserving, and protecting the South Florida ecosystem. The Comprehensive Plan shall provide for the protection of water quality in, and the reduction of the loss of fresh water from, the Everglades. The Comprehensive Plan shall include such features as are necessary to provide for the water-related needs of the region, including flood control, the enhancement of water supplies, and other objectives served by the Central and Southern Florida Project.

(ii) CONSIDERATIONS- The Comprehensive Plan shall—

(I) Be developed by the Secretary in cooperation with the non-Federal project sponsor and in consultation with the Task Force; and

(II) Consider the conceptual framework specified in the report titled "Conceptual Plan for the Central and Southern Florida Project Restudy," published by the Commission and approved by the Governor.

(B) SUBMISSION- Not later than July 1, 1999, the Secretary shall—

(i) Complete the feasibility phase of the Central and Southern Florida Project comprehensive review study as authorized by section 309(l) of the Water Resources Development Act of 1992 (106 Statue. 4844), and by two resolutions of the Committee on Public Works and Transportation of the House of Representatives, dated September 24, 1992; and

(ii) Submit to Congress the plan developed under subparagraph (A)(i) consisting of a feasibility report and a programmatic environmental impact statement covering the proposed Federal action set forth in the plan.

(C) ADDITIONAL STUDIES AND ANALYSES- Notwithstanding the completion of the feasibility report under subparagraph (B), the Secretary shall continue to conduct such studies and analyses as are necessary, consistent with subparagraph (A)(i).

A design agreement to perform preconstruction, engineering and design (PED) activities, including adaptive assessment and monitoring in support of CERP, was executed on May 12, 2000 between the U.S. Army Corps of Engineers (USACE) and SFWMD. This agreement provides for the SFWMD to receive in-kind credit for design work. A Master Program Management Plan (MPMP) for the CERP was executed on August 24, 2000, outlining the protocols and

procedures by which project management plans for all projects included in the agreement would be completed. This document conforms to the guidance provided within the MPMP.

In Section 601 of WRDA 2000 (PL 106-541), Congress approved the C&SF Project Comprehensive Review Study Integrated Feasibility Report and Programmatic Environmental Impact Statement (known as the "Restudy"), which describes and outlines the CERP:

(b) Comprehensive Everglades Restoration Plan –

(1) Approval -

(A) IN GENERAL. —Except as modified by this section, the Plan is approved as a framework for modifications and operational changes to the Central and Southern Florida Project that are needed to restore, preserve, and protect the South Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection. The Plan shall be implemented to ensure the protection of water quality in, the reduction of the loss of fresh water from, and the improvement of the environment of the South Florida ecosystem and to achieve and maintain the benefits to the natural system and human environment described in the Plan, and required pursuant to this section, for as long as the project is authorized.

The components of the BCWPA Project were within the initial 10 projects authorized for implementation in Section 601(b)(2)(C) of WRDA 2000.

(2) SPECIFIC AUTHORIZATIONS -

(C) INITIAL PROJECTS. —The following projects are authorized for implementation, after review and approval by the Secretary, subject to the conditions stated in subparagraph (D), at a total cost of $1,100,918,000, with an estimated Federal cost of $550,459,000 and an estimated non-Federal cost of $550,459,000:

(iv) Water Conservation Areas 3A/3B Levee Seepage Management, at a total cost of $100,335,000, with an estimated Federal cost of $50,167,500 and an estimated non-Federal cost of $50,167,500.

(v) C-11 Impoundment and Stormwater Treatment Area, at a total cost of $124,837,000, with an estimated Federal cost of $62,418,500 and an estimated non-Federal cost of $62,418,500.

(vi) C-9 Impoundment and Stormwater Treatment Area, at a total cost of $89,146,000, with an estimated Federal cost of $44,573,000 and an estimated non-Federal cost of $44,573,000.

(D) CONDITIONS.—

(i)PROJECT IMPLEMENTATION REPORTS.—Before implementation of a project described in any of clauses (i) through (x) of subparagraph (C), the Secretary shall review and approve for the project a project implementation report prepared in accordance with subsections (f) and (h).

(ii) SUBMISSION OF REPORT. —The Secretary shall submit to the Committee on Transportation and Infra-structure of the House of Representatives and the Committee on Environment and Public Works of the Senate the project implementation report required by sub-sections (f) and (h) for each project under this paragraph (including all relevant data and information on all costs).

(iii) FUNDING CONTINGENT ON APPROVAL. —No appropriation shall be made to construct any project under this paragraph if the project implementation report for the project has not been approved by resolutions adopted by the Committee on Transportation and Infrastructure of the House of Representatives and the Committee on Environment and Public Works of the Senate.

Finally, Section 601(h)(4) of WRDA 2000 further requires that PIRs document:

(4) PROJECT-SPECIFIC ASSURANCES-

(A) PROJECT IMPLEMENTATION REPORTS-

(i) IN GENERAL- The Secretary and the non-Federal sponsor shall develop project implementation reports in accordance with section 10.3.1 of the Plan.

(ii) COORDINATION- In developing a project implementation report, the Secretary and the non-Federal sponsor shall coordinate with appropriate Federal, State, tribal, and local governments.

(iii) REQUIREMENTS- A project implementation report shall--

(I) be consistent with the Plan and the programmatic regulations promulgated under paragraph (3);

(II) describe how each of the requirements stated in paragraph (3)(B) is satisfied;

(III) comply with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.);

(IV) identify the appropriate quantity, timing, and distribution of water dedicated and managed for the natural system;

(V) identify the amount of water to be reserved or allocated for the natural system necessary to implement, under State law, subclauses (IV) and (VI);
(VI) comply with applicable water quality standards and applicable water quality permitting requirements under subsection (b)(2)(A)(ii);
(VII) be based on the best available science; and
(VIII) include an analysis concerning the cost-effectiveness and engineering feasibility of the project.

D.3 FEDERAL AGRICULTURE IMPROVEMENT AND REFORM ACT OF 1996 (FARM BILL) AND FEDERAL GRANT LANGUAGE AND OTHER FEDERAL GRANT FUNDING

Farm Bill

On April 4, 1996, Congress enacted the Federal Agriculture Improvement and Reform Act of 1996 (Public Law 104-127, 110 Stat. 1022). Section 390 of the Federal Agriculture Improvement and Reform Act of 1996 provided:

SEC. 390. EVERGLADES ECOSYSTEM RESTORATION.
(a) IN GENERAL.--On July 1, 1996, out of any funds in the Treasury not otherwise appropriated, the Secretary of the Treasury shall provide $200,000,000 to the Secretary of the Interior to carry out this section.
(b) ENTITLEMENT.--The Secretary of the Interior (referred to in this section as the "Secretary") --
(1) shall be entitled to receive the funds made available under subsection (a);
(2) shall accept the funds; and
(3) shall use the funds to--
(A) conduct restoration activities in the Everglades ecosystem in South Florida, which shall include the acquisition of real property and interests in real property located within the Everglades ecosystem; and
(B) fund resource protection and resource maintenance activities in the Everglades ecosystem.

In Section 390, the Secretary of Interior was given broad discretion in the expenditure of the initial $200,000,000 and more limited discretion in the expenditure of the additional $100,000,000 to be generated by the sale of excess or surplus Federal property.

Subsections (b)(1) and (2) allowed the Secretary of Interior to receive and accept the initial $200,000,000, while subsection (b)(3) directed the Secretary to use the funds to "(A) conduct restoration activities in the Everglades ecosystem in south Florida, which shall include the acquisition of real property and interests in real

property located within the Everglades ecosystem; and (B) fund resource protection and resource maintenance activities in the Everglades ecosystem." The Secretary of Interior could utilize these funds to acquire lands or to conduct any restoration activities in the Everglades ecosystem in south Florida on its own or to fund the activities set forth in subsection (b)(3)(B) above without the assistance of others.

Subsection (c) allowed the Secretary of Interior, at his discretion to transfer any portion or all of the funds to the USACE, the State of Florida, or the SFWMD to carry out activities listed in subsection (b)(3). Again, whether the Secretary of Interior provided funds to any of these agencies was entirely within the discretion and subject to the terms and conditions of the Secretary. There was no requirement that any of these funds be spent on lands required for present or future USACE projects.

D.3.1 Framework Agreement

On October 3, 1996, a Framework Agreement was signed between the United States Department of Interior (DOI), the United States Department of the Army, the State of Florida, Florida Department of Environmental Protection (FDEP) and the SFWMD. The Framework Agreement was written to provide a framework for the Secretary of Interior to provide Section 390 funds to the other parties for the Everglades ecosystem restoration for both the acquisition of real property and the construction of features that were intended to become part of existing or future USACE projects. The Agreement provided that except as otherwise provided by law or agreed to by the Secretary of Interior, all Section 390 funds expended would be matched by non-Federal funds on a dollar-for-dollar basis. The Agreement also provides: "Section 390 funds disbursed for the acquisition of real property or the construction of features shall count as Federal funds for cost sharing purposes for Army projects. Funds provided by the non-Federal parties to match Federal funds provided under Section 390 will be treated as non-Federal funds for cost-sharing purposes for Army projects. The value of real estate acquired pursuant to this Article shall be the acquisition cost of such real property for credit purposes under applicable cost-sharing principles."

D.3.2 Department of Interior (Federal Grants)

D.3.2.1 Department of Interior Grant Number Farm Bill-1

In December 1996, the DOI and SFWMD executed a Federal Grant Agreement (Grant Title-East Coast Buffer/Water Preserve Area Land Acquisition Grant No. FB-1) in which DOI provided $18,433,923 in Federal funds to SFWMD for its matching contribution of $18,433,923 for the acquisition of land in the East

Coast Buffer/Water Preserve Areas (WPAs). The other Grant provisions included the provision that "State matching costs are the costs incurred after April 4, 1996 to acquire East Coast Buffer lands to be used to accomplish grant objectives in combination with those lands being acquired with this grant." Among the documents attached and incorporated into the Grant Agreement was the Framework Agreement. The stated objective in the Grant was that the SFWMD would purchase parcels of land within the proposed East Coast Buffer/WPAs, which were contemplated to become part of a future authorized Army project that will help restore the Everglades ecosystem. The approach in the Grant recognized that since April 1996, the SFWMD had acquired 34 parcels of land, entirely with its own funds, totaling 2,134.39 acres in the East Coast Buffer/WPAs at a cost of $20,424,355 of non-Federal funds. The Grant states *"Rather than providing the 50% non-Federal cost share on a dollar-for-dollar basis, the parties agree that for this transaction, the purchase price and the associated acquisition costs of these properties will be treated as the State matching portion of the 50% of the anticipated costs of acquiring an additional 2,206 acres comprising the four parcels described below in Jobs 1 through 4."* Jobs 1 through 4 were acquired entirely with Farm Bill-Federal funds. The SFWMD was to receive a credit towards future purchases if the value of the matching properties exceeded the value of the four parcels in Jobs 1 through 4. The Grant Agreement also recognized that the properties being acquired pursuant to the agreement might not be used for an Army Corps project. In that case, the Grant Agreement provides the following language:

"The process for notifying Interior of desire to retain or dispose of property when it is determined that the property will not be used for an Army project is as follows: The parties recognize the possibility that property or a portion thereof, acquired pursuant to this Grant Agreement may not become a part of an Army project as contemplated by the Framework Agreement. In such circumstances, and subject to the conditions stated below, the District (SFWMD) may: 1. Retain and use the property for other restoration purposes reasonably deemed suitable by Interior; 2. Retain and use the property for purposes other than the restoration of the Everglades ecosystem after compensating Interior for 50% of the fair market value of the property, such value to be determined as of the date of Interior approval of the retention option. However, the SFWMD will reasonably consider a request from Interior to provide matching property or matching funds to acquire replacement property to be used for restoration purposes at fair market value; or 3. Dispose of the property after compensating Interior for 50% of the fair market value of the property, such value to be determined as of the date of Interior approval of the disposal option."

In May 1997, the first amendment to this Federal Grant was signed to add an additional $18,475,817 making the total Federal funding received by SFWMD $36,909,700. The State (SFWMD) provided a contribution of $21,566,077

exceeding the required State-match funds equal to the Federal funds provided by DOI. The lands acquired by SFWMD pursuant to the grant with 50% Section 390 Farm Bill funds and 50% State funds include lands in the BCWPA Project (C-9 Impoundment, C-11 Impoundment, Water Conservation Area (WCA) 3A/3B Seepage Management Area), Site 1 Impoundment, Central Lake Belt Storage Area, North Lake Belt Storage Area, Bird Drive Project Area, and several other possible CERP project areas. Total funds spent pursuant to Federal Grant Agreement (Grant Title-East Coast Buffer/Water Preserve Area Land Acquisition, Grant No. FB-1) is $76,909,740. The total State (SFWMD) contribution of funds that have been expended are $40,000,000 and the total Federal Farm Bill funds was $36,909,740.

C-11 Impoundment- Within the C-11 Impoundment, comprised of approximately 1,830.75 acres, a total of 654.62 acres were acquired using State and Federal funds with a total of approximately $27,355,115 expended. These costs include both the land acquisition cost as well as the cost of any improvements and SFWMD administrative costs for the acquisition of the lands. A total of approximately $13,677,558 in Federal funds was utilized to acquire these lands.

C-9 Impoundment- Within the C-9 Impoundment, comprised of approximately 1,807.39 acres, a total of 1,113.01 acres were acquired using State and Federal funds with a total of approximately $21,353,263 expended. These costs include both the land acquisition cost as well as the cost of any improvements and SFWMD administrative costs for the acquisition of the lands. A total of approximately $10,676,632 in Federal funds was utilized to acquire these lands.

WCA3A/3B Seepage Management Area- Within the WCA3A/3B Seepage Management Area (SMA), comprised of approximately 4,352.83 acres, a total of 221.86 acres were acquired using State and Federal funds with a total of $5,061,470 expended. These costs include both the land acquisition cost as well as the cost of any improvements and SFWMD administrative costs for the acquisition of the lands. A total of approximately $2,530,735 in Federal funds was utilized to acquire these lands.

D.3.2.1.1 Department of Interior Grant Number LWCF-1, Land and Water Conservation Act Funds

In June 1999, the DOI and SFWMD executed another Grant Agreement entitled Everglades Watershed Restoration-Grant Number LWCF-1, in which DOI provided $38,900,000 in Federal funds to the SFWMD for the acquisition of land in the East Coast Buffer/WPA and Southern Corkscrew Regional Ecosystem Watershed Project. SFWMD matched the Federal share with a State share of $38,900,000, making the total expenditures on land acquisition at $77,800,000. This Grant contained language to allow SFWMD to manage these acquired lands

during an Interim Period defined as "...the period of time: 1) commencing a) with respect to Grant Lands, the date of purchase or date of possession under condemnation, as appropriate, and b) with respect to Match Lands, the effective date of the Grant Agreement as defined below, and 2) ending a) sixty (60) days prior to the issuance of a notice to proceed with construction of the respective phase of the District/Corps Project, at which time the Grant Land or Match Land is deemed to be 'Incorporated into a District/Corps Project', or b) on the date of receipt by Interior of written notice from the Corps or the District that the particular Grant Land or Match Land is not to be included within a District/Corps Project, or c) such other date agreed to by Interior and the District." .... "Upon incorporation of each Grant Land or Match Land into a District/Corps Project, such Grant Land or Match Land shall be managed in accordance with Corps approved water management and control plans and operation and maintenance manuals for the project so long as the project remains authorized." This Grant was amended in December 1999 to add an additional $13,900,000 from each of the parties bringing the total to $105,600,000. The Grant was amended again in April 2000 to add an additional $18,900,000 from each of the parties bringing the total to $143,000,000. This additional $38,900,000 was to be used to purchase the Berry Groves property (C-43 Reservoir Project). The DOI's additional $18,900,000 in funding came from Land and Water Conservation Funds provided to the DOI by Congress. The last amendment to this Grant was executed in June 2001 with each party contributing an additional $5,974,000 bringing the total under the Grant to $155,348,000. Not all the lands covered in this Grant Agreement are within the footprint of the C-11 Impoundment, C-9 Impoundment or WCA 3A/3B SMA components.

C-11 Impoundment- Within the C-11 Impoundment, comprised of approximately 1,830.75 acres, a total of 277.70 acres were acquired using State and Federal funds with a total of $33,196,686 expended. These costs include both the land acquisition cost as well as the cost of any improvements and SFWMD administrative costs for the acquisition of the lands. A total of approximately $16,598,343 in Federal Land and Water Conservation funds were utilized to acquire these lands.

C-9 Impoundment- Within the C-9 Impoundment, comprised of approximately 1,807.39 acres, a total of 10.01 acres were acquired using State and Federal funds with a total of $492,325 expended. These costs include both the land acquisition cost as well as the cost of any improvements and SFWMD administrative costs for the acquisition of the lands. A total of approximately $246,163 in Federal funds was utilized to acquire this land.

WCA3A/3B Seepage Management Area - Within the WCA3A/3B SMA, comprised of approximately 4,352.83 acres, a total of 68.27 acres were acquired using State

and Federal funds with a total of $471,603. These costs include both the land acquisition cost as well as the cost of any improvements and SFWMD administrative costs for the acquisition of the lands. A total of approximately $235,802 in Federal funds was utilized to acquire this land.

D.3.2.2 Department of Interior Grant Summary

Between the Federal money contributed from the Farm Bill funds and the Land and Water Conservation funds, the DOI has provided a total of approximately $43,965,233 which will be credited to the Federal Government toward the lands in the BCWPA Project components.

For the C-11 Impoundment, a total of approximately $30,275,901 will be credited to the Federal Government. For the C-9 Impoundment, a total of approximately $10,922,795 will be credited to the Federal Government. For the WCA3A/3B SMA, a total of approximately $2,776,537 will be credited to the Federal Government.

These amounts may be increased or decreased based on a more detailed analysis during the crediting review process after approval of the Project, execution of a Project Cooperation Agreement and certification of the land.

D.4 PROJECT LOCATION AND DESCRIPTION

The BCWPA study area is bordered on the north by the North New River Canal and on the south by the C-6 Canal. WCA 2 and 3 border the project site to the north and west, respectively. To the east is the City of Weston. The study area includes the three project components and the area within the watershed where the components are located. This includes the WCA 3A and 3B and the land within the drainage basins to the east.

D.5 SELECTED PLAN DESCRIPTION

D.5.1 Selected Plan Features and Actions

The selected alternative plan includes the following features: the C-11 Impoundment and associated flow diversion canal and structures, the C-9 Impoundment, the WCA 3A/3B SMA, and associated canal improvements (see

Figure D-2). The following is a general description of the location and design of selected plan features. For a more detailed description of project features, see the Engineering Appendix, ***Appendix A***. All three components are located in western Broward County, Florida. Both the C-9 Impoundment and the C-11 Impoundment are east of US 27 and the WCA 3A/3B SMA is located west of US 27. The component descriptions are as follows:

D.5.1.1 C-11 Impoundment

The C-11 Impoundment project component features a 1,068-acre 4.3-foot deep, aboveground impoundment as the main element of design that carries a Low Hazard Potential Classification. Other design elements include a combined inflow/seepage pump station, assorted gated and non-gated structures, several fixed weirs, one adjustable weir, an emergency overflow spillway, and perimeter embankments and seepage control canals. The design also includes two wetland marsh areas (Mitigation Areas A and B) that when combined with C-9 Impoundment and WCA 3A/3B SMA mitigation areas offset project impacts to existing Department of the Army 404 permitted mitigation areas. The existing C&SF flood damage reduction system will remain operational to manage major storm events that produce more volume of water than project storage availability.

The C-11 Impoundment feature includes approximately 1,830.75 acres of land needed for the footprint of the Project, with approximately 1,252.75 acres of land needed for the above ground storage impoundment, with an effective interior storage area of 1,068 acres at 4.3-foot deep above-ground impoundment (also defined as a reservoir), with approximately 565 acres needed for the design features for Mitigation Area A, which has a 475 acre interior wetland marsh area 1-foot depth and approximately 13 acres for the other wetland marsh (Mitigation Area B). The C-11 Impoundment is located in western Broward County, adjacent to and east of US 27 on the north bank of the C-11 Canal. The northern boundary of the project is approximately 3.5 miles south of the I-75/US-27 Interchange and 2.3 miles north of the C-11 Canal. The southern boundary of this feature is the C-11 Canal. The C-11 Impoundment is approximately 1.5 miles in width from east to west for the northern half, and approximately 1.0 mile in width in the southern half.

The primary purpose of the C-11 Impoundment feature is to reduce the pumping of untreated agricultural and urban runoff into WCA 3A. Project modeling demonstrated that the combined operation of the C-11 Impoundment and C-9 Impoundment will significantly reduce pumping of runoff into WCA 3A. The project with other elements included in the BCWPA Project allow operational flexibility to transfer water to the C-9 Impoundment if storage is available, enable the return of seepage and rainwater collected in WCA 3A/3B SMA to WCA 3A and/or use the current option to send water eastward to tide through

the C-11 and C-9 Canals, if conveyance will not negatively impact existing levels of service flood protection. If all of these alternatives have been exhausted, then the existing S-9 Pump Station will be used to back pump excess flows into WCA 3A and maintain existing levels of flood protection. The storage pool will also assist in reducing seepage from adjacent natural areas WCA 3A and WCA 3A SMA, provide groundwater recharge, and provide benefits in meeting the agricultural, urban, and saltwater intrusion. The impoundment may provide opportunities to further reduce the extent of damages from flooding through operational changes to the C&SF Project and local drainage systems and provide incidental water quality improvements.

The C-11 Impoundment has the following design features (for more details on site plans-see ***Figures 7-2, Section 7*** and ***Plate G-3, Engineering Appendix, Appendix A***):

Structures

S-503 Pump Station (inflow and seepage plants)
S-503A Gated Culvert
S-504 Gated Culvert
S-504B Service & Auxiliary Spillway
S-505A Weir and Sluice Gate
S-505B Broad Crested Weir
S-505C Broad Crested Weir
S-505D Bridge (Open Box Culverts)
S-506A Gated Culvert (sag)
S-506B Weir-Gate Culvert
S-507A through F Non-Gated Culverts
S-508A Non-gated Culvert
S-508B Non-gated Culvert
S-508C Non-gated Culvert
S-508D Non-gated Culvert

Canals

C-511 Seepage Canal
C-512 Seepage Canal
C-513 Seepage Canal

Levees

D-511 Embankment
L-511 Levee (Secondary Containment)
L-512 Levee/Berm
L-513 Levee/Berm

D.5.1.1.1 **Impoundment**

The impoundment requires approximately 1,252.75 acres of land with an effective interior storage area of 1,068 acres at a 4.3-foot deep, for the aboveground impoundment/reservoir that provides 4,592 acre-feet of storage. Embankment heights are 8.5 feet above average interior grade. A system of seepage canals and associated structures is included along the western, northern, and eastern boundaries.

The D-511 Embankment is the perimeter embankment for the 4.3-foot storage pool reservoir. The L-511 Levee is the perimeter containment levee--parallel to D-511 Embankment except where US 27 forms the containment function with the sole purpose of containing an impoundment breach in the very unlikely event it should occur. The containment levee together with the close proximity of the S-9 Pump Station allows the C-11 Impoundment to carry a Low Hazard Potential Classification,

There are two wetland marsh areas proposed to be created and maintained as mitigation credit to offset project impacts to existing Department of the Army 404 permitted mitigation areas located within the C-11 and C-9 Impoundments. When both the C-11 and C-9 Impoundment reservoirs are full and storage is available within the 475-acre "Mitigation A" wetland area, water may be released into the wetland from the C-11 Impoundment (via the S-506A Gated Culvert). Releases from the Mitigation Area A wetland area will be controlled by the S-506B Culvert with Riser. The 13-acre "Mitigation B" wetland area will receive direct rainfall and indirect seepage inflows from the impoundment. Mitigation Area B excess water will be removed via overflow of the low L-513 Levee/Berm into the C-513 Seepage Canal. Rainfall will contribute as well to their hydroperiods.

The water levels in the mitigation areas will be assessed and adaptively managed after construction to optimize project purposes, including wetland restoration. An optimum seasonal stage up to one-foot depth will be managed for the mutual benefit of establishing wetland habitat with associated hydroperiods and project storage capability. Greater depths due to rainfall on top of one foot of storage depth will be limited to short time duration and frequency to minimize adverse impacts. Water will not be released into the Mitigation Area A wetland area if water levels are at or above the one foot target depth (no capability to make releases into Mitigation Area B) as a result of direct rainfall.

Mitigation Wetland Marsh Areas

The C-11 Impoundment footprint includes two existing separated mitigation areas that required the project team to maintain, relocate, or offset with additional mitigation credits within the project design, or in combination with

the other project components under the BCWPA Project. The project as designed limits adverse impacts to the two existing mitigation areas while providing a water supply to sustain their viability and a protective perimeter levee/berm. The project design also adds wetland marsh acreage for mitigation credits to offset the impacts caused by project implementation at other sites within BCWPA. Two mitigation wetland areas within C-11 Impoundment, Mitigation Area A and Mitigation Area B are created by the existing and newly converted wetlands when combined.

Mitigation Area A
The main wetland marsh area within C-11 Impoundment is Mitigation Area A that includes a total of 475 acres of existing and newly converted wetlands. Total acres required for Mitigation Area A are approximately 565 acres, which includes additional acreage for the design features associated with Mitigation Area A. The depth of water in the mitigation area will be dependent on direct rainfall, seepage from the impoundment, releases from the impoundment through S-506A Gated Culvert structure (rated design capacity of 55 cfs) or the setting of flashboards in the discharge S-506B Culvert Risers into the C-511 Seepage Canal. The design allotment for project storage is 1-foot of water that provides water for the wetland hydroperiod while still assisting with one of the main project purpose of diverting runoff from S-9 Pump Station pumping into WCA to elsewhere with multi-purpose usage. Within Mitigation Area A some upland areas created by other historic land uses (i.e. dirt roads, structures, etc.) will be scraped down to average natural grade and other areas will be cleared. The perimeter levee around Mitigation Area A includes the L-511 Levee and the L-512 and L-514 Levee/Berms.

Mitigation Area B
The other smaller wetland marsh area is Mitigation Area B that includes a total of 13 acres of newly converted wetlands. The depth of water in the mitigation area will be dependent on direct rainfall and seepage from the impoundment. That is, there is no direct water supply feature for this area. Excess water with heavy precipitation events may and is permitted to overflow L-513 Levee/Berm or SW 26th St. into adjacent and parallel C-513 and C-512 Seepage Canals, respectively. Within Mitigation Area B the upland areas created by other historic land uses (i.e. dirt roads, structures, etc.) will be scraped down to water table to establish/reestablish the new wetlands marsh area. The perimeter levee around Mitigation Area B includes the L-511 Levee and the L-512 and L-513 Levee/Berms.

D.5.1.1.2 **Pump Stations**

S-503 Inflow Pump Station
S-503 Pump Station has a total design pumping capacity of 1,500 cfs -1,050cfs for inflow pumping and 450 cfs for seepage return pumping. The inflow

pumping capacity was selected based on water budget modeling by SFWMD's Consultant for the interim period before North Lake Belt Storage Area comes online in approximately 25 years. The inflow bank has three bays that include three 350 cfs diesel engine driven pumps. The seepage return pumping capacity includes a safety design factor added to the recent 3-D groundwater LECsR modeling effort. The seepage bank also has three bays that include three 150 cfs electric motor driven pumps. The pump station is located at the southeastern corner of the impoundment off the C-11 Canal, just east of the newly constructed S-381 Gated Obermeyer structure. The pump station is designed to capture available stormwater runoff in the Western C-11 Basin between S-381 and S-13AW (inflow bank) and to return pump seepage intercepted by perimeter control C-511, C-512, and C-513 Seepage Canals (seepage return bank). All diesel pumps located in the inflow bank may be used simultaneously for maximum runoff capture or diversion operations. A 350 cfs pump can also be used to return pump seepage, thereby maintaining the C-11 Canal control stage during non-runoff events. For operational flexibility any combination of pumps can be used to maintain optimum canal levels.

D.5.1.1.3 **Gated Culverts**

S-503A Gated Culvert

S-503A Gated Culvert is a single barreled, gated box structure. The design flow is 200 cfs per with a 5.20-foot hydraulic head differential, although ultimate capacity is much higher than that used for design. The structure is located abutting S-503 Pump Station western side and discharges into the C-11 Canal just east of the S-381 Obermeyer Gate. The structure will allow discharges and releases from the impoundment to drawdown the storage pool to regain storage availability, meet water demands, and/or maintain optimum canal levels. The structure allows operational flexibility in that it provides this capability while S-381 and S-9A Pump Station are in WCA 3 seepage return pump operations. Culvert barrel is a 5 foot x 6 foot box culvert (cast-in-place) and is 100 feet in length.

S-504 Gated Culverts

S-504 Gated Culverts is a double-barrel, gated box structure. The design flow capacity is 1,000 cfs with a headwater and tailwater of 10.30 and 3.50 ft-NGVD, respectively. The design discharge is based on matching C-11 and C-9 Impoundments' inflow pump stations S-503 and S-509 capacities, respectively. Until NLBSA comes online, the maximum diversion/transfer flow rate to the C-9 Impoundment will be 1,000 cfs. The structure is located just east of the southwestern corner of the impoundment on the C-11 Canal. The structure will allow discharges and releases from the impoundment to drawdown the storage pool to regain storage availability, transfer of water to the C-9 Impoundment or the NLBSA, meet water demands, and/or maintain optimum canal levels.

Culvert barrels are two 8 foot x 8 foot box culverts (cast-in-place) and are 180 feet in length.

S-506A Gated Culvert

S-506A Gated Culvert is a single barrel, gated "sag" culvert structure. The design flow capacity is 55 cfs with a 3.25-foot hydraulic head differential. The structure is located in the northwestern corner of the reservoir and conveys flow from the reservoir under C-511 and SW 26th St—hence the "sag" element—into Mitigation Area A, to manage the wetland hydroperiod or make use of the area for extended reservoir storage up to one-foot of depth. Culvert barrel is 48 inches in diameter RCP round culvert and is 340 feet in length.

S-506B Gated Culvert

S-506B Gated Culvert is a double-barrel, gated round culvert structure. The design flow capacity is 75 cfs with a 3.00-foot hydraulic head differential. The structure is located in the northeastern corner of the reservoir and conveys flow from Mitigation Area A under L-511 (SW 26th St) into the C-511 Seepage Canal, to manage the wetland hydroperiod by ensuring depth durations are not prolonged to a point of causing significant adverse impact. Culvert barrels are two 5-feet diameter round RCP and are 60 feet in length.

D.5.1.1.4 **Weirs and other Spillover Water Control Structures**

S-504B Service and Auxiliary Overflow Spillway

The S-504B spillway is a drive over spillway with a service and an auxiliary spillway. The spillway's purpose is to protect embankment integrity should a storm event occur with a less frequent return period than the design storm or succeeding multiple storm events occur that could place the reservoir's embankments at risk of breaching. The service spillway crest is set at 10.30 feet NGVD or at the normal full pool elevation and is 12 feet in length. The spillway contains the service spillway with 31 cfs capacity and an auxiliary spillway with 322 cfs capacity.

S-505A Weir

S-505A Weir is a non-gated broad crested weir structure. The design flow capacity is 220 cfs with a hydraulic head of 0.75 feet. The design flow capacity is that that enables "maximum" seepage to be controlled with minimal areal impacts should a 150 cfs pump in the S-503 seepage bank be off-line. The weir is also associated with a sluice gate with a design flow capacity of an additional 470 cfs that is comparable in conveyance capacity as the S-503 seepage pump bank of 450 cfs. The structure is located at the southeastern boundary of the reservoir in the C-511 Perimeter Seepage Canal. The structure will allow excess seepage that is discharged into the C-11 Canal to be return pumped into the reservoir with the S-503 Pump Station inflow bank. The structure limits C-11

Canal backflow upstream of the weir into C-511 Seepage Canal during times of excess C-11 Canal stages.

S-505B Weir

S-505B Weir is a non-gated broad crested weir structure with a 10-foot notch. The design flow capacity is 250 cfs with a hydraulic head of 0.80 feet. The weir is able to accommodate a higher flow capacity if seepage should prove to be at a higher rate than expected, i.e. the seepage management system would still retain acceptable capacity. The structure is located mid-reach of the eastern C-511 Perimeter Seepage Canal, separating the southeastern and northeastern quadrants. The structure will allow excess staged water collected north of the structure (controlled at 6.0-6.5 ft-NGVD) to discharge south of the structure that is controlled at 3.5 ft-NGVD to prevent impact to flood damage reduction capabilities for nearby private lands. The canal's northern reach higher control stage prevents over drainage of wetlands and reduces the seepage rate out of the reservoir.

S-505C Weir

S-505C Weir is a non-gated broad crested weir structure with a 10-foot notch. The design flow capacity is 750 cfs with a hydraulic head of 1.25 feet. The weir is able to accommodate a higher flow capacity if seepage should prove to be at a higher rate than expected, i.e. the seepage management system would still retain acceptable capacity. The structure is located near the southwestern corner of the reservoir in the C-511 Seepage Canal, just north of the adjacent Seminole Truck Stop. The structure will allow excess seepage that is discharged into the C-11 Canal to be pumped into the WCA 3A with the S-9A Pump Station. The seepage canal's control stage benefits seepage reduction from the WCA 3A, WCA 3A SMA, Mitigation Area A and the impoundment.

D.5.1.1.5 **Non Water Control Structures**

S-505D Non-Gated Culvert

S-505D Non-Gated Culvert is a single-barrel, box culvert structure. The culvert has a rated design flow capacity of 750 cfs. The structure is located near the southwestern corner of the reservoir that provides conveyance of seepage collected and spilled over the S-505C Weir Structure. The box structure functions as a maintenance bridge to the reservoir from US-27 along the C-11 Canal. Culvert barrel is a 10 foot x 10 foot box culvert and is 65 feet in length.

S-507(A-F) Non-Gated Culverts

S-507(A-F) Non-Gated Culverts are a six individual round culvert structures. The culverts have minimum flow requirements as their function is to maintain equal stages in the mitigation areas separated by SW 26th Street near the northwestern corner of the reservoir. Culvert barrels are 48 inches in diameter RCP round culverts and is 72 feet in length.

S-508A Gated Culvert
S-508A Gated Culvert is a single-barrel, culvert structure. The culvert has a minimum flow capacity with minimal hydraulic head differential. The structure provides seepage conveyance collected from C-513 to C-512 Seepage Canals under SW 26th St. Culvert barrel is 48 inches in diameter, and 225 feet in length.

S-508B Gated Culvert
S-508B Gated Culvert is a triple-barrel, culvert structure. The culvert has a 358 cfs design flow capacity with minimal hydraulic head differential. The structure provides conveyance of seepage collected from C-512 to C-511 Seepage Canals under L-511. Culvert barrel are 72 inches in diameter round culverts and is 272 feet in length.

S-508C Non-Gated Culvert
S-508C Non-Gated Culvert is a single-barrel, culvert structure. The culvert has a minimum design flow capacity with minimal hydraulic head differential. The structure is located between the finger lakes in Mitigation Area A and provides seepage conveyance collected from the western finger lake to the eastern finger lake within Mitigation A. Culvert barrel is 48 inches in diameter round culvert and 225 feet in length.

S-508D Non-Gated Culvert
S-508D Non-Gated Culvert is a single-barrel, culvert structure. The culvert has a minimum design flow capacity with minimal hydraulic head differential. The structure is located in Mitigation Area A between the eastern finger lake and mid-reach of the C-511 Seepage Canal and provides conveyance of seepage collected from the finger lakes within Mitigation A to C-511 Seepage Canal. Culvert barrel is 48 inches in diameter round culvert and 136 feet in length.

D.5.1.1.6 **Existing Features**

S-13AW Gated Culvert
S-13AW Gated Culvert is a gated four barrel culvert structure. The structure is located in the C-11 Canal at the intersection of Griffin Road and 100th Avenue, approximately 8.6 miles east of S-381. S-13AW is the basin divide structure between the Western and Eastern C-11 Basins. The structure currently operates during dry conditions to maintain an optimum canal elevation to the east of 2.20 ft-NGVD at S-13 Pump Station. S-13 is approximately 4.5 miles east of S-13AW. This structure is also opened to move water to tide during runoff events in order to reduce pumping at S-9 Pump Station under favorable tide and Eastern C-11 Basin conditions. Culvert barrels are 6-foot diameter round CMP and are 200 feet in length.

S-13 Flood Pump Station

S-13 Pump Station has a total pumping capacity of 540 cfs. The structure is located in the C-11 Canal, approximately 300 feet west of US 441. The pump station is designed to remove excess stormwater in the Eastern C-11 Basin and maintain an optimum water surface elevation of 2.2 ft-NGVD for the C-11 Canal. The structure is also equipped with a 16-foot wide by 11-foot high vertical lift gate that operates to maintain the optimum water surface elevation when conditions are favorable for gravity discharge to tide.

S-381 Gated Spillway

The S-381 gated spillway is located in the C-11 Canal near the southeastern corner of the impoundment, just west of the proposed S-503 Pump Station. The S-381 gated spillway is a three-bay Obermeyer (proprietary) gated structure that is engaged with a submerged bladder. The spillway design flow capacity is 2,880 cfs with a minimal (less than 1/10 foot) head differential. The design is based on matching S-9 Pump Station capacity with no negative impact to existing levels flood protection for the Western C-11 Basin. The S-381 gated spillway is normally closed for the backpumping of WCA 3 seepage collected in the C-11 Canal by the S-9A Pump Station. The S-381 gated spillway is opened only during S-9 Pump Station operations for flood damage reduction in the Western C-11 Basin or for releasing flows to the basin to meet water supply demands (including prevention of saltwater intrusion). The Obermeyer gate is designed so that in the unlikely event of failure it is in the open position. This allows water to be pumped through the S-9 Pump Station maintaining flood protection for the basin should the structure fail.

D.5.1.1.7 **Seepage Canals**

The Impoundment will include three seepage canals: (1) C-511 around the eastern, northern, and western perimeter of the reservoir, (2) C-512 around the mostly eastern and northern perimeter of Mitigation A, and (3) C-513 around the mostly eastern and perimeter of Mitigation B.

C-511 Seepage Canal

The C-511 Seepage Canal has two purposes: (1) primary purpose is to intercept seepage from the reservoir to minimize impacts to nearby private lands' existing levels of service of flood protection and (2) secondary purpose is to convey under emergency condition breach flow to the C-11 Canal should the unlikely event of a breach should occur. The canal has two stage divide weir structures S-505B and S-505C for control. The canal receives excess seepage collected by the C-512 and C-513 Seepage Canals. The canal also receives excess seepage collected in the finger lakes located in Mitigation Area A via non-gated culvert S-508D under the L-511 Levee.

The southeastern reach of the seepage canal--south of S-505B--is maintained at the control stage of 3.5 ft-NGVD by the S-503 Pump Station (seepage bank). Should the pump station experience failure, the S-505A Weir Structure combined with a sluice gate for control, provides gravity discharge capacity into the C-11 Canal to prevent seepage canal impacts. Discharge into C-11 Canal is managed by return pumping into the reservoir with the S-503 Pump Station (inflow) or by the S-9 or S-9A Pump Stations which function to provide primary and seepage control for the Western C-11 Basin. The control stage north of S-505B at a stage of 6.0-6.50 ft-NGVD is identified to prevent impact to the level of service of flood protection in areas to the east and over drainage of their design water table for wetlands and lakes.

The western reaches of the seepage canal--north of S-505C--is maintained at the control stage of 6.0-6.5 ft-NGVD primarily by S-505C Weir Control Structure which prevents over-drainage of abutting wetlands and reduces the seepage rate out of the reservoir. The downstream weir structure prevents impacts to the existing Seminole Truck Stop and prevents backflow from elevated C-11 Canal stages during diversion operations of transferring water from the C-11 Impoundment to the C-9 Impoundment. Excess seepage passively discharged through S-505C structures can either be pumped into WCA 3 by the S-9A Pump Station (seepage) or be return-pumped by the S-503 Pump Station (inflow) with disengagement of the S-381 Obermeyer Gate. Excess seepage may also be discharged passively by the S-505B Weir Control Structure into the C-511 eastern reach and managed in same manner as described in the preceding eastern reach paragraph.

C-512 Seepage Canal

The C-512 Seepage Canal intercepts seepage from Mitigation Area A eliminating or reducing negative impacts to nearby private lands' existing levels of service flood protection. The canal also receives excess seepage collected by C-513 Seepage Canals and discharges into the eastern reach of the C-511 Seepage Canal.

The seepage canal is maintained at the control stage of 6.00ft-NGVD by discharging into the C-511 Seepage Canal via non-gated culvert S-508B under the L-511 Levee. Excess collected seepage is managed in same manner as the C-511 Seepage Canal's eastern reach.

C-513 Seepage Canal

The C-513 Seepage Canal intercepts seepage from Mitigation Area B to eliminate or reduce negative impacts to nearby private lands' existing levels of service flood protection. The seepage canal is maintained at the control stage of 6.00ft-NGVD by discharging into the C-513 Seepage Canal via non-gated culvert S-508A under SW 26th St. Excess collected seepage is managed in same manner as the C-511 Seepage Canal's eastern reach.

D.5.1.1.8 **Embankments, Levee, and Levee/Berms**

Embankments

D-511 Embankment
The D-511 Embankment is the impoundment's embankment structure that allows the normal maximum storage of water up to 4.3 feet deep with a design crest elevation of 14.5 ft-NGVD or 8.5 feet above assumed average natural grade of 6.00 ft-NGVD. The embankment design meets the impoundment's Low HPC with an associated L-511 Levee that enables the total impoundment design to contain and convey a breach flow to the C-11 Canal should D-511 fail unexpectedly. The embankment is constructed of homogenous material and armored with soil cement (plate and steeped) revetment on the interior (lake side) to protect structure integrity from wave impacts during high wind events. The embankment is grassed on the exterior (land side) for prevention of typical rainfall runoff and occasional wave over-wash erosive-type forces. Embankment crest is 14 feet wide.

Levees

L-511 Levee
The L-511 Levee is the impoundment's secondary containment levee that enables containment and conveyance of a possible breach flow to the C-11 Canal should D-511 Embankment fail unexpectedly. For this purpose, the levee has a design crest elevation of 11.00 ft-NGVD or 5.0 feet above assumed average natural grade of 6.00ft-NGVD. The levee is designed to temporary withstand high stages and is therefore not armored for wave impacts (no revetment). The levee is grassed on both slopes for prevention of typical rainfall runoff erosive-type forces.

Levee/Berms
The levee/berms are low levees no more than 3 feet above an enclosed interior average natural grade to prevent the impoundment of water deep enough to pose a hazard under any meteorological event. That is, the limited storage depth on the interior will not be that which may create flooding nor a dangerous kinematic wave should a breach occur. Large precipitation events will cause ponding on both sides of the levee/berms limiting pressures on the structures, thereby virtually eliminating the possibility of a full breach. The levee/berms are capable of extending storage availability (volume) for the C-11 Impoundment by the allowance of utilizing one-foot of storage within the mitigation wetlands enclosed by said levee/berms. The levee/berms also provide an ecosystem protective berm function by the capture of and drainage prevention of rain water that assists natural hydroperiods of the natural areas. Material for construction

of these low earthen structures is expected to be a mix of degraded limestone, sands with some peat or muck.

L-512 Levee/Berm

The L-512 Levee/Berm is Mitigation Area A's mostly northern and eastern levee that allows the normal maximum storage of water up to 1.0-foot deep with a design crest elevation of 9.5 ft-NGVD or 3 feet above assumed average natural grade of 6.5 ft-NGVD. The levee is designed for low stages in an emergent vegetation environment that will not experience waves of any practical force. The levee is grassed on both slopes for prevention of typical rainfall runoff erosive-type forces.

L-513 Levee/Berm

The L-513 Levee/Berm is Mitigation Area B's mostly eastern levee that has no inflow other than direct rainfall and seepage. The levee was designed with a crest elevation of 8.0 ft-NGVD or 2 feet above assumed average natural grade of 6.0 ft-NGVD. The levee is designed for low stages in an emergent vegetation environment that will not experience waves of any practical force. The levee is grassed on both slopes for prevention of typical rainfall runoff erosive-type forces.

L-514 Levee/Berm

The L-514 Levee/Berm is Mitigation Area A's mostly western and northern levee that allows the normal maximum storage of water up to 1-foot deep with a design crest elevation of 9.5 ft-NGVD or 3 feet above assumed average natural grade of 6.5 ft-NGVD. The levee is designed for low stages in an emergent vegetation environment that will not experience waves of any practical force. The levee is grassed on both slopes for prevention of typical rainfall runoff erosive-type forces.

L-515 Levee/Berm

The L-515 Levee/Berm is a levee/berm on the interior of Mitigation Area A surrounding the two finger-lakes. The levee/berm isolates the mitigation area pool from the lakes and does not allow the transfer of water. Groundwater modeling demonstrated that the deep abandoned quarries penetrate a high conductivity ground layer. The levee berm has a design crest elevation of 9.0 ft-NGVD or 3 feet above assumed average natural grade of 6.0 ft-NGVD (or scraped to). The levee is designed for low stages in an emergent vegetation environment that will not experience waves of any practical force. The levee is grassed on both slopes for prevention of typical rainfall runoff erosive-type forces.

D.5.1.1.9 Real Estate Required and Cost for C-11 Impoundment, Mitigation Area A and Mitigation Area B

The C-11 Impoundment, Mitigation Area A and Mitigation Area B require fee estate, as set forth in ***Section D.7*** below, consisting of approximately 1,830.75 acres within 80 ownerships. The land uses in this area consists of potential residential development and agricultural. There were 11 relocations with relocation payments of $1,022,032. This component lies in Township 50 South, Range 39 East, in all or parts of Sections 14, 15, 22, 23, 26, and 27.

Of the approximately 1,830.75 acres required for this component, SFWMD has acquired 1,715.71 acres. There are approximately 1,252.75 acres required for the impoundment, approximately 565 acres required for Mitigation Area A and approximately 13 acres required for Mitigation Area B. A total of 654.62 acres were acquired using State and Federal funds pursuant to the terms of Farm Bill-DOI Federal Grants. The total purchase price of the 654.62 acres was $24,705,790, including improvements and 91-646 relocation payments. SFWMD's administrative costs for the acquisition of these lands were $1,627,293. SFWMD received credit under the Farm Bill Grant for all of the administrative costs except some of its labor costs. A total of 277.70 acres were acquired using State and Federal funds pursuant to the terms of Land and Water Conservation Fund-DOI Federal Grant. The total purchase price of this 277.70 acres was $28,792,150. SFWMD administrative costs for the acquisition of these lands were $4,404,536. SFWMD received credit under the Farm Bill Grant for all of the administrative costs except for some of its labor costs. ***See Section D.3.2***. An additional 591.61 acres were acquired utilizing only State funds. In accordance with the CECW-SAD memorandum dated July 30, 2009 signed by the Director of Civil Works, U.S. Army Corps of Engineers the current guidance for the CERP, Land Valuation and Crediting, these lands were valued in a Gross Appraisal at current fair market value as all were acquired after February 2002. The estimated value of these 591.61 acres is $88,741,500 which includes improvements with SFWMD's expended administrative costs associated with the acquisition of these lands being $16,558,247. There were 191.78 acres acquired by SFWMD through the Environmental Resources Permitting process with a $0 valuation because they are also acquired subject to a Department of the Army Section 404 regulatory mitigation area permit.. An additional 115.04 acres, owned by several public entities have not been acquired. The estimated value of these additional 115.04 acres is approximately $17,256,000. Estimated future SFWMD administrative costs are $1,932,000. All estimated land costs are in fee, see ***Section D.7*** below. Future Federal administrative expenses are estimated at $495,000. Total estimated costs for the approximately 1,830.75 acres which includes SFWMD's actual purchase price for the DOI Grant lands, the estimated value of lands acquired only with State funds, SFWMD's projected future acquisition costs, SFWMD's current administrative/incidental costs of acquisition, SFWMD's future estimated administrative/incidental costs,

utility/facility relocation costs, incremental real estate costs, and contingency is estimated at $210,473,000 or $210,171,000 not including Utility Relocation costs. For full details see ***Table D-3.***

D.5.1.2 **Water Conservation Area 3A/3B Seepage Management Area**

The Water Conservation Area 3A/3B Seepage Management Area (WCA 3A/3B SMA) feature footprint consists of approximately 4,352.83 acres of short hydroperiod wetlands. The relatively narrow strip of land is oriented north-south, approximately one-half mile wide and approximately 14.9 miles long. The WCA 3A SMA is located in Broward County and borders I-75/US-27 interchange (north), US 27 (east), C-11 Canal (south), and Everglades Protection Levee Central & Southern Florida Project L-37 Levee (west). The area is approximately 6.3 miles in length from north to south and 0.6 miles in width from east to west. The WCA 3A SMA is a wetland area also known as the WCA 3A Everglades Buffer Strip. The design includes a new levee with associated borrow canal. The design also includes considerations for US 27 stormwater runoff and Florida Power and Light (FPL) transmission line with associated access road. The WCA 3B SMA is primarily a wetland area also known as the WCA 3B Everglades Buffer Strip. West of the site are WCAs 3A and 3B. South of the site are the Pennsuco wetlands. There is one trailer park (Holly Lakes Mobile Home Park) and a FPL transmission line and electrical substations located within this feature. These existing property uses and structures necessitate design elements to provide continued access and to prevent additional flood damages potentially caused by project implementation. (For location and details related to the structures in the WCA 3A/3B SMA, see ***Plates G-2 through G-7, Engineering Appendix, Appendix A.*** For location and details related to the FPL Substation-see ***Plate G-4, Engineering Appendix, Appendix A***). For location and details related to Holly Lakes Mobile Home Park -see ***Plate G-5, Engineering Appendix, Appendix A.***

The purpose of the WCA 3A/3B SMA features is to provide a system to reduce seepage losses from WCA 3 and to establish a habitat buffer between the WCA natural area and urban development occurring to the east. Seepage reduction for WCA 3 helps retain water in the natural system that has been impacted by drawdowns to meet agricultural and urban water supply demands, and prevention of saltwater intrusion into the surficial aquifer. Project modeling demonstrated that controlling higher water levels/stages seasonally in the study area with associated canals reduced seepage losses significantly. Also, controlling water levels seasonally create hydroperiods within the wetland area that are beneficial to improving native flora and fauna.

The design includes a new conveyance canal with associated levees, borrow canals and water control structures. The design also includes considerations for mitigating flood impacts for one mobile home park and the FPL transmission

power lines and associated access road. The conveyance canal (C-502B) within WCA 3B SMA has the purpose of conveying Western C-11 Basin excess water that is diverted south to the C-9 Impoundment and in the future to the CERP component the North Lake Belt South Area. The canal also serves another CERP component, North New River Improvements, as a portion of a conveyance system that provides an alternate water supply delivery route from Lake Okeechobee (LOK) to Miami-Dade County and the South Dade Conveyance System in the future.

Other than the purpose of seepage management for WCA 3, WCA 3A/3B SMA must also provide seepage control to prevent negative impacts to existing areas within and outside project area under WRDA 2000 Savings Clause requirements. These areas include FPL Substation, US 27 Highway, Holly Lakes Mobile Home Park, South Broward Drainage District residents, and other residents who live in near vicinity of the project area of influence.

The proposed parallel canal system that includes C-502A and C-502BBorrow Canals will function as seepage interception canals that will collect seepage from the WCA 3 and WCA 3A/3B SMA. If canal stages are increased above levels expected to cause negative impacts, stages may be reduced or "controlled" by discharging into the existing C&SF system in the following manner:

- C-502A Borrow Canal stage is controlled by existing G-86N Structure with discharge capability into the C-11 Canal.
- C-502B Canal stage north of Krome Avenue is dual controlled by new S-502B Gated Culverts with discharge capability into the C-11 Canal and the existing S-30 Structure with discharge capability into the C-9 Canal. These reaches may also be alternately controlled with the existing S-32 Structure with discharge capability into the C-6 Canal.
- C-502B Borrow Canal stage south of Krome Avenue is controlled by new S-516A Weir with discharge capability into the C-6 Canal.
- C-503 Borrow Canal stage is controlled by new S-516B Weir with discharge capability into the C-6 Canal.

The WCA 3A/3B SMA has the following design features (for more details on site plans-see see ***Plates G-2 through G-7, Engineering Appendix, Appendix A***):

Structures

S-502B Gated Culverts (replacement for G-86S)
S-515 Gated Culvert
S-516A Triangular-Profile Weir
S-516B Triangular-Profile Weir
FPL Non-Gated Culverts 1-19

Bridges
- B-500 FPL Sub-station
- B-501 Holly Lakes Mobile Home Park

Canals
- C-502B Canal (conveyance)
- C-502A Borrow Canal
- C-502B Borrow Canal
- C-503 Borrow Canal

Levees
- L-502A Levee
- L-502B Levee
- L-502B Levee (side cast)
- L-502E Levee/Berm
- L-503 Levee

Flood Damage Reduction Systems
- Holly Lakes Mobile Home Park
  - S-514A Pump Station
  - L-502C Levee
  - C-502C Seepage Canal

The L-502A and L-502B Levees provide the ability to control stages within WCA 3A/3B SMA, as well as maintaining the separation of wetland/natural area water from diverted urban runoff water and WCA 3 seepage (i.e. protective berm). The L-503 Levee provides the same ability as the L-502A and L-502B Levees to control stages within the southern tip of WCA 3B SMA south of C-6 Canal (Miami Canal). The L-502E Levee/Berm is a low-level protective berm separating the project area from FPL lands.

The C-502B Conveyance Canal conveys up to 1,000 cfs of runoff diverted form the Western C-11 Basin to C-9 Impoundment and in future to SDCS and NLBSA.

D.5.1.2.1 **Holly Lakes Mobile Home Park**

A "ring" flood damage reduction system is included for Holly Lakes Mobile Home Park to mitigate for possible impact to their existing surface water management system due to increase water levels in the northern WCA 3B SMA. The system includes a levee (L-502C), a borrow canal (C-502C) and electric motor pump station with power backup generator set (S-514A). The stage in the perimeter canal will be controlled by seepage interception within the borrow canal and pumped into the C-502B Conveyance Canal (for location and details-see ***Plate G-5, Engineering Appendix, Appendix A***).

D.5.1.2.2 **Pump Stations**

S-514A Pump Station (formerly S-507A)
The S-514A is a flood protection pump station for Holly Lakes Mobile Home Park to offset possible reduction of effectiveness of the existing flood protection system. Loss of effectiveness may occur due to reduced ground storage resulting from the increased control elevation of the lands surrounding the Trailer Park. The pump station provides a total pumping capacity of 60 cfs. It is located on the north side of the park and pumps from C-502C Canal and discharges into the C-502B Conveyance Canal. S-514A is a 2-bay pump station with two 30 cfs electric motor driven pumps. Both pumps combined provide more flood protection than required for a 100-year 24-hour storm event. For operational flexibility, one pump or both can be used for optimum canal levels.

D.5.1.2.3 **Gated Spillways and Culverts**

S-502B Gated Culvert Structure
The S-502B Gated Culverts is a seven barreled, gated culvert structure. The design flow capacity is 1,000 cfs with a 0.29-foot hydraulic head differential. The structure is located south of the C-11 Canal in alignment with Griffin Road west of US-27. The structure will operate when diversion operations from C-11 Basin to C-9 Impoundment occur. The structure will also function as the replaced G-86S Stoplog Riser in maintaining C-502B Conveyance Canal stages, but at new project stages between +6.50 ft-NGVD (wet season) and +5.50 ft-NGVD (dry season). Culvert barrels are 8-foot diameter round and are 60 feet in length.

S-515 Gated Culverts
The S-515 Gated Culverts is a double-barreled, gated culvert structure. The design flow is 600 cfs with a design head of 1.3 feet. The structure is located on C-6 Canal near the junction of C-6 Canal with US 27. The structure has the project purpose of allowing higher stages to be held within the C-6 Canal between it and the S-31 Gated Culverts at L-30/L-33 Levee terminus meeting. The higher stage will provide additional seepage management part of the objective of the WCA 3B SMA. The structure will also operate the same as the S-31 structure by controlling dry-season water supply deliveries for the C-6/C-7 Canal basins. Additionally, the structure will include a manatee barrier to prevent manatees from migrating further west up the C-6 Canal. Culvert barrels are 8-foot diameter round and are 60 feet in length.

D.5.1.2.4 **Weirs and other Water Control Structures**

S-516A Triangular-Profile Weir
S-516A Weir is an ungated triangular-profile (aka triangular cross-section) weir structure. The design flow is 7.50 cfs with a hydraulic head of 0.20 feet. The

structure is located at the confluence of the C-502B Borrow Canal with the C-6 Canal. The structure will allow excess water collected in the C-502B Borrow Canal to discharge into the C-6 Canal to prevent impact to flood damage reduction capabilities for nearby private-owned properties. The borrow canal's control stage benefits seepage reduction for the WCA 3B/3B SMA. The weir crest elevation is set at 4.80 ft-NGVD and is 20 feet in width.

S-516B Triangular-Profile Weir

S-516B Weir is identical to that of S-516A Weir Structure. The structure is located at the confluence of the C-503 Borrow Canal with the C-6 Canal. The structure will allow excess water collected in the C-503 Borrow Canal to discharge into the C-6 Canal to prevent impact to flood damage reduction capabilities for nearby private-owned properties. Controlling the borrow canal's stage benefits seepage reduction for the WCA 3B/3B SMA, and provides enhancement of the enclosed wetlands' hydroperiod. The weir crest elevation is set at 4.80 ft-NGVD and is 20 feet in width.

D.5.1.2.5 **Non-Control Structures**

Ungated Culverts

FPL Non-Gated Culverts 1 through 19

FPL has a maintenance access road that runs north to south through the WCA 3B/3B SMA. Nineteen ungated culverts will be placed along the length of the access road to promote east-west flows under the road in the wetland area. All culverts will have an inlet and outlet pools with minimum surface area of 900 square feet (30'x30') and 6-foot minimum depth. In the WCA 3A SMA the culverts are numbered FPL 1 through 9. In the WCA 3B SMA the culverts are numbered FPL 10 through 19. Additional culverts may be required in the next design phase.

FPL 1 through 4 and 7 through 19 culverts are single barreled, ungated culvert structures. The flow rate will be variable dependent on water table elevations and wetland inundation at the time--relatively slow flow rates on the order of less than 1 fps are desirable. Culvert barrels are round 4-foot diameter culverts and are 30 feet in length. The barrel inverts are set at elevation 0.00 ft-NGVD for complete submergence to reduce interior vegetation growth.

FPL 4, 5 and 6 are triple barreled, ungated culvert structures. The flow rate will be variable dependent on water table elevations and wetland inundation at the time. Culvert barrels are round 4-foot diameter culverts and are 30 feet in length. The barrel inverts are set at elevation 0.00 ft-NGVD for complete submergence to reduce interior vegetation growth.

Bridges

Bridges are used for canal crossings where water control structures are not required. Because the C-502B Canal is gravity flow over a relatively long distance that has insignificant relief, head losses are critical to the performance of the canal. Well-designed bridge structures will provide conveyance with small head loss in comparison to typical head losses associated with culvert structures. Therefore, bridges are used in the project design.

B-500 Bridge
B-500 is a bridge structure for FPL access to the FPL power substation spanning across C-502B Canal. The bridge is located about 7.5 miles south of the I-75/US-27 Interchange on US 27.

B-501 Bridge
B-501 is a bridge structure for access to the Holly Lakes Mobile Home Park spanning across C-502B Canal where the channel has be modified to a concrete U-channel. The bridge is located about 9.0 miles south of the I-75/US-27 Interchange on US 27.

D.5.1.2.6 **Existing Features**

S-9 Flood Pump Station
S-9 Pump Station is a flood damage reduction pump station for the Western C-11 Basin. The pump station is located at the western end of the C-11 Canal between the L-37 and L-33 Levees. The pump station provides a total pumping capacity of 2,880 cfs. The pump station discharges the urban runoff collected in the Western C-11 Basin directly into WCA 3A.

S-9A Seepage Pump Station
S-9A Pump Station is a seepage control pump station that replaced the S-9 Pump Station role of backpumping seepage losses from WCA 3. The pump station is located on the L-37 Levee just north of the S-9 Pump Station. The pump station provides a total pumping capacity of 500 cfs for seepage collected in the C-11 Canal between the pump station and the S-381 Obermeyer Gate. Riser -control structures S-9XN, S-9XS, G-86N, and G-86S all control water levels within the Everglades Buffer Strip (WCA 3A/3B SMA) with excess water discharged into the C-11 Canal. The pump station discharges into WCA 3A. S-9A is a 4-bay pump station with two 175 cfs diesel engine driven pumps, and two 75 cfs electric motor driven pumps. For operational flexibility any combination of pumps can be used to maintain optimum canal levels.

S-9XN and S-9XS Culverts with Risers
S-9XN and S-9XS Stoplog Riser structures are double-barreled stoplog riser structures. S-9XN is located on the L-37 Borrow Canal at the confluence with

the C-11 Canal. S-9XS is located on the L-33 Borrow Canal at the confluence with the C-11 Canal. The structures are used to control WCA seepage by controlling stages in the borrow canals. Excess water is discharged into the C-11 Canal for backpumping into WCA 3A. The barrels are CMP culverts with 6-foot diameters.

G-86N and G-86S Culverts with Risers

G-86S Stoplog Riser structure is to be replaced with the S-502B Gated Culvert structure. G-86N Stoplog Riser structure will remain in operation. Both structures are single-barreled stop log riser structures. G-86N is located on the US-27 Borrow Canal at the confluence with C-11 Canal on the north side. G-86S is located on the US 27 Borrow Canal at the confluence with C-11 Canal on the south side. The structures are used to control WCA seepage by controlling stages in the US-27 borrow canal. Excess water is discharged into the C-11 Canal for backpumping into WCA 3A. The barrels are CMP culverts with 5-foot diameters.

S-30 Gated Culverts

S-30 Gated Culvert structure is a triple-barreled structure. S-30 is located on C-9 Canal and serves as a bridge for US-27. The structure is used to release excess water from the Everglades Buffer Strip (WCA 3B SMA) and on rare occasions allow excess C-9 Basin water to route as reverse flow through to C-6 Canal for flood damage reduction (via L-33 Borrow to S-32 Gated Culvert). Under the selected plan, the structure will provide control for maintaining seasonal water levels in WCA 3B SMA and water diverted from Western C-11 Basin to C-9 Impoundment. The barrels are RCP culverts with 7-foot diameters (288 feet in length).

S-32 Gated Culverts

S-32 Gated Culvert structure is a double-barreled structure. S-32 is located on L-33 Borrow canal and discharges into the C-6 Canal. The structure is used to release excess water from the Everglades Buffer Strip (WCA 3B SMA) for seepage management purposes and on rare occasions allow excess C-9 Basin water to route through to C-6 Canal for flood damage reduction. Under the selected plan, the structure will provide control for maintaining seasonal water levels in WCA 3B SMA. The barrels are CMP culverts with 6-foot diameters.

S-32A Gated Culvert

S-32A Gated Culvert structure is a single-barreled structure. S-32A is located on L-30 Borrow Canal at the confluence with the C-6 Canal. The structure is used to release excess water from the L-30 Borrow canal for seepage management purposes. Under the selected plan, the structure may allow excess water from WCA 3B SMA to be routed into the L-30 Borrow canal for conveyance south should a demand exist and conditions are favorable for operations. The barrel is a CMP culvert with a 4.5-foot diameter.

D.5.1.2.7 **Canals**

Conveyance Canal

C-502B Conveyance Canal
The only main conveyance canal for this project component is the C-502B Conveyance Canal. Construction of the C-502B Conveyance Canal will primarily consist of enlargement of the existing US 27 borrow canal. The canal design conveyance capacity is 1,000 cfs and includes the reach from C-11 Canal to C-9 Canal. C-502B Conveyance Canal control stages will be managed to prevent excess seepage loss from WCA 3B and to prevent excess seepage from flowing out of WCA 3B SMA to the east toward South Broward Drainage District residents. Another factor in stage control for long durations is to maintain the highest stage possible that does not impact the road base of the parallel US 27 Highway. These control stages will be determined by analysis of monitoring results with implementation of project features. However, they are expected to reflect the seasonally controlled water levels in the WCA 3B SMA between 5.50 and 6.50 ft-NGVD when deliveries are not being made.

C-502B Conveyance Canal has one unique feature in having a 2,385-foot constricted reach that abuts the Holly Lakes Mobile Home Park and the US 27 right-of-way. The constricted canal reach was designed to reduce impact to the Trailer Park through acquisition of land and still provide low head loss conveyance in the constrained channel width with US 27 on the eastern bank.

With future CERP Projects coming online, C-502B may be enlarged further as part of North New River Deliveries that will allow water supply deliveries to be conveyed from Lake Okeechobee to SDCS at a conceptual design capacity of 1,500 cfs through this project area. Also, enlargement of C-502B may be required for delivery to NLBSA at a CERP conceptual design capacity of 2,500 cfs.

Flood Damage Reduction Canal

C-502C Flood Damage Reduction Canal
The C-502C Canal consists of a newly constructed "ring" seepage canal used to provide flood damage reduction for the Holly Lakes Mobile Home Park. The canal design conveyance capacity is greater than 60 cfs that would match design pump station capacity of S-514A. Parameters for canal design included a control depth greater than 5 feet for reducing some types of vegetation growth. The canal reach starts in the southeast corner of the Park, runs west, north, and then east around the Park's perimeter to Pump Station S-514A in the northeast corner where excess water is discharged into C-502B Canal. C-502C Canal control stage will be maintained at 5.50 ft-NGVD with the pump station.

Borrow Canals

C-502A Borrow Canal

The C-502A Borrow Canal consists of a new canal created by the excavation of material for L-502A Levee construction, the main purpose of the feature reach. The borrow canal is located north of C-11 Canal; south of I-75; abutting the southbound right-of-way of US 27, and east of the L-502A Levee with a 15-foot setback from levee toe. The canal will primarily intercept seepage from WCA in the WCA 3A and WCA 3A SMA. Excess water accumulated in the borrow canal will be controlled by G-86N Stoplog Structure that discharges into the C-11 Canal. The canal control stage may vary initially with project implementation dependent on groundwater monitoring results over the area. However the initial setting of canal control stage will be seasonal with a stage of 7.00 ft-NGVD during the wet season and 6.50 ft-NGVD during the dry season. The canal will also receive stormwater runoff from US 27 via parallel dry retention swale treatment system. As a borrow canal, the bottom elevation will vary with quantity of material required to construct L-502A to a design height of 8.5 ft-NGVD as natural grade varies from ±8.00 ft-NGVD near I-75 to ±6.00 near C-11 Canal. The canal bottom width will be a minimum of 5 feet.

C-502B Borrow Canal (north of Krome Avenue)

The C-502B Borrow Canal consists of a new canal created by the excavation of material for L-502B Levee construction, the main purpose of the feature reach. The borrow canal is located north of FL 997 (Krome Avenue), south of C-9 Canal, abutting the southbound ROW of US 27 till curving southwestward to terminate at a designated point on Krome Avenue, and east of the L-502B Levee with a 15-foot setback from levee toe. The canal will primarily intercept seepage from WCA 3. Excess water accumulated in the borrow canal will be controlled by new S-502B Gated Culverts in the far north (north terminal end of C-502B Conveyance Canal) and existing S-30 Structure in the north, that discharges into the C-11 and C-9 Canals, respectively. As a borrow canal, the bottom elevation will vary with quantity of material required to construct L-502B to a design height of 6.5 to 7.0 ft-NGVD as natural grade varies between ±3.00 ft-NGVD and ±5.00. The canal bottom width will be a minimum of 5 feet.

C-503 Borrow Canal

The C-503 Borrow Canal consists of a new canal created by the excavation of material for L-503 Levee construction, the main purpose of the feature reach. The borrow canal is located south of C-6 Canal running ±0.35 mile from and parallel to Krome Avenue to north boundary of former camp ground, then west to Krome Avenue, staying east and north of the L-503 Levee with a 15-foot setback from levee toe. The canal will primarily intercept seepage from WCA 3. Excess water accumulated in the borrow canal above stage of 4.80 ft-NGVD will be controlled by S-516B Weir Structure that discharges into the C-6 Canal. A

stage of 5.00 ft-NGVD is maintained during non-precipitation events providing a trickle flow between 5.00 and 7.50 cfs. During storm events, the weir is designed with a capability of passing over 25 cfs with a canal stage of 5.50 ft-NGVD. As a borrow canal, the bottom elevation will vary with quantity of material required to construct L-502B to a design height of 7.25 ft-NGVD as natural grade varies between ±2.00 ft-NGVD and ±5.00. The canal bottom width will be a minimum of 5 feet.

D.5.1.2.8 **Embankments, Levees and Levee/Berms**

The WCA 3A/3B SMA project component has four levees to contain canal conveyances and excess stages within WCA 3A SMA and WCA 3B SMA: L-502A Levee, L-502B Levee (north), L-502B Levee (south, 2 levees separated by Krome Avenue), and L-503 Levee; and one flood damage reduction levee L-506C Levee. In addition to the WCA 3B SMA levees, the project includes 2 levee/berms L-502E Levee/Berm and L-502F Levee/Berm. Levees are structures that are not expected to have permanent pools on either side and do not pose a hazard to life, nor significant property loss should a breach occur. Because of the fluctuating hydroperiods within the Seepage Management Areas with indirect control of water levels, permanent pools are not expected on the interior side the majority of the time. All levees have a top width of 12 feet and grassed side slopes with a 1 on 3 slope.

L-502A Levee

The L-502A Levee provides retention of excess stages of the WCA 3A SMA wetland area and functions as a barrier to waters of different water quality, wetland versus stormwater runoff from US 27 (treated in a dry retention treatment swale system). The levee extends north from C-11 Canal to I-75 and is located west side of C-502A Borrow Canal with a 15-foot setback from canal top-of-bank. The levee design crest elevation of 8.5 ft-NGVD is below that of US-27 road grade (between ±12.00 ft-NGVD and ±13.00 ft-NGVD) over the greater part of the reach. However, the levee will be overbuilt to an elevation of 9.5 ft-NGVD to allow for settling. Therefore, the public may enjoy the recreational-type scenery of the wetlands as they drive along the divided highway. Should the borrow canal stages rise extraordinarily high (FEMA 100-year base flood is 9.0 ft-NGVD) overflow would be into the SMA versus the highway that also serves as a hurricane evacuation route. Levee overtopping will not present a hazard potential as no private property or dwellings are located in WCA 3A SMA. Levee has a crest width of 10 feet with side slopes of 1V:3H. The L-502A Levee will contain reinforced overflow sections. These reinforced overflow sections will be approximately 50 feet in length and be reinforced with TRM or other geotechnical product to provide overflow protection for the levee. Soil hardening is another alternative. The overflow section will be approximately every ½ mile. The L-502A Levee will contain six overflow sections.

L-502B Levee (North)

The L-502B Levee (north) provides retention of excess stages of the WCA 3B SMA and functions as a barrier to waters of different water quality, wetland versus stormwater runoff from US 27. The L-502B Levee (north) is constructed with borrow from excavation of the C-502B Conveyance Canal. The levee extends north from C-9 Canal to S-502B Gated Culvert 500 feet south of C-11 Canal and is located west of C-502B Canal with a 40-foot setback from canal top-of-bank. The setback dimension is designed to allow canal enlargement that is identified with the North New River Improvement project if deemed necessary in the future. The levee design crest elevation is approximately 6.50 to 7.5 feet NGVD, which is 2.0 to 3.0 feet above natural grade with a width varying less than 10 feet. Some borrow material will still be hauled to designated disposal areas temporary for other use or for permanent (design) disposal. The L-502B Levee (north) will contain reinforced overflow sections. These reinforced overflow sections will be approximately 50 feet in length and be reinforced with TRM or other geotechnical product to provide overflow protection for the levee. Soil hardening is another alternative. The overflow section will be approximately every ½ mile. The L-502B Levee (north) will contain seven overflow sections.

L-502B Levee (South)

The L-502B Levee (south) provides retention of excess stages of the WCA 3B SMA and functions as a barrier to waters of different water quality, wetland versus stormwater runoff from US 27. The levee extends from C-9 Canal south along US 27 and Krome Avenue to the L-33 Canal. The levee is located west of C-502B Borrow Canal with a 15-foot setback from canal top-of-bank. The levee design crest elevation of 6.5 ft-NGVD is below that of US-27 road grade (between ±11.00 ft-NGVD and ±12.00 ft-NGVD) over the greater part of the reach. However, the levee will be overbuilt to an elevation of 7.5 ft-NGVD to allow for settling. The public may enjoy the recreational-type scenery of the wetlands as they drive along the divided highway. Additionally, should the borrow canal stages rise extraordinarily high (FEMA 100-year base flood is 8.00 ft-NGVD), overflow would be into the SMA versus the highway that also serves as a hurricane evacuation route. Levee overtopping will not present a hazard potential as no private property or dwellings reside in WCA 3B SMA other than sites that are provided with flood damage reduction mitigating systems. Levee has a crest width of 10 feet.

The levee height as design is not expected to be overtopped as it is approximately 0.25 feet higher than the boundary bank/levee for the C-6 Canal. Should the area experience a high volume precipitation event, overflow will occur over the bank/levee with discharge into the C-6 Canal. The C-6 Canal provides overflow relief of 3B SMA to tide if necessary through project and C&SF system structures. Levee has a crest width of 10 feet. The L-502B Levee (south) levee will contain reinforced overflow sections. These reinforced overflow

sections will be approximately 50 feet in length and be reinforced with TRM or other geotechnical product to provide overflow protection for the levee. Soil hardening is another alternative. The overflow section will be approximately every ½ mile. The L-502B Levee (south) will contain two overflow sections.

L-502C Levee

The L-502C Levee is the levee forming the Holly Lakes Mobile Home Park perimeter flood damage reduction system and functions to protect the Park from elevated control stages within WCA 3B SMA. Seepage under and through the levee is collected in the C-502C Seepage Canal and pumped into C-502B Conveyance Canal for flood protection. The levee design crest elevation is 8.50 ft-NGVD, which provides 2.0 feet of levee superiority when WCA 3B SMA is at maximum control stage of 6.50 ft-NGVD. The design levee height is thought adequate as the FEMA 100-year flood is 8.00 ft-NGVD and C-502B provides overflow relief of WCA 3B SMA to tide if necessary through project and C&SF system structures.

L-503 Levee

The L-503 Levee provides retention of excess stages of the WCA 3B SMA wetland area and functions as a boundary barrier to separate existing wetlands from future areas approved for mining or areas that are expecting impact from mining in close proximity. The levee has two continuous directional reaches: (1) slants southwesterly from C-6 Canal (Miami Canal) along WPA FS proposed alignment for future NNR Deliveries and (2) east-west reach along northern boundary of former Boy Scout camp. Both reaches are located east and south of the C-503 Borrow canal with a 15-foot setback from canal top-of-bank. The levee design crest elevation of 7.25 ft-NGVD and is above that of C-6 Canal bank/levee. However, the levee will be overbuilt to an elevation of 8.25 ft-NGVD to allow for settling. Levee overtopping is not expected since design levee height is above that of C-6 Canal bank/levee, but should the event occurs, there would be no impact as no private property or dwellings reside in the area. Levee has a crest width of 10 feet. The L-503 levee will contain reinforced overflow sections. These reinforced overflow sections will be approximately 50 feet in length and be reinforced with TRM or other geotechnical product to provide overflow protection for the levee. Soil hardening is another alternative. The overflow section will be approximately every ½ mile. The L-503 levee will contain two overflow sections.

Levee/Berms

The levee/berms are low levees no more than 3 feet above an enclosed interior average natural grade to prevent the impoundment of water deep enough to pose a hazard under any meteorological event. That is, the limited storage depth on the interior will not be that that may create flooding nor a dangerous kinematic wave should a breach occur. Large precipitation events will cause ponding on both sides of the levee/berms limiting pressures on the structures, thereby

virtually eliminating the possibility of a full breach. The levee/berms may also provide an ecosystem protective berm function by the capture of and drainage prevention of rainwater that assists natural hydroperiods of the natural areas. Material for construction of these low earthen structures is expected to be a mix of degraded limestone, sands with some peat or muck. All levee/berms have a top width of 10 feet and grassed side slopes with a 1 on 4 slope (or 4H:1V).

L-502E Berm

The L-502E Berm is a scrape formed berm surrounding the formerly known Bishop/Nixon properties/tracts. The tracts contain unresolved HTRW contamination and it was decided by the SFWMD to omit these tracts from the project at this time. The berm will function by containing runoff from the site until such water is proved to have no impact to the surrounding wetlands. For this reason, the berm is to be constructed with surrounding material knowing that the berm will degrade with time. The HTRW is not considered high risk, which allows this assumption to be valid and considered sound design. The berm design crest elevation is 8.00 ft-NGVD, which provides 1.5 feet of levee superiority when WCA 3B SMA is at design wet season control stage of 6.50 ft-NGVD. The design height is also thought adequate, as the FEMA 100-year flood is approximately 8.00 ft-NGVD.

L-502F Levee/Berm

The L-502F Levee/Berm is a natural area protective levee/berm with a design crest elevation of 8.00ft-NGVD or 3.0 feet above assumed "exterior" average natural grade of 5.00ft-NGVD. The levee/berm also separates project lands from FPL lands, though FPL those lands remain as yet undeveloped and are natural wetland marsh areas in their existing state. The levee is designed for low stages in an emergent vegetation environment that will not experience waves of any practical force.

D.5.1.2.9 **Fish and Wildlife Design Features**

The WCA 3A SMA and WCA 3B SMA occupy the area identified early in CERP that will function as a natural area buffer area from urban development encroachment occurring from the east. Being nestled abutting WCA 3A and WCA 3B, the area provides spatial extent for the historic everglades ecosystem. In addition to spatial extent the project provides the following benefits as well: (1) excavation for the canals will provide fish habitat and (2) management of hydroperiods within the 3A SMA and 3B SMA should provide a better quality habitat for indigenous animals and promote population expansion.

D.5.1.2.10 **Real Estate Required and Cost for the Water Conservation Area 3A/3B Seepage Management Area**

The WCA 3A/3B SMA lies in Township 50 South, Range 39 East with portion of Sections 3, 4, 9, 10, 15, 22, 27, and 34, Township 49 South, Range 39 East, Sections 33, and 34, Township 51 South, Range 39 East, Sections 3, 10, 15, 22, 27 and 34 and in Miami-Dade, Township 52 South, Range 39 East, Sections 3, 9 and 10.

The WCA 3A/3B SMA consists of approximately 4,352.83 acres, of which approximately 851.39 acres are owned by Florida Power & Light Company (FPL), 42 acres are owned by the Florida Department of Transportation (FDOT), and 490 acres were acquired and provided by the SFWMD for the original C&SF Project for the right-of-ways for Levees L-33 and L-37, which are west of the lands owned by FPL.

For the land owned by FPL, a perpetual flowage easement will be required. For the lands owned by the FDOT, a supplemental agreement as set forth in the CERP Master Agreement will provide the Project with perpetual easements sufficient to operate and maintain the Project. For the lands owned by SFWMD and acquired for the original C&SF Project, SFWMD will provide these lands free of cost as they were acquired and provided for a prior Federal Project, the C&SF Project.

There are approximately 56.44 acres in public ownership, with approximately 42.15 acres owned by Broward County and 14.29 acres owned by the City of Pembroke Pines. These acres are existing roadways that will be abandoned and conveyed in fee to the SFWMD.

The State of Florida, Trustees of the Internal Improvement Fund owns approximately 36.94 acres which will be provided by a supplemental agreement as set forth in the CERP Master Agreement and will provide perpetual easements sufficient to operate and maintain the Project.

The remaining approximately 2,876.06 acres will require a fee estate, as set forth in ***Section D.7*** below. The required lands will not include the acquisition of 288.88 acres owned by FPL and lands in the Holly Lakes Mobile Home Park, or the 7.92-acre Bishop/Nixon parcels.

SFWMD has acquired all of the remaining approximately 2,876.06 acres. A total of 68.27 acres were acquired using State and Federal funds pursuant to the terms of a Land and Water Conservation Fund DOI-Federal Grant. The total purchase price for this 68.27 acres was $471,603 including SFWMD administrative costs of $25,042. A total of 221.86 acres were acquired using State and Federal funds pursuant to the terms of Farm Bill DOI-Federal Grant.

The total purchase price for the 221.86 acres was $5,061,470 including SFWMD administrative costs of $717,785. See ***Section D.3.2.*** An additional approximately 2,585.93 acres were acquired utilizing only State funds. For valuation of these approximately 2,585.93 acres in compliance with the CECW-SAD memorandum dated July 30, 2009 signed by the Director of Civil Works, U.S. Army Corps of Engineers the current guidance for the CERP, Land Valuation and Crediting, these lands were broken down into two categories. Lands acquired prior to April 1999 (comprised of approximately 2,431 acres) were valued at "assemblage" value in a Gross Appraisal at current market value. Lands and parcels acquired by SFWMD after April 30, 1999 totaling approximately 254.41 acres were valued as individual parcel acquisitions. Lands and parcels acquired prior to April 1999 totaling approximately 2,331.52 were valued as several aggregate parcels. There were 3 relocations with relocation payments totaling $243,813. The estimated gross real estate cost are not intended and do not reflect an estimate of the fair market value of any individual parcel of land. All estimated land costs are in fee except for the lands belonging to Florida Power & Light, the State of Florida, and FDOT. See ***Section D.7*** below. Total estimated costs for the entire approximately 4,352.83 acres which includes SFWMD's actual purchase price for lands funded by DOI Grants, the estimated value of lands acquired by SFWMD using only State funds, the estimated value of lands that have not been acquired by SFWMD, estimated costs of Utility Relocations including contingency and administrative costs, SFWMD's current administrative/incidental costs of acquisition, SFWMD's current administrative costs which were cost shared under the DOI Grants, PL91-646 costs; SFWMD's future estimated acquisition and administrative/incidental costs, future Federal administrative/incidental costs, incremental real estate costs, and contingency is estimated at $152,736,000 or $132,451,000 not including Utility Relocation costs. For more details on the Real Estate Costs for the WCA 3A/3B SMA, see ***Table D-4.***

D.5.1.3 **C-9 Impoundment**

The C-9 Impoundment feature includes approximately 1,807.39 acres of land needed for the footprint of the Project, consisting primarily of a 1,641 acre 4.3-foot deep above-ground impoundment (also defined as a reservoir) as the main element of design that carries a High Hazard Potential Classification with the remaining acres required for construction of the other features associated with the impoundment. Other design features include two pump stations (inflow and seepage), assorted gated and non-gated structures, several fixed weirs, an emergency overflow spillway, and perimeter levees and seepage control canals. Within the approximately 1,807.39 acres required for the impoundment are two existing Department of the Army 404 permitted mitigation areas. The Project contemplates the acquisition of mitigation credits from an established or future mitigation bank to offset the loss of the current DA 404 permitted mitigation areas. In the event that mitigation credits are not available at the time of design

and construction, a potential exists to construct two wetland marsh areas (Mitigation Area C with approximately 247 acres required for the interior wetland marsh area of 234 acres and Mitigation Area D with approximately 136 acres required for the interior wetland marsh area of approximately 105 acres) that when combined with C-11 Impoundment and WCA 3A/3B SMA mitigation credits offset project impacts to existing DA 404 permitted mitigation areas; however, potential HTRW on these lands would have to be remediated by the SFWMD prior to their use. This option is discussed in further detail in ***Section A.6.12, Engineering Appendix, Appendix A***. In the future, when CERP project component North Lake Belt Storage Area (NLBSA) is implemented under the current CERP plan, the C-9 Impoundment is to be converted into a Stormwater Treatment Area (STA). This will require minimal project configuration change other than relocation of proposed inflow pump station. The existing C&SF flood damage reduction system will remain operational to manage major storm events that produce more volume of water than project storage availability.

The C-9 Impoundment is located in southwestern Broward County, adjacent to and east of US 27 on the north bank of the C-9 Canal. The northern boundary of the project is approximately 10.7 miles south of the I-75/US-27 Interchange. The C-9 Canal located 1.9 miles further south makes up the southern boundary. The C-9 Canal is also approximately 0.4 miles north of the intersection of Krome Avenue and US 27. The impoundment is approximately 1.4 miles in width from east to west.

The primary purpose of the C-9 Impoundment features is to supplement C-11 Impoundment storage to reduce the pumping of untreated agricultural and urban runoff from the Western C-11 Basin into WCA 3A. Project modeling demonstrated that the combined operation of the C-9 Impoundment and C-11 Impoundment will significantly reduce pumping of runoff into WCA 3A. Another purpose of the C-9 Impoundment features is to pump and store excess stormwater runoff from the C-9 Basin when storage volume is not needed for the Western C-11 Basin. The storage pool will also assist in reducing seepage from adjacent natural areas WCA 3B and WCA 3B SMA, provide groundwater recharge, and provide benefits in meeting the agricultural, urban, and saltwater intrusion prevention water supply demands. The C-9 Impoundment may additionally provide opportunities to further reduce the extent of damages from flooding through operational changes to the C&SF Project and local drainage systems, and provide limited water quality improvements.

The project design requires use of the conveyance canals, C-502B Canal and the S-502B Gated Culvert structure to transfer water from the C-11 Impoundment to the C-9 Impoundment.

The following is a detailed list of C-9 Impoundment elements (for more details on site plans-see ***Plates G-5 and G-6, Engineering Appendix, Appendix A***):

Structures
- S-S-509 Pump Station
- S-510 Gated Culverts
- S-510A Service & Auxiliary Spillway
- S-511 Gated Culverts
- S-512A Seepage Pump Station
- S-512B CIT Weir & Flap-gated Culverts
- S-512C CIT Weir & Flap-gated Culverts

Canals
- C-509E Seepage Canal
- C-509W Seepage Canal

Levees
- D-509 Embankment

The D-509 Embankment is the perimeter embankment for the 4.3-foot storage pool.

D.5.1.3.1 **Impoundment**

The C-9 Impoundment consists primarily of 1,641 acres and is a 4.3-foot deep, above-ground impoundment that provides 7,056 acre-feet of storage. The C-9 Impoundment carries a High Hazard Potential Classification (FEMA Guidelines) impoundment justified through dam-break analyses demonstration. The impoundment area includes approximately 1,807.39 acres, 1,641 acres of which is storage with the remainder required for embankment, levees and structures.

D.5.1.3.2 **Pump Stations**

S-509 Inflow Pump Station

S-509 Pump Station has a design pumping capacity of 1,075 cfs—1,000cfs for inflow pumping and 75cfs for seepage return pumping. The pump station is located on the southern boundary of the impoundment on the C-9 Canal. The pump station is designed to capture available stormwater runoff in the C-9 Basin and diverted water from the C-11 Impoundment (Western C-11 Basin), and to return pump seepage intercepted by the C-9 Canal and C-509 perimeter seepage canal conveyed to the C-9 Canal. S-509 Pump Station has five bays that include four 250 cfs diesel engine driven pumps and one 75 cfs electric motor driven pump. All diesel pumps may be used simultaneously for maximum runoff capture or receiving diverted water from C-11 Impoundment. The 75 cfs and one 250 cfs pumps can be used to return pump seepage and maintain C-9 Canal level during non-runoff event times. For operational flexibility any combination of pumps can be used to maintain optimum canal levels.

S-512A Seepage Pump Station

S-512A Pump Station has a design pumping capacity of 225 cfs. The pump station is located on the eastern boundary of the impoundment, midway between the northern and southern boundaries. The pump station is designed to return pump seepage intercepted by the C-509 Seepage Canal eastern reach to maintain an optimal stage of 3.00 ft-NGVD.

D.5.1.3.3 **Gated Culverts and Spillways**

S-510 Gated Culverts

S-510 Gated Culverts is a double-barreled, gated culvert structure. The design flow capacity is 500 cfs with a 0.93 foot hydraulic head differential. The structure is located on the southern boundary of the impoundment in near vicinity to the S-509 pump station and discharges into the C-9 Canal. The structure controls releases from the impoundment to drawdown the storage pool, to meet water demands and/or maintain optimal canal stages. Culvert barrels are 8-foot diameter (or equivalent box culverts) and are 75 feet in length.

S-511 Gated Culverts

S-511 Gated Culverts is a double-barreled, gated culvert structure. The design flow is 500 cfs with a 0.90 foot hydraulic head differential. The structure is located in the C-9 Canal just east of the southeastern corner of the impoundment. The structure will function as a canal divide. The gate position is dependent on the feature operational mode. Scenarios given include the following: (1) when water is released from Impoundment into C-9 Canal, the gate may be opened fully or partially to move water to the east if desired, but would be closed if water was to move south by way of C-502B Canal west of US 27 through the existing S-30 Gated Culverts structure, (2) during storm runoff events, the gate may be opened fully or partially that would benefit pumping of the C-9 Basin with or without simultaneous diversion operations from the C-11 Impoundment. Additionally, the structure will include a manatee barrier to prevent manatees from migrating further west up the C-9 Canal. Culvert barrels are 8-foot diameter (or equivalent box culverts) and are 60 feet in length.

S-512B and S-512C Flap-Gated Culverts

S-512B and S-512C Flap-Gated Culverts are triple barreled, gated culvert structures. The design flow is 150 cfs with a 0.25-foot hydraulic head differential. The structures are co-located with the S-512B and S-512C Weirs, respectively, at the southwestern and southeastern corner boundaries of the impoundment in the C-509W and C-509E Seepage Canals, respectively. The structures have two functions: (1) prevent backflow up the C-509 Seepage Canal when C-11 Impoundment diversion operations are being performed and (2) provide access across the C-509 Seepage Canal to the impoundment and C-9

Levee bank road. Culvert barrels are 6-foot diameter (or equivalent box culverts) and are 40 feet in length.

D.5.1.3.4 **Weirs and other Water Control Structures**

S-510A Emergency Overflow Spillway
The S-510A Service and Auxiliary Overflow Spillway is a non-gated spillway located near the southwestern boundary and will discharge into the C-9 Canal. The spillway's purpose for a High HPC impoundment is to protect embankment integrity by prevention of hydraulic or excessive wave overtopping in case of an incalculable event, succeeding extreme storm events, or misoperation of the pump station that could place the reservoir's embankments at risk of failure. The service spillway crest is set at 8.80ft-NGVD or at the normal maximum full pool level and is 19 feet in length.

S-512B and S-512 C CIT Weir
S-512B and S-512C Weirs are non-gated broad crested weir structures. The design flow is 150 cfs with a hydraulic head of 0.70 feet. The structures are co-located with the S-512B and S-512C Flap-gated Culvert structures, respectively, at the southwestern and southeastern corner boundaries of the impoundment in the C-509E and C-509W Seepage Canals, respectively.

The S-512B structure will allow excess seepage that is discharged into the C-9 Canal to be return pumped into the impoundment with the S-509 Pump Station. The structure limits drawdown effects upstream of the weir with a control stage between 4.40 ft-NGVD and 5.10 ft-NGVD during S-509 pumping operations. The seepage canal's control stage benefits seepage reduction from the WCA 3B, WCA 3B SMA, northern boundary mitigation area and the impoundment.

The S-512C structure will provide emergency relief of excess stages in the eastern C-509 Canal reach should the S-512A Pump Station experience power outage temporarily. Separation between normal operations of the C-9 Canal and the C-509E Seepage Canals is desired to maintain the C-509E Seepage Canal at optimal stage for seepage control of the impoundment. The weir crest elevations are set at 4.05 ft-NGVD and are 90 feet in width. The weirs are corrugated in shape with 10-foot sides.

D.5.1.3.5 **Existing Features**

S-30 Gated Culverts
S-30 Gated Culvert structure is a triple-barreled structure. The structure is located on C-9 Canal and serves as a bridge for US 27. The structure is used to release excess water from the Everglades Buffer Strip (WCA 3B SMA) and on rare occasions allow excess C-9 Basin water to route as reverse flow through to C-6 Canal for flood damage reduction (via L-33 Borrow to S-32 Gated Culvert).

Under the selected plan, the structure will provide control for maintaining seasonal water levels in WCA 3B SMA and water diverted from Western C-11 Basin to C-9 Impoundment. The barrels are RCP culverts with 7-foot diameters (288 feet in length).

S-29A Gated Spillway
S-29 Gated Spillway is a four-bay spillway with a design flow of 4,780 cfs. The structure is located in the City of North Miami Beach near the mouth of the C-9 Canal and about 500 feet from the shore of Lake Maule. The structure maintains optimum water control stages upstream in C-9 Canal and is able to pass the Standard Project Flood (SPF). The optimum control stage as measured at S-29 is 2.00 ft-NGVD for normal operations to prevent coastal saltwater intrusion. The structure weir crest elevation is set at –11.00 ft-NGVD with gate dimensions of 15.0 feet high by 22.8 feet wide.

D.5.1.3.6 **Canals**

Seepage Canals
The Impoundment will include two seepage canals with one aligned along the eastern boundary, C-509E, and one aligned along the western boundary, C-509W.

C-509E Seepage Canal
The C-509E Seepage Canal is the impoundment's eastern perimeter seepage interception canal located along and parallel to the northern and eastern D-509 Embankment. The S-512A Pump Station located on C-509E return pumps excess collected seepage from this canal when canal stages are higher than 3.00ft-NGVD. The S-512C Weir and Culvert structure located on C-509E at the confluence with the C-9 Canal provides secondary control should the S-512A Pump Station experience a power outage. Should loss of power occur excess seepage will begin to overflow the S-512C Weir at stage 4.05ft-NGVD. This will prevent significant impact to developed areas to the east of the impoundment. Backflow up the seepage canals from high stages expected with floods collected in the C-9 Canal is prevented with the S-512C Flap-gated Culvert.

C-509W Seepage Canal
The C-509W Seepage Canal is the impoundment's western perimeter seepage interception canal located along and parallel to the western D-509 Embankment. This seepage canal is controlled by the S-512B Weir and Flap-gated Culvert located on C-509W at the confluence with the C-9 Canal. Backflow up the seepage canals from high stages expected with diversion of C-11 Basin water operations is prevented with the S-512B Flap-gated Culvert.

Embankments

D-509 Embankment

The D-509 Embankment is the impoundment's embankment structure that allows the normal maximum storage of water up to 4.3 feet deep safely under all design conditions. The embankment is a simple straight smooth 1-on-3 slope that is 15 feet high above the calculated average natural grade of the project area. The waterside slope is armored with a 24" thick CSA Plate from toe to crest. The crest is armored with a 12" thick CSA Plate, 14.0 feet wide. The landside of the perimeter embankment will be grassed and maintained for rainfall runoff erosion protection.

Real Estate Required and Cost for C-9 Impoundment, Mitigation Area C and Mitigation Area D

The C-9 Impoundment lies on and north of the southern border of the county. This component lies in Township 51 South, Range 39 East and includes all of Sections 26 and 35 and portions of Sections 13, 15, 22, 27, and 34. SFWMD designates this area as cells 17, 18, and parts of 19.

This component consists of approximately 1,807.39 acres within thirty (30) ownerships. SFWMD has acquired all lands required for this component. This component requires fee estate, except for the approximately 667.07 acres formerly owned by Sunset Lakes Associates, Inc., (now owned by G.L. Homes of Sunset Lakes Associates, Ltd.)., over which a perpetual flowage easement will be obtained by virtue of the requirements of a SFWMD Environmental Resource Permit and Department of the Army 404 permit, which easement will include the right to construct earthen berms and related water management facilities, as set forth in ***Section D.7*** below. There was no value for this approximately 667.07 acres as they were provided by the terms and conditions of the ERP and DA regulatory permits. There were 2 relocation benefits paid in the amount of $31,700 in the acquisition lands for the C-9 Impoundment.

A total of 1,113.01 acres were acquired using State and Federal funds pursuant to the terms of the DOI Farm Bill Federal Grant. The total purchase price of the 1,113.01 acres was $21,353,263 which includes SFWMD administrative costs for the acquisition of these lands of $515,373 and PL 91-646 costs of $31,700. A total of 10.01 acres were acquired using State and Federal funds pursuant to the terms of the DOI Land and Water Conservation Funds-DOI Federal Grant. The total purchase price of the 10.01 acres was $492,325 which includes SFWMD administrative costs for the acquisition of these lands of $31,825. See ***Section D.3.2***.

An additional 17.3 acres were acquired utilizing only State funds. In accordance with the CECW-SAD memorandum dated July 30, 2009 signed by the Director of

Civil Works, U.S. Army Corps of Engineers the current guidance for the CERP, Land Valuation and Crediting, these lands were valued in a Gross Appraisal at current fair market value as all were acquired after February 2002. The estimated value of these 17.3 acres is $2,162,500. The SFWMD's administrative/incidental costs of acquisition of these 17.3 acres are $255,818. Total estimated costs for the approximately 1,807.39 acres required for the Project which includes SFWMD's actual purchase price for DOI Grant lands, the estimated market value of lands acquired with State funds, SFWMD's current administrative/incidental costs of acquisition, SFWMD's current administrative costs which were cost shared under the DOI Grants, PL91-646 costs; SFWMD's future estimated acquisition and administrative/incidental costs, future Federal administrative/incidental costs, incremental real estate costs and contingency is $38,011,000. There are no Utility Relocation costs in the C-9 Impoundment. For more details on the Real Estate costs associated with the C-9 Impoundment, see ***Table D-5***.

D.6 UNIFORM RELOCATION ASSISTANCE ACT, PL 91-646

In accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (P.L. 91-646), relocation assistance is required to be provided to affected residents and business. The following is a breakdown of the owners or tenants and twelve businesses that qualified for relocation assistance benefits under the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (P.L. 91-646).

D.6.1 C-11 Impoundment

There were 23 relocations with relocation payments of $1,022,032. They included 11 residential, 11 nurseries and one (1) asphalt plant.

D.6.2 WCA 3A/3B SMA

There were 3 relocations required within this component with relocation payments of $243,813. All were residential relocations.

D.6.3 C-9 Impoundment

There were 2 relocations with relocation payments of $31,700 within this component. Both were residential relocations.

D.7 ANALYSIS OF ESTATES REQUIRED FOR PROJECT

The Programmatic Regulations for the CERP, 33 CFR 385, Part 385.5, require the development of Six Program-Wide Guidance Memorandum. Section 1.10.3 of the July 2007 draft Six Program-Wide Guidance Memorandum provide that an analysis to determine the estates required for implementation of a project should be determined using the following guidelines.

Estates Required for CERP Projects

For all lands determined to be required for CERP Projects, the interests required for implementation generally will be fee simple, based on assumptions that all or a significant portion of the rights in the land will be required for project purposes. Although fee acquisition should be the standard estate for CERP projects, lesser estates such as flowage or conservation easements should be considered, as appropriate, if the benefits of the project can still be achieved with the lesser estate. The PIR should provide the rationale for such lesser estates.

To verify the appropriateness of fee simple acquisition or less than fee acquisition, the PIR must include the following analysis and the conclusions must be reflected in the appropriate report sections. The level of detail required for the analysis will vary depending on the project feature involved.

Determine the Rights that Are Required to Construct and Perform Operation, Maintenance, Repair, Rehabilitation, And Replacement (OMRR&R) for the Project:

- *Identify the affirmative rights on the land that are required to implement the project.*
- *In addition to affirmative rights that may be required, identify restrictions on use (restrictive covenants) by the fee owner that are required so as not to interfere with project purposes and outputs.*
- *Identify the length of time that the affirmative rights or restrictive covenants are needed for the project.*
- *Determine whether constructed project features may need to be modified over time due to uncertainties in science, formulation, or design (adaptive management).*
- *Determine whether project land, or portions thereof, will be open for public use (either active or passive uses).*

Other Factors to be Considered:

- *Compare the cost/value of specific types of easements to fee value.*
- *Assess potential for severance damages from fee acquisition.*
- *Determine whether public owners have legal capability to convey fee.*
- *Assess stewardship/OMRR&R considerations regarding the risk and consequences of encroachment on project land by adjacent owners; the risk and consequences of violation of easement terms by fee owners; and monitoring and enforcement capabilities of Sponsor.*
- *Assess negative perception by public of private benefits or gain due to landowner reservations where easements are selected.*
- *Assess whether State Marketable Title Act requires re-recording of easement instruments.*

For the analysis, the estates for each of the three project components were determined independently utilizing not only the factors set forth above but Engineering Regulation 405-1-12, Chapter 12, paragraph 12-9 because of the nature of the components.

D.7.1 C-11 Impoundment

The C-11 Impoundment feature includes approximately 1,830.75 acres, with approximately 1,252.75 acres of storage impoundment and two wetland marsh area Mitigation Area A comprised of approximately 565 acres and Mitigation Area B comprised of approximately 13 acres of wetland marsh area. At the maximum normal pool depth of 4.3 feet the storage impoundment has 4,592 acre-feet of storage. Embankment heights are 14.5 feet above average interior grade. Additionally, the impoundment has an exterior containment levee, L-511, and a new seepage canal is included along the western and eastern boundaries.

The impoundment has been determined to be a dam with the levee on all four sides having to meet dam safety criteria. Chapter 12, paragraph 12-9 of ER 405-1-12 requires fee title for dam sites and permanent easements for flowage areas. Access to the interior of the impoundment must be restricted. The lands within the impoundment cannot have any structures of any kind and other uses would be extremely limited. All these lands required for the C-11 Impoundment consisting of approximately 1,252.75 acres are required in fee.

In addition, the C-11 Impoundment component also includes two wetland marsh areas, Mitigation Area A comprised of approximately 565 acres and Mitigation Area B comprised of approximately 13 acres of wetland marsh area. Levee/Berms, culverts, weirs and other control structures will be constructed in or around these mitigation areas. In Mitigation Area A, approximately 38.7 acres of the 565 acres will be required for the Levee/Berms, culverts, weirs and other control structures. For Mitigation Area B, approximately 3.6 acres of the 13 acres will be required for the Levee/Berms, culverts, weirs and other control structures. These lands required for the Levee/Berms, culverts, weirs and other control structures will be provided in fee.

Public Use: All recreation and public use features will be compatible with the environmental purposes of the impoundment. Public access will not be allowed for motorized vehicles such as airboats, power boats, ORVs, OHVs, and swamp buggies due to issues relating to project incompatibility and liability. Public access will be provided for bicycles, pedestrians, equestrians and non-motorized boats. The nature-based activities that will be permitted in and around the impoundment include bicycle riding, horseback riding, nature study, wildlife viewing, walking, canoeing and kayaking, and fishing. All are well-suited to the environmental purposes of this project. A parking area for visitors to the

impoundment is planned to be 90' by 200' allowing for 10 cars and 20 vehicles with trailers with a 90' turning radius for school buses which will be outside the impoundment. The final site will be chosen by the designers during the detail design phase or plans and specifications with the understanding that locating the public access site adjacent to the truck stop is not an acceptable alternative. There is also a proposed canoe launch with a platform walkway at this impoundment, an information kiosk, shaded benches, footbridges, trash barrels, protective fencing, and two vaulted toilets with solar fans. This site will provide access to the trail system and the canals. The southern boundary of the C-11 Impoundment is the C-11 Canal's northern ROW which is an existing equestrian trail and needs to be linked to the levees of the C-11 Impoundment. During design, placement of culverts in canals as land bridges or footbridges will be necessary to ensure continued east west connectivity and provide a connection from the equestrian trail to the impoundment levee. Since the levee/berms around the two mitigation areas are low level berms, they will not be used for recreation purposes.

The following analysis is on the remaining 535.7 acres required for the two mitigation areas that are not required for construction of features and is in accordance with the draft Six Program-Wide Guidance Memoranda, Section 1.10.3.

Mitigation Area A comprised of approximately 526.3 acres not required for construction of features and Mitigation Area B comprised of approximately 9.4 acres of wetland marsh area not required for construction of features. These two wetland marsh areas are to be maintained as mitigation areas to offset impacts with project implementation to existing DA 404 permitted mitigation areas. The wetland marsh areas water levels will be managed in the following manner, but will be assessed and adaptively managed after construction for optimizing project purposes, including that of wetland restoration: (1) an optimum seasonal stage up to one-foot depth will be managed for the mutual benefit of establishing a wet habitat with associated hydroperiods and project storage capability; and (2) greater depth events accounting for additional rainfall with one-foot storage will be limited to short durations of time and frequency to minimize negative impact to these maintained existing and to-be-restored natural areas. Water will not be released into Mitigation Area A wetland if water levels are at or above target depths (no capability to make releases into Mitigation Area B). Note, direct rainfall will provide the fluctuating hydroperiods; however, it must be recognized that fluctuating events without extremes is advantageous to the ecosystem's flora and fauna. This synergistic cooperation benefits the multiple objectives of CERP, primarily that of ecosystem restoration.

Affirmative Rights and Restrictions/Prohibitions Required: The affirmative rights required over the approximately 535.7 acres include the right to flow water across the lands at any time and for any period of time together with rights to conduct all monitoring activities which will require continuous access to all portions of the property; the right to clear and remove any brush, debris and natural obstructions which, in the opinion of the representative of the Grantee in charge of the Project, may be detrimental to the Project, and the right to plug and/or fill any and all existing ditches within the premises.

In addition to supplying additional storage, these two Mitigation Areas will have to be maintained as functional wetland marsh areas. In order to accomplish the maintenance of these areas as functional wetlands the following activities will have to be prohibited:

Restrictions and Prohibitions that would be required to maintain the Mitigation Areas as functional wetland areas as well as water storage areas would include:

a. Construction or placing of buildings, roads, signs, billboards or other advertising, asphalt or concrete pavement, utility poles, communications facility or tower, conduit, or any other structures of any kind or nature on or above the ground;

b. Dumping or placing of soil or other substance or material as landfill, or dumping or placing of trash, waste, or unsightly or offensive materials;

c. Removal or destruction of trees, shrubs, or other vegetation or harvesting of wood products;

d. Mining, excavation, dredging, removal or alteration of the surface of the land, including any substance that must be quarried or removed by methods that will consume or deplete the surface, including, but not limited to, the removal of topsoil, sand, gravel, rock, loam, and peat; any use or activity that causes or is likely to cause significant pollution of any surface.

e. Surface use except for purposes that permit the land or water area to remain in its natural condition;

f. Activities detrimental to flood damage reduction, water management, conservation, environmental restoration, water storage, erosion control, soil conservation, reclamation, fish and wildlife habitat preservation, and allied purposes,

g. Acts or uses detrimental to such aforementioned retention of land or water areas;

h. Planting of nuisance, exotic, or non-native plants as listed by the Exotic Pest Plant Council (EPPC), or its successor;

i. Fishing, hunting, and trapping;

j. Recreational uses, including but not limited to the use of airboats, power boats, ORVs, OHVs, and swamp buggies or non-motorized boats.

k. Any use or activity that causes or is likely to cause significant soil degradation or erosion or significant depletion or pollution of any surface or subsurface waters, including any and all agricultural activities of any kind or nature and use of the property to graze livestock of any kind.

Length of Time for Which Affirmative Rights and Restrictions/ Prohibitions are Required: The affirmative rights and restrictions/ prohibitions will be required for the life of the project or until Congress de-authorizes the project.

Need for Modification of Project Features Over Time: Each CERP Project including the Broward County Water Preserve Area project is required to assess the need for Adaptive Management. This Adaptive Management plan has been integrated and coordinated, to the extent possible, with the RECOVER Monitoring and Assessment Plan. An adaptive management plan for the project has also been developed, which is critical to defining steps that can be taken in the event that expected restoration results are not realized. This plan helps assure that anticipated project benefits will be realized.

Acquiring a "Perpetual Conservation and Flowage Easement" estate as the minimal interest required to support the lands in Mitigation Areas A and B would severely limits the utility of the remainder. The affirmative rights established by the proposed easement include the right of the government to "flow water across and over the lands at all time". The remainder, subject to such a Perpetual Conservation and Flowage Easement, would have little or no market value. This of course means that the acquisition cost for the proposed Perpetual Conservation and Flowage Easement would be essentially the same as for fee acquisition. In addition, the easement would represent a liability to the underlying property owner. This is particularly so in order to not leave owners with lands so burdened by restrictions and easements that the lands so restricted would have little or no utility or market value. There is a much higher risk of encroachments, with private owners and the burden of restrictions is greater on private owners given the nature of the existing uses. The restrictions are necessary to support project purposes and can best be enforced by obtaining fee.

Based on the preceding analysis, it has been determined that acquisition of the "fee simple" interest is required. Corps and CERP policy requires fee title where project features are to be constructed so a lesser interest cannot be recommended for those areas.

D.7.2 C-9 Impoundment

The C-9 Impoundment feature includes approximately 1,807.39 acres, consisting of a 1,641 acre 4.3-foot deep above-ground impoundment and associated

structures, including pump stations, gated spillway, gated culvert structures, fixed weir structures, service and auxiliary spillway structure, and perimeter seepage control canals along the western, northern, and eastern boundaries. At the maximum normal pool depth of 4.3 feet the impoundment has 7,056 ac-ft of storage. When CERP project component NLBSA is constructed and operational, the current CERP plan is for C-9 Impoundment to be converted into a STA. This will require minimal project configuration change other than relocation of proposed inflow pump station. The purpose of the C-9 Impoundment features is twofold: (1) pump and store excess stormwater runoff from the C-9 Basin to reduce loss of runoff to tide and (2) store diverted Western C-11 Basin runoff to prevent discharge of untreated runoff into WCA 3A by the S-9 Pump Station.

The impoundment has been determined to be a dam with the embankments and levees on all four sides having to meet dam safety criteria. Chapter 12, paragraph 12-9 of ER 405-1-12 requires fee title for dam sites and permanent easements for flowage areas. Access to the interior of the impoundment must be restricted. The lands within the impoundment cannot have any structures of any kind and other uses would be extremely limited. Leaving rights outstanding in third parties would also inhibit future operational changes in the impoundment and the other facilities associated with the Impoundment.

All these lands for construction and operation of the impoundment and associated structures are required in fee, except for the approximately 667.07 acres formerly owned by Sunset Lakes Associates, Inc. (now owned by G.L. Homes of Sunset Lakes Associates, Ltd.) over which a perpetual flowage easement which includes the right to construct earthen berms and related water management facilities). In 1998, as a condition of issuance of certain SFWMD and Department of the Army Permits, Sunset Lakes Associates executed a Declaration (Declaration) Regarding Certain Requirements of the SFWMD and a Deed of Conservation Easement over approximately 667.07 acres within the C-9 Impoundment. The Declaration in paragraph 3 provides Grant of Flowage Easement. Upon issuance of a District Permit for the Subject Property and receipt of any other permit required by the Broward County Department of Natural Resource Protection and the United States Army Corps of Engineers, Owner shall grant to the District (SFWMD), in perpetuity, a flowage easement over and across the Adjacent Property for the drainage and storage of surface waters over, across and upon the Adjacent Property (the Adjacent Property was the 658.93 acres). The Deed of Conservation Easement in paragraph 3 provides: "Notwithstanding anything else contained in this Conservation Easement, the Grantor (Sunset Lakes Associates) and the Grantee (SFWMD and Broward County) understand that the District (SFMWD) shall be entitled to use the Conservation Area for surface water flowage purposes and is subject to any applicable DNRP licensing requirements, permitted to permanently or intermittently flood all or any of the Conservation Area and to construct such

earthen berms or related water management facilities as needed to facilitate storage of surface water on the Conservation Area, all as provided in that certain Declaration Regarding Certain Requirements of the South Florida Water Management District and that certain Sunset Lakes Flowage and Storage Easement. It is further understood by all parties that the Grantor shall be under no obligation to restore, maintain or preserve the Conservation Area after the District has commenced any activities permitted pursuant to the Sunset Lakes Flowage Easement and Declaration Regarding Certain Requirements of the South Florida Water Management District." A search of the Broward County records and the SFWMD records did not produce the Sunset Lakes Flowage and Storage Easement. SFWMD has proposed contacting the Grantor to obtain the easement and provided it contains language proposed in paragraph 3 of the Deed of Conservation/Perpetual Flowage Easement, the estate should be sufficient for project purposes, if it is determined that the estate is not sufficient then SFWMD will be required to acquire the fee.

D.7.3 WCA 3A/3B Seepage Management Area

The WCA 3A/3B SMA feature footprint consists of approximately 4,352.83 acres. The WCA 3A/3B SMA is primarily a degraded wetland area also known as the Everglades Buffer Strip. The design includes a new conveyance canal with associated levee and new levees with associated borrow canal. The design includes new water control structures, two flood protection systems and access bridges. The design also includes considerations for the FPL transmission line corridor and associated access roads. For construction of the design features of the WCA 3A/B SMA, approximately 276.52 acres will be required. This land is required in fee.

For the remaining approximately 4,076.31 acres, approximately 490 acres were acquired by SFWMD and provided for the C&SF Project, a prior Federal Project. The SFWMD has fee and perpetual easements over these lands for construction and operation of L-33 and L-37 and their respective borrow canals, both constructed as part of the C&SF Project. The perpetual easements held by SFWMD are inclusive enough that the areas can be flooded and are sufficient for project purposes.

Public Use: The WCA 3A/3B SMA recreation area consists of a footbridge over the C-11 Canal that connects the north and south areas of the WCA 3A/3B SMA. The foot bridge allows people to get around the S-9 pump. Two canoe launches are proposed: one in WCA 3A SMA and one in WCA 3B SMA each accessing the existing borrow canal inside the project along the existing L-37 levee. The parking area for visitors to the seepage management recreation area is designed to be 90' by 200' allowing for 10 cars and 20 vehicle trailer with a 90' turning radius for school buses. The conceptual design proposes an information kiosk,

shaded benches, a footbridge, two canoe launches with platform walkways, two bike racks, protective fencing, signage and two vault toilets with solar fan and a 13 mile trail with an improved surface on the existing Levee L-37 which is on the west side of WCA 3A/3B SMA.

The following analysis is on the remaining approximately 3,586.31 acres required for the WCA 3A/B SMA and is in accordance with the draft Six Program-Wide Guidance Memoranda, Section 1.10.3.

The purpose of the WCA 3A/3B SMA features are to provide a system to reduce seepage losses from WCA 3 and to establish a habitat buffer between the WCA natural area and urban development occurring to the east. Seepage reduction for WCA 3 helps retain water in the natural system that has been impacted by drawdowns to meet agricultural and urban water supply demands, and prevention of saltwater intrusion into the surficial aquifer. Project modeling demonstrated that controlling higher water levels/stages seasonally in the seepage management area with associated canals reduced seepage losses from the adjacent Water Conservation Areas significantly. Also, controlling water levels seasonally create hydroperiods within the wetland area that are beneficial to improving native flora and fauna. The WCA 3A/3B SMA operates for the purpose of managing seepage loss from WCA 3A and WCA 3B, respectively. The management is conducted through creation of a step down seepage area where water levels (surface and water table) are controlled. The WCA 3A SMA will have a control water level of +7.50 ft-NGVD during the wet season and +6.50 ft-NGVD during the dry season. The WCA 3B SMA with a lower average ground elevation will have a control water level (again, surface and water table) of +6.50 ft-NGVD during the wet season and +5.50 ft-NGVD during the dry season.

Affirmative Rights and Restrictions/Prohibitions Required: The affirmative rights required over the approximately 3,586.31 acres include the right to flow water across the lands at any time and for any period of time together with rights to conduct all monitoring activities which will require continuous access to all portions of the property; the right to clear and remove any brush, debris and natural obstructions which, in the opinion of the representative of the Grantee in charge of the Project, may be detrimental to the Project, and the right to plug and/or fill any and all existing ditches within the premises.

In addition to supplying seepage management, WCA 3A/3B SMA will be maintained as functional wetland areas. In order to accomplish the maintenance of these areas as seepage management and wetlands the following activities will have to be prohibited:

Restrictions and Prohibitions that would be required to maintain the WCA 3A/3B SMA for seepage management and wetland areas as well as water storage area would include:

a. Construction or placing of buildings, roads, signs, billboards or other advertising, asphalt or concrete pavement, utility poles, communications facility or tower, conduit, or any other structures of any kind or nature on or above the ground;

b. Dumping or placing of soil or other substance or material as landfill, or dumping or placing of trash, waste, or unsightly or offensive materials;

c. Removal or destruction of trees, shrubs, or other vegetation or harvesting of wood products;

d. Mining, excavation, dredging, removal or alteration of the surface of the land, including any substance that must be quarried or removed by methods that will consume or deplete the surface, including, but not limited to, the removal of topsoil, sand, gravel, rock, loam, and peat; any use or activity that causes or is likely to cause significant pollution of any surface;

e. Surface use except for purposes that permit the land or water area to remain in its natural condition;

f. Activities detrimental to flood damage reduction, water management, conservation, environmental restoration, water storage, erosion control, soil conservation, reclamation, fish and wildlife habitat preservation, and allied purposes;

g. Acts or uses detrimental to such aforementioned retention of land or water areas;

h. Planting of nuisance, exotic, or non-native plants as listed by the Exotic Pest Plant Council (EPPC), or its successor;

i. Fishing, hunting, and trapping;

j. Recreational uses, including but not limited to the use of airboats, power boats, ORVs, OHVs, and swamp buggies or non-motorized boats; and

k. Any use or activity that causes or is likely to cause significant soil degradation or erosion or significant depletion or pollution of any surface or subsurface waters, including any and all agricultural activities of any kind or nature and use of the property to graze livestock of any kind.

Length of Time for Which Affirmative Rights and Restrictions/ Prohibitions are Required: The affirmative rights and restrictions/ prohibitions will be required for the life of the project or until Congress de-authorizes the project.

Need for Modification of Project Features Over Time: Each CERP Project including the Broward County Water Preserve Areas project is required to assess the need for Adaptive Management. This Adaptive Management plan has been integrated and coordinated, to the extent possible, with the RECOVER

Monitoring and Assessment Plan. An adaptive management plan for the project has also been developed, which is critical to defining steps that can be taken in the event that expected restoration results are not realized. This plan helps assure that anticipated project benefits will be realized.

CONCLUSION AND OWNERSHIPS:

A Gross Appraisal was completed by the Jacksonville District to determine the market value of the potential interests for the project. Among the estates reviewed was a "Perpetual Conservation and Flowage Easement" estate as the minimal interest.

The Perpetual Conservation and Flowage Easement would severely limit the utility of the remainder. The affirmative rights established by the proposed easement include the right of the government to "flow water across and over the lands at all time". The remainder, subject to such a Perpetual Conservation and Flowage Easement, would have no market value. This of course means that the acquisition cost for the proposed Perpetual Conservation and Flowage Easement would be essentially the same as for fee acquisition. In addition, the easement would represent a liability to the underlying property owner. This is particularly so in order to not leave owners with lands so burdened by restrictions and easements that the lands so restricted would have little or no utility or market value. The same consideration would be afforded to lands held by public entities, but in most cases, restrictions exist forbidding public entities from conveying a fee estate. Where fee is not absolutely required, the nature of governmental/utility ownership, as opposed to private ownership, is such that the uneconomic remnant argument holds less sway. There is also far less possibility of encroachments on lands restricted by easements when the underlying lands are held by local or state governmental entities or a public utility as opposed to a private owner. Put simply, there is a much higher risk of encroachments, with private as opposed to public owners and the burden of restrictions is greater on private than on public owners given the nature of the existing uses. The restrictions are necessary to support project purposes and can best be enforced by obtaining fee where possible and by obtaining restrictive easements from public entities or public utilities where fee acquisition would otherwise require an exchange.

Based on the preceding analysis, it has been determined that acquisition of the "fee simple" interest is required where possible. Only where legal restrictions or compelling practical matters make acquisition of fee inadvisable will a lesser interest be recommended. Corps and CERP policy requires fee title where project features are to be constructed so a lesser interest cannot be recommended for those areas. In areas where project features are not to be constructed and the land is owned by a public entity or utility and legal restrictions or practical

matters make fee acquisition impossible or impractical, lesser estates will be provided.

Approximately 851.39 acres are owned in fee or easement by FPL within the WCA 3A/3B SMA. This approximately 851.39 acres is part of a transmission line corridor over which it has been determined a perpetual flowage easement (permanent flooding) will be obtained. The issue centers on the effect occasionally raising the water level by one or two feet will have on the transmission towers; with the need to assure the towers are not damaged by the project, and that access for maintenance is maintained. Acquisition of fee title would require relocation of the entire transmission line and all power poles. The operation of the project will require the raising of approximately 30 percent of the existing power poles within the area. A perpetual flowage easement will be required as water levels in this area will be raised by eliminating the current drainage of the area and water levels will increase from zero (0) to two (2) feet above current levels for a greater duration. These changes will not prevent FPL from operating and maintaining its existing electrical transmission lines as well as constructing and operating additional electrical transmission lines that may be permitted on these lands.

For the approximately 42 acres owned by the Florida Department of Transportation (FDOT), a supplemental agreement between the SFWMD and FDOT will provide the Project with interests sufficient to operate and maintain the Project.

For the approximately 56.44 acres in public ownership, with approximately 42.15 acres owned by Broward County and the remaining approximately 14.29 acres owned by the City of Pembroke Pines, fee will be the required estate.

The State of Florida, Trustees of the Internal Improvement Fund own approximately 36.94 acres which will be provided by a supplemental agreement between the SFWMD and State as set forth in the CERP Master Agreement and will provide perpetual easements sufficient to operate and maintain the Project. The State of Florida is prohibited by State law from conveying the fee title to the SFWMD.

For the remaining approximately 2,599.54 acres, these lands will also be subject to a step down seepage area where water levels (surface and groundwater table) are controlled to an extent greater than currently exists. Thus the flood protection for these lands will not be maintained at the levels existing as of December 2000 (WRDA 2000). The WCA 3A SMA will have a control water level of +7.50 ft-NGVD during the wet season and +6.50 ft-NGVD during the dry season. The WCA 3B SMA with a lower average ground elevation will have a control water level (again, surface and water table) of +6.50 ft-NGVD during the

wet season and +5.50 ft-NGVD during the dry season. In order to maintain these water level controls. SFWMD owns all of this land which will be provided in fee.

D.8 PROPOSED ESTATES

Based on the analysis set forth in paragraph D.7 above, the following estates will be required. In accordance with Chapter 12, Engineering Regulation 405-1-12, paragraph 12-10c which states: "For all non-standard estates not within the scope of District's approval authority, approval may be obtained either by placing the body of the nonstandard estate in the REP of a feasibility report or other study decision document that is approved by HQUSACE, or by request for approval forwarded prior to use of such estate through Division to HQUSACE (ATTN: CERE-A) for appropriate coordination, review, and final determination.", approval of the non-standard estates for the Florida Power & Light lands and Sunset Lakes Associates, Ltd. lands set forth below are requested by approval of the PIR.

D.8.1 Standard Estate – Fee

The fee simple title to (the land described in _____), subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

D.8.2 Non-Standard Estate Flowage Easement (Permanent Flooding) Florida Power & Light Company Lands

The perpetual right, power, privilege and easement permanently to overflow, flood and submerge (the land described in Schedule A) (Tract No.___), (and to maintain mosquito control) in connection with the operation maintenance of the Broward County Water Preserve Area project as authorized by the Act of Congress approved _____, and the continuing right to clear and remove any brush, debris and natural obstructions which, in the opinion of the representative of the non-Federal sponsor in charge of the project, may be detrimental to the project, together with all right, title and interest in and to the timber, structures and improvements situate on the land (excepting electrical transmission lines and towers); provided that no structures for human habitation shall be constructed or maintained on the land, that no other structures shall be constructed or maintained (excepting electrical transmission lines and towers) on the land except as writing by the representative of the Non-Federal project sponsor in charge of the project, and that no excavation shall be conducted and no landfill placed on the land without such approval as to the location and method of excavation and/or placement of landfill; the above estate is taken subject to existing easements for public roads and highways, other

public utilities, railroads and pipelines; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used and enjoyed without interfering with the use of the project for the purposes authorized by Congress or abridging the rights and easement hereby acquired; provided further that any use of the land shall be subject to Federal and State laws with respect to pollution.

D.8.3 Standard Temporary Work Area Easement

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. ___ and ___), for a period not to exceed _____ years, beginning with date possession of the land is granted to the Non-Federal Sponsor, for use by the United States, its representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies), and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Central and Southern Florida, Broward County Water Preserve Areas Project, together with the right to trim, cut, fell and remove from all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

D.8.4 Temporary Access Road Easement

A temporary and assignable easement and right-of-way in, on, over, and across (the land described in Schedule A) for a period not to exceed _____, for the location, construction, operation, maintenance, alteration, replacement and use of (an) access road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove from all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B); subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

D.8.5 Non-Standard Perpetual Flowage Easement (Sunset Lakes Associates, Ltd.)

The perpetual right, power, privilege and easement permanently to overflow, flood and submerge (the land described in Schedule A) (Tract No.___), (and to construct, operate and maintain earthen berms and levees or related water management facilities as needed to facilitate storage of surface water) in

connection with the operation maintenance of the _____ project as authorized by the Act of Congress approved _____, and the continuing right to clear and remove any brush, debris and natural obstructions which, in the opinion of the representative of the non-Federal sponsor in charge of the project, may be detrimental to the project, together with all right, title and interest in and to the timber, structures and improvements situate on the land (excepting electrical transmission lines and towers); provided that no structures for human habitation shall be constructed or maintained on the land, that no other structures shall be constructed or maintained (excepting electrical transmission lines and towers) on the land except as writing by the representative of the Non-Federal project sponsor in charge of the project, and that no excavation shall be conducted and no landfill placed on the land without such approval as to the location and method of excavation and/or placement of landfill; the above estate is taken subject to existing easements for public roads and highways, other public utilities, railroads and pipelines; together with the rights to prohibit the following:

1. Commercial or industrial activities.
2. Construction of any kind, including, but not limited to, construction of dwellings, septic system, swimming pools, storage tanks, advertising structure or signs, asphalt or concrete pavement, utility poles, communications facility or tower, conduit, or utility line.
3. Dumping of refuse, wastes, sewage, or other debris;
4. Harvesting wood products,
5. Activities detrimental to flood damage reduction, water management, conservation, environmental restoration, water storage, erosion control, soil conservation, reclamation, fish and wildlife habitat preservation, and allied purposes,
6. Any mining or alteration of the surface of the land, including any substance that must be quarried or removed by methods that will consume or deplete the surface, including, but not limited to, the removal of topsoil, sand, gravel, rock, and peat. In addition, exploring for, developing, and extracting oil, gas, hydrocarbons, or petroleum products.
7. Any use or activity that causes or is likely to cause significant soil degradation or erosion or significant depletion or pollution of any surface or subsurface waters.
8. The draining, filling, or dredging of the wetland areas.
9. Prohibition of livestock
10. Prohibition of all agricultural activity,

reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used and enjoyed without interfering with the use of the project for the purposes authorized by Congress or abridging the rights and easement hereby acquired; provided further that any use of the land shall be subject to Federal and State laws with respect to pollution.

D.9 FACILITY, UTILITY RELOCATIONS

Since the BCWPA Project is located in the largely undeveloped area along the western edge of urbanized Broward and Miami-Dade Counties, the need for utility relocation has been minimized. Conflicts with existing or proposed utilities have been avoided by design modification whenever possible. The cases where utility relocation will be required include construction sites for structures and canals, as well as within areas developed for water storage. All known necessary utility relocations are listed, since accounting for the impact of any construction interference is an essential part of project planning. No additional lands are required for these relocations; utilities will be removed, raised in place, or relocated on project lands. Preliminary Attorney's Opinions of Compensability have been completed and the results of the analysis are provided below.

ANY CONCLUSION OR CATEGORIZATION CONTAINED IN THIS REAL ESTATE PLAN, OR ELSEWHERE IN THIS PROJECT REPORT, THAT AN ITEM IS A UTILITY OR FACILITY RELOCATION TO BE PERFORMED BY THE NON-FEDERAL SPONSOR AS PART OF ITS LERR RESPONSIBILITIES IS PRELIMINARY ONLY. THE GOVERNMENT WILL MAKE A FINAL DETERMINATION OF THE RELOCATIONS NECESSARY FOR THE CONSTRUCTION, OPERATION, OR MAINTENANCE OF THE PROJECT AFTER FURTHER ANALYSIS AND COMPLETION AND APPROVAL OF FINAL ATTORNEY'S OPINIONS OF COMPENSABILITY FOR EACH OF THE IMPACTED UTILITIES AND FACILITIES."

D.9.1 Florida Power & Light Company

Both high voltage transmission and consumer delivery distribution electrical lines are either close to or cross the BCWPA.

In order to construct both the C-9 and C-11 Impoundments, all the residential and commercial properties contained within the area will be acquired, the associated structures demolished, and the electrical distribution lines relocated, abandoned or salvaged. The BCWPA components that will require electrical utility relocation due to land acquisition are the C-11 Impoundment, approximately 10.0 miles of line and the C-9 Impoundment, approximately 0.5 mile of line.

Aerial electrical distribution lines along entrance of the Holly Lakes Mobile Home Park in the middle of WCA 3A/3B SMA will require relocation during canal construction. These electrical lines are owned and maintained by FPL. FPL has an easement interest over the lands, a permit from the Florida Department of Transportation, and/or a franchise agreement with Broward County or the local municipality that allows its electrical lines to be located within the road rights of way. For those areas where FPL has an easement,

these easements represent a compensable interest which will have to be extinguished upon relocation or abandonment of the lines. The compensation would be the relocation or removal of these electrical lines. For those areas where FPL has a permit to place and operate its electrical lines within the road rights of way from the Florida Department of Transportation, Broward County or the local municipality, a determination was made that a compensable interest exists and therefore FPL would be entitled to compensation for relocation. The permits were reviewed and contain the following language: "Whenever necessary for the construction, repair, improvement, maintenance, safe and efficient operation, alteration or relocation of all, or any portion of said highway as determined by the Director, Division of Maintenance, any or all of said poles, wires, pipes, cables, or other facilities and appurtenances authorized hereunder, shall be immediately removed from said highway or reset or relocated thereon as required by the Director, Division of Maintenance, and at the expense of the permittee unless reimbursement is authorized." Pursuant to FDOT's Utility Accommodation Manual which defines relocation as an adjustment of utility facilities by the highway project, FDOT would not reimburse utilities for relocations if the relocations are for the purpose of improving, repairing or maintenance of the road. However, if the purpose is not for highway or road improvements, repairs or maintenance, Florida cases have determined that the entity requiring the relocation must pay for the relocation even if it is a governmental entity. The relocation or removal of these lines is required for the construction and implementation of an impoundment or seepage management area and not for road construction. Therefore it was concluded that FPL has a compensable interest in the permitted lines as well as in the areas where it owns an easement interest.

In addition, project effects upon an electrical transmission corridor owned by FPL within WCA 3A/3B SMA are being evaluated. The issue centers on the effect that occasionally raising the water level between zero to two feet will have on the transmission towers along with the need to assure that the towers are not damaged by the project and access for maintenance is maintained. Survey data and updated modeling, to be conducted during detailed design, will be used to identify the specific towers within the 14 mile transmission line corridor and any portions of the access road that may be affected. Based on currently available information, it is estimated that up to 30% of the towers in SMA 3B may be affected by the project. Proposed solutions include elevating the access road and base areas, covering the tower bases with a protective coating, raising the towers in place, or moving the towers to new higher base pads adjacent to where they are now located. Once the potential impacts are identified during detail design, the most cost effective plan for utility protection will be executed under separate agreements between FPL and the USACE as part of the project costs. FPL owns fee to all the lands underlying the electrical transmission corridor, except for

9.53 acres owned in fee by the State over which FPL has been granted an easement, and therefore it was determined that FPL has a compensable interest.

D.9.2 Communication Lines and Towers – BellSouth/AT&T, WilTel Communications, Epik Communications, Broadwing Communications and Northstart Communications

BellSouth (now AT&T)

Relocation of telephone lines due to impoundment construction is approximately the same as described above for electrical lines, for a total of approximately 10 - 12 miles of line. These BellSouth/AT&T lines are attached to the FPL electrical lines and are permitted by FPL. BellSouth does not have a compensable interest and will be required to remove, relocate or abandon these lines when the FPL lines are removed, relocated or abandoned.

In addition to aerial lines, BellSouth has about 8.0 miles of underground fiber optic lines and one remote terminal unit within the C-11 Impoundment. BellSouth has said that these fiber optic lines will have to be rerouted, since they are an important part of its communication network. There is a second Bell South remote terminal unit on the south side of S.W. 26th Street just west of the City of Weston Public Works Facility that serves the SBA Tower Site. Since it is now located outside the perimeter levee for the impoundment, it can remain where it is.

An underground BellSouth fiber optic cable that serves the FPL Andytown Substation will need to be relocated during construction. Entry to the substation located within WCA 3B SMA requires construction of an access bridge over canal C-502B. BellSouth suggested including a protective conduit for the fiber optic cable in the bridge design. BellSouth has a major trunk route that runs along the west side Highway U.S. 27 next to the BCWPA Project. At the Johnson Street entrance to the Holly Lakes Mobile Home Park, near the middle of WCA 3B SMA, construction of a new access bridge across canal C-502B will require the relocation of the BellSouth underground fiber optic line, which enters the subdivision there.

These underground fiber optic lines are all within the existing road rights of way and are permitted by the Florida Department of Transportation, Broward County or the local municipality. For those areas where BellSouth has a permit to place and operate its electrical lines within the road rights of way from the Florida Department of Transportation, Broward County or the local municipality, a determination was made that a compensable interest exists and therefore BellSouth would be entitled to compensation for relocation. The permits were reviewed. All FDOT permits contain the following language: "Whenever necessary for the construction, repair, improvement, maintenance,

safe and efficient operation, alteration or relocation of all, or any portion of said highway as determined by the Director, Division of Maintenance, any or all of said poles, wires, pipes, cables, or other facilities and appurtenances authorized hereunder, shall be immediately removed from said highway or reset or relocated thereon as required by the Director, Division of Maintenance, and at the expense of the permittee unless reimbursement is authorized." Pursuant to FDOT's Utility Accommodation Manual which defines relocation as an adjustment of utility facilities by the highway project, FDOT would not reimburse utilities for relocations if the relocations are for the purpose of improving, repairing or maintenance of the road. However, if the purpose is not for highway or road improvements, repairs or maintenance, Florida cases have determined that the entity requiring the relocation must pay for the relocation even if it is a governmental entity. The relocation or removal of these lines is required for the construction and implementation of an impoundment or seepage management area and not for road construction. Therefore it was concluded that BellSouth has a compensable interest in the permitted lines as well as in the areas where it owns an easement interest. Permits from Broward County or the local municipalities contain language similar to that in the FDOT permits. It was the conclusion that relocation of the BellSouth fiber optics lines was not for road construction and therefore BellSouth does have a compensable interest under Florida law.

There is a major fiber optics trunk route that runs along the west side of US 27 within the FDOT ROW for U.S. 27 next to the BCWPA Project. It includes Bell South/AT&T and Level 3 Communications (which acquired the four fiber optic companies previously located within this corridor over the last six years, including WilTel Communications, Epik Communications, Broadwing Communications and Northstart Communications. In the event fiber optic lines require relocation due to project canal or culvert construction, the preferred relocation procedure involves boring a route underneath and then splicing that line back into the system.

WilTel Communications

As a result of an agreement executed with the SFWMD on December 15, 2004, the WilTel Communications fiber optic line that extended east from US 27 along SW 26th Street to its operational amplifier on the east side of the C-11 Impoundment on the SBA Communication tower site and its ampliflier facilities have been relocated to a site in Pembroke Pines outside the C-11 and C-9 Impoundment project lands. The cost of this relocation was paid for by the SFWMD pursuant to the conditions of the above agreement. Again these are permitted by FDOT and the FDOT permits contain the same language as in the FPL and BellSouth permits, and therefore it was determined that WilTel Communications had a compensable interest.

Broadwing Communications, Epik Communications, and Northstart Communications

Broadwing Communications, Epik Communications, and Northstart Communications also had major trunk routes that run alongside US 27 next to the BCWPA and have since been acquired by Level 3 Communications. All have FDOT permits containing the same language as that in the FPL and BellSouth permits issued by FDOT and therefore have a compensable interest. In the event the fiber optic lines require relocation due to project canal or culvert construction, the preferred relocation procedure involves boring a route underneath and then splicing that line back into the system.

AT&T Communications

At the Johnson Street entrance to the Holly Lakes Mobile Home Park, near the middle of WCA 3B Seepage Management Area, construction of a new access bridge across canal C-502B is proposed. AT&T cable television service enters the area at this entrance as well, suspended overhead from FPL poles. These AT&T cable television lines are connected to the FPL electrical lines and are permitted by FPL. AT&T Communications does not have a compensable interest and will be required to remove, relocate or abandon these lines when the FPL lines are removed, relocated or abandoned.

D.9.3 Water and Sewer Lines

The City of Pembroke Pines has a 24-inch water main along the entrance road to the Holly Lakes Mobile Home Park, as well as a 12-inch water main near its south end, that will require relocation due to construction of canal C-502B. The 12-inch water line may be accommodated by a surface connection above the canal.

The City of Pembroke Pines has two 10-inch wastewater pipes that enter the Holly Lakes Mobile Home Park from U.S. 27 that will require relocation due to construction of canal C-502B. These pipes are located parallel to the Johnson Street entrance, near the middle of WCA 3B SMA.

These lines are located within the right of way of the roads leading into Holly Lakes Mobile Home Park. The City of Pembroke Pines owns and maintains the road and the right of way by virtue of a dedication. It also owns, maintains and operates the underground water and sewer lines. It was determined that the City of Pembroke Pines has a compensable interest in these facilities.

D.10 TEMPORARY WORK AREAS

Lands within the Project will be used for temporary work, staging or lay down areas, as required. No additional lands outside the project footprint will be required.

D.11 INDUCED FLOODING

On December 11, 2000, WRDA 2000 was signed into law by the President of the United States (Public Law No. 106-541, of the 106th Congress). Section 601(h)(5) contains a Savings Clause that provides protection for existing legal sources of water that will be eliminated or transferred due to project implementation and no significant and adverse reduction in the level of service for flood protection that was in existence on the date of enactment and in accordance with applicable law. The Programmatic Regulations for the Everglades (33 CFR §§ 385.5 and 385.35-37) require a programmatic guidance memorandum on existing legal sources of water, and a determination of the pre-CERP baseline conditions and direction about what constitutes "levels of service for flood protection ... in accordance with applicable law" existing on date of enactment of WRDA 2000. These formal processes will involve extensive coordination with Federal, State and local agencies, the SFWMD, Tribes, stakeholders in CERP, and the public. Both of these processes also require concurrence by the Secretary of Interior and the Governor of the State of Florida. The guidance memorandum, the pre-CERP baseline, and direction about what constitutes "levels of service for flood protection" are still being developed.

To ensure the levels of service of flood protection will not be diminished by this Project, hydrologic and hydraulic analysis was performed using surface water and groundwater modeling. The results of the analysis indicate that the Project is not expected to result in increases in stages in canal systems adjacent to the Project site; however, additional analysis will be undertaken during detailed design work to further identify Project features and operations necessary to ensure that the level of service of flood protection in areas adjacent to the Project site is maintained.

Section 601(h)(5) contains a Savings Clause that provides protection for existing legal sources of water that will be eliminated or transferred due to project implementation and for no significant and adverse reduction in the level of service for flood protection that was in existence on the date of enactment and in accordance with applicable law. Section 601(h)(5) provides:

> (5) SAVINGS CLAUSE.--
> (B) MAINTENANCE OF FLOOD PROTECTION.--Implementation of the Plan shall not reduce levels of service for flood protection that are--
> (i) in existence on the date of enactment of this Act; and

(ii) in accordance with applicable law.

The purpose of the Savings Clause is to insure the levels of service for flood protection existing as of December 2000 are protected with the Project in place. The expected performance refers to the performance of the system in place as of December 2000 when modeled against the period of record. It does not refer to specific design flood targets such as the 10-year flood. The analysis for assessing the impacts to the level of service for flood protection for the C-11 Impoundment and C-9 Impoundment areas were relatively simple because both are considered dams and the areas within the impoundments will become reservoirs. The Mitigation areas (A&B in the C-11 Impoundment area) were evaluated to determine if the hydrological conditions would be modified and increased by the project operations.

Mitigation Areas A and B are two wetland marsh areas are proposed to be created and maintained as mitigation credit to offset project impacts to existing 404 permitted mitigation areas located within the C-11 and C-9 Impoundments. When both the C-11 and C-9 Impoundment reservoirs are full and storage is available within the 475-acre "Mitigation A" wetland area, water may be released into the wetland from the C-11 Impoundment (via the S-506A Gated Culvert). Releases from the Mitigation Area A wetland area will be controlled by the S-506B Culvert with Riser. The 13-acre "Mitigation B" wetland area will receive direct rainfall and indirect seepage inflows from the impoundment. Mitigation Area B excess water will be removed via overflow of the low L-513 Levee/Berm into the C-513 Seepage canal. Rainfall will contribute as well to their hydroperiods.

The water levels in the mitigation areas will be assessed and adaptively managed after construction to optimize project purposes, including wetland restoration. An optimum seasonal stage up to one-foot depth will be managed for the mutual benefit of establishing wetland habitat with associated hydroperiods and project storage capability. Greater depths due to rainfall on top of one foot of storage depth will be limited to short time duration and frequency to minimize adverse impacts. Water will not be released into the Mitigation Area A wetland area if water levels are at or above the one foot target depth (no capability to make releases into Mitigation Area B) as a result of direct rainfall.

For these mitigation areas it was determined that an interest in these lands were required.

WCA 3A/3B Seepage Management Area

The purpose of the WCA 3A/3B SMA features is to provide a system to reduce seepage losses from WCA 3 and to establish a habitat buffer between the WCA natural area and urban development occurring to the east. Seepage reduction

for WCA 3 helps retain water in the natural system that has been impacted by drawdowns to meet agricultural and urban water supply demands, and prevention of saltwater intrusion into the surficial aquifer. Project modeling demonstrated that controlling higher water levels/stages seasonally in the study area with associated canals reduced seepage losses significantly. Also, controlling water levels seasonally create hydroperiods within the wetland area that are beneficial to improving native flora and fauna.

The design includes a new conveyance canal with associated side cast levee and a new levee with borrow canals and water control structures. The design also includes considerations for mitigating flood impacts for two mobile home parks and the FPL transmission power lines and associated access road. The conveyance canal (C-502B) within WCA 3B SMA has the purpose of conveying Western C-11 Basin excess water that is diverted south to the C-9 Impoundment and in the future to the CERP component the North Lake Belt Storage Area. The canal also serves another CERP component, North New River Improvements, as a portion of a conveyance system that provides an alternate water supply delivery route from Lake Okeechobee (LOK) to Miami-Dade County and the South Dade Conveyance System in the future.

For the WCA 3A/3B Seepage Management Area, it was determined that an interest would be required because of increases in depth, duration and frequencies with which water will be held on the lands for the benefit of the project.

D.12 EXISTING FEDERAL PROJECTS

Components of the C&SF Project lie within the project area. The C&SF components include the North New River Canal, Levee 37, Canal 11, and Levee 33. SFWMD will not receive credit for any lands provided or required for the original C&SF Project.

D.13 FEDERALLY OWNED LANDS

There are no Federally-owned lands in the project area.

D.14 NAVIGATIONAL SERVITUDE AND OTHER LANDS

The navigation servitude is not applicable to the Project.

D.15 ACCESS TO PROJECT AREA

Access to the structures around WCA 3B SMA is near the I-75/I-595/US-27 interchange area. The S-502B Gated Culvert structure is accessed by going

south on US 27 about 5.9 miles from the interchange area and turning right (west) onto Griffin Road to structure. The B-500 bridge (FPL substation) is accessed from US 27 about 7.5 miles from the interchange area. The B-501 bridge (Holly Lakes Mobile Home Park) is accessed from US 27 about 9.0 miles from the interchange area. Access to S-514A Pump Station (Holly Lakes Mobile Home Park) is made by going south on US 27 about 9.0 miles from the interchange area. Access to S-516B Weir structure at the confluence of C-503 Borrow with C-6 Canal is made by going south on US 27 about 13.4 miles from the interchange area to Krome Ave., then right (west) and travel about 0.9 miles to the south west bank of the C-6 Canal. Get on and travel down (southeast) C-6 Canal levee/bank to weir.

The main access to the C-11 Impoundment is from the southwestern boundary off US 27 just south of the Seminole truck stop located at the intersection of US 27 and the C-11 Canal. Access to project site is made by driving along the C-11 levee bank road and crossing over the C-511 Seepage canal via S-505C Flap-gated Culvert structure onto embankment or to continue along the levee bank road. A public access can be made just north of same truck stop where public parking is available. An alternate access to the impoundment, top of levee, and the major structural features is from the proposed public access area in the northwestern portion of the project. This location can be reached from U.S. 27 and SW 26th Street. Access by vehicle to pump station S-503 is from the top of levee from either direction mentioned previously. Also, personnel will be able to reach the pump station by foot from Griffin Road south of C-11 Canal, by passing over the S-381 structure service bridge.

The main access to the C-9 Impoundment, top of embankment, and major structural features (i.e. S-509 inflow pump station and S-510 discharge spillway) is from the southwestern corner off of US 27 over the S-512B culvert structure, just north of the C-9 Canal along the canal's levee bank road. An alternate access to the impoundment, top of embankment, and major structural features is from the northern boundary where the S-512A seepage pump is located. This location can be reached from SW 196th Avenue off Pines Boulevard.

D.16 BORROW, STAGING AND DISPOSAL SITES

Borrow and disposal sites will be within the Project lands or on lands own by SFWMD. Staging areas are included within the requirements of lands identified as required for the components of the project.

D.17 MINERAL AND TIMBER ACTIVITIES

There are no known minerals of value in the project area.

D.18 NON-FEDERAL AUTHORITY TO PARTICIPATE IN THE PROJECT

The SFWMD was created by virtue of Florida Statutes, Chapter 373, Section .069 to further the State policy of flood damage prevention, preserve natural resources of the State including fish and wildlife and to assist in maintaining the navigability of rivers and harbors. (There are other enumerated purposes but they are not directly applicable to this Project.) The SFWMD is specifically empowered to

> *Cooperate with the United States in the manner provided by Congress for flood control, reclamation, conservation, and allied purposes in protecting the inhabitants, the land, and other property within the district from the effects of a surplus or a deficiency of water when the same may be beneficial to the public health, welfare, safety, and utility. (Section 373.103)*

To carry out the above purposes, the SFWMD is empowered to

> *...hold, control, and acquire by donation, lease, or purchase, or to condemn any land, public or private, needed for rights-of-way or other purposes, and may remove any building or other obstruction necessary for the construction, maintenance, and operation of the works; and to hold and have full control over the works and rights-of-way of the district.*

The term *works of the district* is defined by Section 373.019 to be

> *...those projects and works, including, but not limited to, structures, impoundments, wells, and other water courses, together with the appurtenant facilities and accompanying lands, which have been officially adopted by the governing board of the district as works of the district.*

Section 373.139 specifically empowers the SFWMD

> *...to acquire fee title to real property and easements therein by purchase, gift, devise, lease, eminent domain, or otherwise for flood control, water storage, water management, and preservation of wetlands, streams and lakes, except that eminent domain powers which may be used only for acquiring real property for flood control and water storage.*

and

> *FLORIDA STATUTES*
> *TITLE XXVIII. NATURAL RESOURCES; CONSERVATION, RECLAMATION, AND USE*
> *CHAPTER 373. WATER RESOURCES*
> *PART I. STATE WATER RESOURCE PLAN*

373.1501. South Florida Water Management District as local sponsor

(1) As used in this section and s. 373.026(8), the term:

(b) "Department" means the Department of Environmental Protection.

(c) "District" means the South Florida Water Management District.

(f) "Project" means the Central and Southern Florida Project.

(g) "Project Component" means any structural or operational change, resulting from the restudy, to the Central and Southern Florida Project as it existed and was operated as of January 1, 1999.

(h) "Restudy" means the Comprehensive Review Study of the Central and Southern Florida Project, for which federal participation was authorized by the federal Water Resources Development Acts of 1992 and 1996 together with related Congressional resolutions and for which participation by the South Florida Water Management District is authorized by this section. The term includes all actions undertaken pursuant to the aforementioned authorizations which will result in recommendations for modifications or additions to the Central and Southern Florida Project.

(2) The Legislature finds that the restudy is important for restoring the Everglades ecosystem and sustaining the environment, economy, and social well- being of South Florida. It is the intent of the Legislature to facilitate and support the restudy through a process concurrent with Federal Government review and Congressional authorization. Nothing in this section is intended in any way to limit federal agencies or Congress in the exercise of their duties and responsibilities. It is further the intent of the Legislature that all project components be implemented through the appropriate processes of this chapter and be consistent with the balanced policies and purposes of this chapter, specifically s. 373.016.

(4) The district is authorized to act as local sponsor of the project for those project features within the district as provided in this subsection and subject to the oversight of the department as further provided in s. 373.026. The district may:

(a) Act as local sponsor for all project features previously authorized by Congress;

(b) Continue data gathering, analysis, research, and design of project components, participate in preconstruction engineering and design documents for project components, and further refine the Comprehensive Plan of the restudy as a guide and framework for identifying other project components;

(c) Construct pilot projects that will assist in determining the feasibility of technology included in the Comprehensive Plan of the restudy; and

(d) Act as local sponsor for project components.

(5) In its role as local sponsor for the project, the district shall comply with its responsibilities under this chapter and implement project components

through appropriate provisions of this chapter. In the development of project components, the district shall:

(a) Analyze and evaluate all needs to be met in a comprehensive manner and consider all applicable water resource issues, including water supply, water quality, flood protection, threatened and endangered species, and other natural system and habitat needs;

(b) Determine with reasonable certainty that all project components are feasible based upon standard engineering practices and technologies and are the most efficient and cost-effective of feasible alternatives or combination of alternatives, consistent with restudy purposes, implementation of project components, and operation of the project;

(c) Determine with reasonable certainty that all project components are consistent with applicable law and regulations, and can be permitted and operated as proposed. For purposes of such determination:

1. The district shall convene a preapplication conference with all state and federal agencies with applicable regulatory jurisdiction;

2. State agencies with applicable regulatory jurisdiction shall participate in the preapplication conference and provide information necessary for the district's determination; and

3. The district shall request that federal agencies with applicable regulatory jurisdiction participate in the preapplication conference and provide information necessary for the district's determination;

(d) Consistent with this chapter, the purposes for the restudy provided in the Water Resources Development Act of 1996, and other applicable federal law, provide reasonable assurances that the quantity of water available to existing legal users shall not be diminished by implementation of project components so as to adversely impact existing legal users, that existing levels of service for flood protection will not be diminished outside the geographic area of the project component, and that water management practices will continue to adapt to meet the needs of the restored natural environment.

(e) Ensure that implementation of project components is coordinated with existing utilities and public infrastructure and that impacts to and relocation of existing utility or public infrastructure are minimized.

(6) The department and the district shall expeditiously pursue implementation of project modifications previously authorized by Congress or the Legislature, including the Everglades Construction Project. Project components should complement and should not delay project modifications previously authorized.

(7) Notwithstanding any provision of this section, nothing herein shall be construed to modify or supplant the authority of the district or the

department to prevent harm to the water resources as provided in this chapter.
(8) Final agency action with regard to any project component subject to s. 373.026(8)(b) shall be taken by the department. Actions taken by the district pursuant to subsection (5) shall not be considered final agency action. Any petition for formal proceedings filed pursuant to ss. 120.569 and 120.57 shall require a hearing under the summary hearing provisions of s. 120.574, which shall be mandatory. The final hearing under this section shall be held within 30 days after receipt of the petition by the Division of Administrative Hearings.

D.19 ZONING ORDINANCES

Investigation indicates that no enactments of zoning ordinances are proposed in lieu of, or to facilitate, acquisition in connection with the Project.

D.20 ACQUISITION SCHEDULES

The SFWMD already owns nearly all the lands required for construction of the Project. Acquiring fee/easements is the responsibility of the SFWMD. The SFWMD anticipates having all lands available by construction.

D.21 HAZARDOUS TOXIC OR RADIOLOCICAL WASTE (HTRW)/ RESIDUAL AGRICULTURAL CHEMICALS

HAZARDOUS TOXIC OR RADIOLOCICAL WASTE (HTRW)

A review of the HTRW database indicates that there are several solid waste landfills and other waste disposal sites, including potential HTRW disposal sites, located within and in the vicinity of project lands. The 7.92-acre Bishop/Nixon parcel located within the WCA 3A/3B SMA component was identified as a potential HTRW disposal site that necessitated additional environmental assessment. A previous Phase I/II Environmental Assessment addressing the subject parcels was completed in November 2002. This investigation was conducted on the periphery of the subject area. In order to refine the potential liability associated with acquiring/excluding the subject properties, a Phase III Environmental Assessment was conducted in November 2003. Based on the Phase III Assessment report, the results of soil sampling indicated detections of various compounds, including metals, pesticides and petroleum constituents. The analytical data indicates that exceedances of the Soil Cleanup Target Levels (SCTLs) were noted in all soil borings and solid waste was detected in every soil boring installed. The soil impacts are directly attributed to the illicit land filling activities. Groundwater sampling results also indicated positive detections of various compounds. Multiple exceedances of Groundwater Concentration Target Levels (GCTLs) for ammonia, lead, bis(2-ethylhexyl), phtalate, chloroform and

benzene were identified. The groundwater impacts are also attributed to the land filling activities. These chemical analyses suggest that there may be an issue associated with the high levels of ammonia detected in the groundwater and the surface soils. Ammonia within the groundwater of the Bishop/Nixon property may pose some risks to aquatic life if the property was converted into a water retention reservoir and the water seeps into the reservoir at rate such that less than a 10-fold dilution (per NOAA 1999) is achieved. In addition, there exists the potential for ammonia and other toxic substances to migrate from the landfill into a water retention reservoir installed in the vicinity of the property.

In an effort to reduce the risks associated with the presence of the landfill, a berm will be constructed around the site excluding it from the WCA 3B SMA. The L-502E Berm is a scrape formed berm surrounding Bishop/Nixon properties/tracts. The berm will function by containing runoff from the site until such water is proved to have no impact to the surrounding wetlands. SFWMD would construct a buffer area surrounding the landfill area with the installation of constructed wetland within the buffer. Construction of the berm, buffer area and wetland would be a 100% non-Federal cost.

HTRW sites east of project lands are not expected to adversely affect project implementation, as the surface and groundwater flow gradients are eastward, away from project lands. Surface and groundwater will be monitored as part of project operations to ensure that HTRW materials in the vicinity of the project lands are not adversely affecting the attainment of project goals and objectives.

RESIDUAL AGRICULTURAL CHEMICALS

The USACE HTRW policy (ER 1165-2-132) directs that Construction of Civil Works projects in HTRW-contaminated areas should be avoided where practicable. In September 2011, the ASA(CW) provided an exception to this HTRW policy for CERP Projects (Memorandum for Deputy Commanding General for Civil and Emergency Operations, Subject: Comprehensive Everglades Restoration Plan (CERP) – Residual Agricultural Chemicals, Dated September 14, 2011). A copy of this policy is included in **Appendix A, Part 2, Section A.19.** If specific criteria are met, this policy memorandum allows residual agrichemicals to remain on project lands and allows the USACE to integrate response actions directly into the construction plan. At the request of the SFWMD, Section 7.11 of this PIR has been included in the BCWPA PIR to comply with the ASA(CW) policy. A copy of the letter from the SFWMD requesting application of the policy is included in **Appendix A, Part 2, Section A.19.** This section sometimes refers to soils containing agricultural chemicals as "impacted soils."

Selenium is the only residual agricultural chemical of concern within the footprint the BCWPA C-9 and C-11 features. Selenium is of particular interest

since it presents a potential ecological risk to USFWS trust species when tainted soils are hydrated. Assessments have also concluded that the 5,500 acre WCA 3A/3B SMA is free from selenium and poses no risk to USFWS trust species. A component specific assessment of project lands where residual agricultural chemicals appear to be present as a result of legal application is provided in the Preliminary Soil Management Plan, **Appendix A, Section A.19.**

As of October 2011, multiple environmental assessments have been completed. As requested by USFWS, SFWMD has secured funding to complete additional sampling and characterization of soils/sediments, including toxicity testing for FY 12, within the areas of ecological concern proposed by the USFWS. This study will help USFWS determine if any and to what extent, corrective action may be needed to alleviate ecological risk concerns regarding selenium impacted soils. Once all of the environmental audits have been completed, the SFWMD will again initiate coordination with the FDEP which is the delegated RCRA authority for Florida to determine what response actions, if any, are outstanding. The SFWMD and FDEP will consult with the USFWS to ensure that the final project design protects USFWS Trust Species protected under the Endangered Species Act and the Migratory Bird Treaty Act. If outstanding non-RCRA response actions are warranted, the SFWMD may enter into an "Agreement for Specified Remediation" (ASR) or similar type agreement with the FDEP that lays out the steps necessary to ensure that the final project design meets ecological protection standards. Written documentation of all regulatory coordination will be provided to HQUSACE for review prior to project construction.

The USACE will address risks during design and construction of the project components by: 1) Regulatory review of plans and specifications by the FDEP which is the delegated RCRA authority in Florida; 2) Review of environmental audits and environmental risk assessments by the USFWS for potential impacts to Threatened and Endangered Species; 3) Incorporation of appropriate safety and handling specifications into the project bid documents; 4) Review of plans and specifications by the USACE Environmental and Munitions Center for Expertise (EM CX) prior to contract advertisement; 5) Conducting appropriate supervision and oversight of construction; 6) Conducting confirmation sampling after feature construction, and 7) SFWMD's obtaining final approval of construction actions by FDEP. These safeguards further reduce the risk of future releases or exposure and are consistent with USACE construction standards and requirements.

As stated in the guidance, the NFS is responsible for any future costs associated with the presence of residual agricultural chemicals remaining on Federal project lands, including any potential liability related to their

presence. Regardless of the constructing agency, the SFWMD will be financially responsible for correcting any portion of a constructed feature that fails to meet a specification for maximum total constituent concentration or leachate concentration as required in the relevant FDEP approved soil management plan.

Consistent with the September 14, 2011 Memorandum from Ms. Jo-Ellen Darcy, Assistant Secretary of the Army (Civil Works), SFWMD, the NFS, will be 100% responsible for the costs of all actions taken due to the presence of residual agricultural chemicals, at no expense to the Federal Government and any future costs associated with the presence of residual agricultural chemicals at the Federal project site are 100% a SFWMD cost and responsibility. As stated in the September 14, 2011 Memorandum, normal project engineering and construction activities will remain part of total project cost, provided that these are the same activities required to implement the project features absent the presence of residual agricultural chemicals. More specifically:

- SFWMD will ensure the development, planning and execution of Federal, state, and/or locally required response actions to address residual agricultural chemicals, including any soil management activities, at 100% SFWMD cost.
- SFWMD is 100% responsible for costs of characterization of the project lands necessary to determine an appropriate response action for the residual agricultural chemicals.
- Removal of soils that are RCRA hazardous waste are a 100% SFWMD responsibility.
- SFWMD is 100% responsible for the costs of characterizing the project lands in preparation for conducting a response action for removal of soils that are identified as hazardous waste.
- SFWMD will regularly update the District Commander regarding its progress in developing and ensuring execution of the required response actions.
- SFWMD agrees that any future costs associated with the presence of residual agricultural chemicals remaining on Federal project lands are 100% SFWMD responsibility, including any potential liability related to their presence. This includes responsibility for any disposal units.
- SFWMD acknowledges that the Jacksonville District will not conduct actions to address residual agricultural chemicals during the operation, maintenance, repair, replacement and rehabilitation phase of the project.

D.22 PROJECT SUPPORT

There is no known or anticipated opposition to the project by landowners in the project area or any known or anticipated landowner concerns related issues that could impact the acquisition process.

D.23 MITIGATION

The selected plan includes replacement compensation for impacted Department of the Army 404 mitigation sites, which will be provided within the C-11 Impoundments through incorporation of fish and wildlife enhancement features. Details of the mitigation are provided in ***Section 7.1.3.3*** in the main report.

D.24 CERTIFICATION AND CREDITING FOR ACTUAL AND INCIDENTAL COSTS ACQUIRED UNDER THE DEPARTMENT OF INTERIOR GRANTS

Pursuant to the terms and conditions of the DOI Grant Agreements, SFWMD submitted and DOI reviewed and approved the actual acquisition costs and SFWMD's administrative/incidental costs, (excluding SFWMD's staff costs) in the C-11 Impoundment for the acquisition of 932.32 acres in the amount of $59,529,769. In the WCA 3A/3B SMA, DOI reviewed and approved the actual acquisition costs and SFWMD's administrative/incidental costs, (excluding SFWMD's staff costs) for the acquisition of 290.13 acres in the amount of $5,533,073. In the C-9 Impoundment, DOI reviewed and approved the actual acquisition costs and SFWMD's administrative/incidental costs, (excluding SFWMD's staff costs) for the acquisition of 1,123.02 acres in the amount of $21,813,888.

The total of $86,876,730 was cost shared equally between the federal funds and SFWMD funds provided pursuant to the DOI Grant Agreements. The Jacksonville District proposes that since DOI has reviewed and approved these costs that the Corps would accept these approved costs without a further detailed review. The review would consist of only insuring the amounts credited to each party pursuant to the accounting of DOI and the SFWMD .The sum of $43,438,365 shall be credited to the Federal share and the sum of $43,438,365 shall be credited to the SFWMD share of total project costs. This would prevent the review of the same information by two Federal Agencies and would be consistent with the terms of the Framework Agreement, which provides: "Section 390 funds disbursed for the acquisition of real property or the construction of features shall count as Federal funds for cost sharing purposes for Army projects. Funds provided by the non-Federal parties to match Federal funds provided under Section 390 will be treated as non-Federal funds for cost-sharing purposes for Army projects. The value of real estate acquired pursuant to this Article shall be the acquisition cost of such real property for credit

purposes under applicable cost-sharing principles." This proposal would also reduce future administrative costs.

These amounts may be increased or decreased based on a more detailed analysis during the review process after approval of the Project, execution of a Project Cooperation Agreement and certification of the land.

D.25 BASELINE COST ESTIMATES AND MCACES COST ESTIMATES

Real estate cost estimates are based on either (1) the actual SFWMD acquisition costs and actual administrative costs provided by SFWMD and approved by the DOI or on estimated acquisition and administrative costs. For lands owned by the SFWMD or by the State of Florida and not acquired pursuant to the DOI Grants, market value was used in accordance with the CECW-SAD memorandum dated July 30, 2009 signed by the Director of Civil Works, U.S. Army Corps of Engineers SUBJECT: CERP, Land Valuation and Crediting.

Table D-1 provides the MCACES Cost Estimate for Real Estate Costs for the entire BCWPA Project, including the C-11 Impoundment, the WCA 3A/3B SMA and the C-9 Impoundment.

Table D-2 provides the Baseline Cost Estimate for Real Estate Costs for the entire BCWPA Project, including the C-11 Impoundment, the WCA 3A/3B SMA and the C-9 Impoundment.

Table D-3 provides the MCACES Cost Estimate for Real Estate Costs for the C-11 Impoundment,

Table D-4 provides the MCACES Cost Estimate for Real Estate Costs for the WCA 3A/3B SMA.

Table D-5 provides the MCACES Cost Estimate for Real Estate Costs for the C-9 Impoundment.

The baseline cost estimate is generated based on a gross appraisal performed by CESAJ and verified through USACE South Atlantic Division (CESAD) and Headquarters, USACE.

Draft EC405-1-04 Chapter 4, APPRAISAL, dated October 2008, paragraph 4-21 Gross Appraisals provides as follows:

> *d. Incremental Real Estate Costs. Formerly categorized as "contingencies," these elements of real estate costs must be anticipated and must be supported by narrative discussion. Incremental costs represent anticipated*

costs above the estimated market value of the tracts themselves (but not the administrative acquisition costs). Incremental cost estimates are intended to take into account the reliability of the data available, the type and scope of the project and the real estate involved.

APPENDIX 4-C of Draft EC405-1-04 Chapter 4, APPRAISAL, paragraph 17. provides as follows:

17. INCREMENTAL REAL ESTATE COSTS: These are added costs that were formerly captured as contingencies. Incremental item costs should be evaluated and explained. Appraisers may consider lumping these cost estimates together depending on the level of study detail. However, having them as separate items may foster better understanding and easier revisions to future study effort on this same project. Incremental costs include (but are not limited to) the following:

a. Potential uneconomic remnants: $xxxx

b. Unknowns for level of study definition: $xxxx (The lower the level of mapping and project clarity the higher this incremental element should be.)

c. Unforeseen aspects due to inaccessibility: $xxxx

d. Cost / value increases from potential development pressures and/or zoning changes: $xxxx

e. Negotiation latitude above estimated market value: $xxxx

f. Potential for excessive condemnation costs/awards: $xxxx

g. Potential for unknown natural resources or minerals: $xxxx

h. Other incremental costs (please identify): $xxxx

C-11 IMPOUNDMENT

For the C-11 Impoundment, only 706.65 acres valued in the Gross Appraisal in C-11 Impoundment, 115.04 acres are publicly owned lands (53.71 owned by FDEP-Indian Trace Community; 15.69 acres owned by Indian Trace Community and 44.92 owned by Broward County). The public owned lands are all existing roads within the footprint of the C-11 Impoundment. The remaining 591.61 acres are owned by the SFWMD and were acquired after April 1999 and would be valued as of date of certification. An Incremental Real Estate Cost analysis was prepared with the Incremental Real Estate costs for the C-11 Impoundment calculated at $14,955,664. The following items were considered in the C-11 Impoundment Incremental Real Estate Cost analysis.

a. Potential uneconomic remnants: For the lands owned by Broward County and Indian Trace Community, it is unlikely that there would be any uneconomic

remnants. SFWMD has acquired lands that will be outside the footprint of the project but there should be no uneconomic remnants. **$0**

b. Unknowns for level of study definition: The footprint of the C-11 Impoundment is defined; however, it is still subject to change during PED. Additional modeling may show areas hydrologically impacted by the Project outside the footprint of the project estimates are approximately 50 acres; this is covered in the Cost Risk Analysis for this potential change in boundary. **$0**

c. Unforeseen aspects due to inaccessibility: Access to the C-11 Impoundment should not be an issue as it is adjacent to U.S. highway 27. **$0**

d. Cost/value increases from potential development pressures and/or zoning changes: C-11 Impoundment zoning and land use designations allow for low density residential and agricultural uses. The allowed densities range from one unit per two acres to one unit per five acres. The permitted agricultural uses would include nurseries, sod farms, groves, produce farms and other similar type uses. In the foreseeable future it is unlikely that zoning and land use would change. The market for new housing and residential land has continued to deteriorate over the last two years. There is an oversupply of housing product that has never been sold, much of it never completed. Foreclosures are at unprecedented levels as home owners default and lenders take the units back. As evidenced by the lack of recent sales data there is little demand for residential land at this time. Absent demand for new housing and residential land, the obvious conclusion of highest and best use for the subject properties is to hold until economic conditions strengthen to the point that new residential development is feasible. Nurseries or other similar agricultural uses could be interim uses until such time that development is feasible. **$0**

e. Negotiation latitude above estimated market value: There are only 115.04 acres are publicly owned lands (53.71 owned by FDEP-Indian Trace Community; 15.69 acres owned by Indian Trace Community and 44.92 owned by Broward County), an incremental real estate cost of 25% is applied for negotiation latitude. **$4,314,000**

f. Potential for excessive condemnation costs/awards: While it is unlikely that condemnation would be necessary to acquire the lands owned by Indian Trace and Broward County, there is still that potential. An additional 1% was place on the potential for condemnation costs and awards. **$172,560**

g. Potential for unknown natural resources or minerals: Outstanding mineral interest should have been acquired during the land acquisition; however, there still exists the possibility that the mineral ownership was not extinguished. The

1% contingency is applied to those lands not acquired and to those lands acquired by SFWMD. **$1,594,954**

h. Other incremental costs: the reliability of the data available and potential valuation variance. Since incremental real estate cost were already discussed above for the lands currently owned by Indian Trace Community and Broward County, the following discussion is limited only to those lands owned by SFWMD which are comprised of 591.61 acres. Because market conditions have changed dramatically in the last two years, it was difficult to estimate a time adjustment as there have been no recent sales of similar properties in this area. However, it is clear that land prices in general have come down substantially from their peak in 2006. Based on the variation in per acre values a 10% incremental real estate cost was applied to these costs. **$8,874,150**

WCA 3A/3B SEEPAGE MANAGEMENT AREA

For the WCA3A/3B Seepage Management Area, 2,679.31 acres were valued in the Gross Appraisal, with 56.44 acres being publicly owned lands and consisting of 4 parcels; 36.94 acres owned by the State of Florida; 254.41 acres owned by the SFWMD and acquired after April 1999 and were therefore valued as individual parcels within 32 parcels. The remaining 2,331.52 acres are owned by the SFWMD and acquired prior to April 1999 and were valued as several assembled parcels. An Incremental Real Estate Cost analysis was prepared with the Incremental Real Estate costs for the WCA 3A/3B SMA calculated at $11,767242. The following items were considered in the WCA 3A/3B SMA Incremental Real Estate Cost analysis

a. Potential uneconomic remnants: For all the lands within the WCA 3A/3B SMA, it is unlikely that there would be any uneconomic remnants. SFWMD will acquire the entire parcels. **$0**

b. Unknowns for level of study definition: The footprint of the WCA 3A/3B Seepage Management Area is defined; however, it is still subject to change during PED. Therefore a slight incremental real estate cost is added for this potential change in boundary. **$0**

c. Unforeseen aspects due to inaccessibility: Access to the WCA 3A/3B SMA should not be an issue as it is adjacent to U.S. highway 27. **$0**

d. Cost/value increases from potential development pressures and/or zoning changes: WCA 3A/3B SMA zoning and land use designations allow for low density residential and agricultural uses. The allowed densities range from one unit per two acres to one unit per five acres. The permitted agricultural uses would include nurseries, sod farms, groves, produce farms and other similar type

uses. In the foreseeable future it is unlikely that zoning and land use would change. The market for new housing and residential land has continued to deteriorate over the last two years. There is an oversupply of housing product that has never been sold, much of it never completed. Foreclosures are at unprecedented levels as home owners default and lenders take the units back. As evidenced by the lack of recent sales data there is little demand for residential land at this time. Absent demand for new housing and residential land, the obvious conclusion of highest and best use for the subject properties is to hold until economic conditions strengthen to the point that new residential development is feasible. Nurseries or other similar agricultural uses could be interim uses until such time that development is feasible. **$0**

e. Negotiation latitude above estimated market value: There are only 36.94 acres which are state owned. An incremental real estate cost of 25% was applied for negotiation latitude. **$184,700**

f. Potential for excessive condemnation costs/awards: It is extreme likely that any lands which are publicly owned would have to be condemned. **$0**

g. Potential for unknown natural resources or minerals: Outstanding mineral interest should have been acquired during the land acquisition; however, there still exists the possibility that the mineral ownership was not extinguished. 1% **$1,113,297**

h. Other incremental costs: the reliability of the data available and potential valuation variance. Since incremental real estate cost were already discussed above for the privately owned lands, an incremental cost was added to those lands owned by SFWMD which are comprised of 300.26 acres acquired after April 1999 and valued as individual parcels and the remaining 2,331.52 acres were acquired prior to April 1999. **$10,469,245**

C-9 IMPOUNDMENT

For the C-9 Impoundment, only 17.3 acres were valued in the C-9 Impoundment with all being owned by the SFWMD and being acquired after April 1999. In accordance with draft EC405-1-04 Chapter 4, APPRAISAL, dated October 2008, paragraph 4-21 Gross Appraisals, an Incremental Real Estate Cost table was prepared with the Incremental Real Estate costs for the C-9 Impoundment calculated at **$4,225,715**. The following items were considered in the C-11 Impoundment Incremental Real Estate Cost analysis.

a. Potential uneconomic remnants: For the lands owned by SFWMD there should be no uneconomic remnants. **$0**

b. Unknowns for level of study definition: The footprint of the C-9 Impoundment is defined; however, it is still subject to change during PED. This was covered in the Real Estate Risk Analysis. **$0**

c. Unforeseen aspects due to inaccessibility: Access to the C-9 Impoundment should not be an issue as it is adjacent to U.S. highway 27. **$0**

d. Cost/value increases from potential development pressures and/or zoning changes: C-9 Impoundment zoning and land use designations allow for low density residential and agricultural uses. The allowed densities range from one unit per two acres to one unit per five acres. The permitted agricultural uses would include nurseries, sod farms, groves, produce farms and other similar type uses. In the foreseeable future it is unlikely that zoning and land use would change. The market for new housing and residential land has continued to deteriorate over the last two years. There is an oversupply of housing product that has never been sold, much of it never completed. Foreclosures are at unprecedented levels as home owners default and lenders take the units back. As evidenced by the lack of recent sales data there is little demand for residential land at this time. Absent demand for new housing and residential land, the obvious conclusion of highest and best use for the subject properties is to hold until economic conditions strengthen to the point that new residential development is feasible. Nurseries or other similar agricultural uses could be interim uses until such time that development is feasible. **$0**

f. Potential for excessive condemnation costs/awards: Since SFWMD owns all 17.30 acres; there is no known potential for condemnation costs and awards. **$0**

g. Potential for unknown natural resources or minerals: Outstanding mineral interest should have been acquired during the land acquisition; however, there still exists the possibility that the mineral ownership was not extinguished. **$213,290**

h. Other incremental costs: (1) the reliability of the data available and potential valuation variance. For the lands owned by SFWMD, which are comprised of 17.30 acres and because market conditions have changed dramatically in the last two years, it was difficult to estimate a time adjustment as there have been no recent sales of similar properties in this area. However, it is clear that land prices in general have come down substantially from their peak in 2006. Because of the variation in per acre values a 10% incremental real estate cost was applied. **$216,250**

h. Other incremental costs: (2) Because of selenium on lands required for replacement of existing DA 404 permitted mitigation lands within the C-9 Impoundment, the PDT determined that the alternative of acquisition of

mitigation credits from a mitigation bank was the best alternative at an estimated cost of $5,535,000. However the PDT also recognized that mitigation credits may not be available at the time of construction and that the use of the 383 acres contaminated with selenium may be the only option to provide the mitigation required. These lands were part of the DOI funded lands at an actual acquisition of $9,331,175. Taking into account, the estimated $5,535,000 for the mitigation credits and subtracting it from the $9,331,175 (actual acquisition cost of the approximately 383 acres of land) leaves an incremental cost of **$3,796,175**.

Engineering Regulation 1110-2-1302, paragraph 20.a states that: "cost risk analysis is the process of identifying and measuring the cost impact of project uncertainties of the estimated Total Project Cost (TPC). It shall be accomplished as a joint analysis between the cost engineer and the designers or appropriate PDT members that have specific knowledge and expertise on all possible project risks." The Engineering Regulation defines TPC as "all Federal and authorized non-Federal costs represented by the Civil Works Work Breakdown Structure features and respective estimates and schedules, including the lands and damages, relocations, project construction costs..."

As mandated in the 19 September 2007 memorandum, Subject: Initiatives to Improve Accuracy of Total Project Costs in Civil Works Feasibility Studies Requiring Congressional Authorization, NWW will direct the Agency Technical Review (ATR) "of cost estimates, construction schedules, and contingencies included in all decision documents requiring Congressional authorization."

A Cost and Schedule Risk Analysis was completed by the Jacksonville District in February 2012. The Jacksonville District vetted the CSRA through the ATR process and NWW approved the contingencies. The report, located in Appendix C of the PIR, describes the methodology, process, key assumptions, and limitations of the risk analysis. It also explains the results, major findings, observations, and recommendations of the risk analysis.

Based on the CSRA a contingency was recommended and only applied on the amount of $39,380,445. The total contingency for the Real Estate was calculated at $15,082,710. This number was derived as follows: A contingency of 38.3% was applied on the amount of $24,190,560 in the C-11 Impoundment for a total contingency of $9,264,984. A contingency of 38.3% was applied on the amount of $5,249,170 in the WCA3A/3B SMA for a total contingency of $2,010,432. A contingency of 38.3% was applied on the amount of $9,940,715 in the C-9 Impoundment for a total contingency of $3,807,294.

Included in the Real Estate Baseline and MCACES cost estimates below are Utility/Facility Relocation costs of $20,829,000 which includes costs for

relocations and contingencies in the C-11 Impoundment of $324,000 and the WCA 3A/3B SMA of $20,505,000.

The total real estate costs including the Utility/Facility Relocation costs for the BCWPA Project is **$401,221,000 (rounded)**. The total real estate costs, (without Utility/Facility Relocation costs), for the BCWPA Project are **$380,633,000 (rounded).**

TABLE D-1: MCACES COST ESTIMATE FOR BCWPA PROJECT

PROJECT: BROWARD COUNTY WATER PRESERVE AREA - COMBINED				
LANDS AND DAMAGES:			DATE: **FEBRUARY 2012**	
ESTATE	**ACRES**	**LAND COST**	**FEDERAL**	**SFWMD**
FEE-GRANT FEDERAL COST SHARED-ACQUIRED-DOI FARM BILL	1989.49	$49,855,665	$24,927,833	$24,927,833
FEE-GRANT FEDERAL COST SHARED-ACQUIRED-DOI LWCF	355.98	$29,699,211	$14,849,606	$14,849,606
FEE-STATE FUNDED ONLY ACQUIRED AFTER APRIL 1999	863.32	$113,933,250		$113,933,250
FEE-STATE FUNDED ONLY ACQUIRED PRIOR TO APRIL 1999	2331.52	$81,603,200		$81,603,200
FEE-STATE FUNDED NOT ACQUIRED	115.04	$17,256,000		$17,256,000
SA-STATE	36.94	$1,847,000		$1,847,000
FEE-PUBLIC	56.44	$0		$0
FEE- MITIGATION LANDS	191.78	$0		$0
FLOWAGE EASEMENT FPL	851.39	$0		$0
PERPETUAL EASEMENT-MITIGATION LANDS BY PERMIT	667.07	$0		$0
SA FDOT	42.00	$0		$0
OTHER	490.00	$0		
MITIGATION BANK CREDITS		$5,535,000		$5,535,000
SUBTOTAL	7,990.97	$299,789,326	$39,777,438	$260,011,888
IMPROVEMENTS-COST SHARED	1	$7,500	$3,750	$3,750
IMPROVEMENTS-STATE	3	$383,489		$383,489
SEVERANCE:		$0		
MINERALS		$0		
TOTAL LANDS AND DAMAGES		**$300,180,316**	$39,781,188	$260,399,127
UTILITY RELOCATION		$11,179,000	$0	$11,179,000
CONTINGENCY		$9,409,000	$0	$9,409,000
ADMINISTRATION		$241,000	$26,000	$215,000
ACQ/ADMIN				
FED FUTURE		$1,578,000	$1,578,000	
NON-FED FUTURE		$4,010,000		$4,010,000
NON-FED PRIOR STATE		$19,972,747		$19,972,747
NON-FED FARM BILL COST SHARED		$2,860,451	$1,430,226	$1,430,226
NON-FED LWCF COST SHARED		$4,461,403	$2,230,702	$2,230,702
PL 91-646 COST SHARED		$1,053,732	$526,866	$526,866
PL 91-646 STATE		$243,813		$243,813
SUBTOTAL		$355,189,462	$45,572,981	$309,616,071
INCREMENTAL REAL ESTATE COST		$30,948,821	$123,750	$30,825,071
CONTINGENCY		$15,082,710	$614,332	$14,468,378
TOTAL ESTIMATED RE COST		$401,220,993	$46,311,063	$354,909,930
TOTAL ESTIMATED RE COSTS RD)		**$401,221,000**	**$46,311,000**	**$354,910,000**

TABLE D-2: BASELINE COST ESTIMATE FOR BCWPA PROJECT

ESTIMATED PROJECT REAL ESTATE COSTS			DATE: **FEBRUARY 2012**	
PROJECT: BROWARD COUNTY WATER PRESERVE COMBINED				
1	LANDS AND DAMAGES		FEDERAL	SFWMD
01AA	PROJECT PLANNING	$240,000	$240,000	
01B--	ACQUISITIONS			
01B20	BY LOCAL SPONSOR (LS)-FUTURE	$1,030,000		$1,030,000
	BY LOCAL SPONSOR (LS)-PRIOR	$19,972,747		$19,972,747
	BY LOCAL SPONSOR (LS)-FARM BILL DOI GRANTS	$2,860,451	$1,430,226	$1,430,226
	BY LOCAL SPONSOR (LS)-LWCF DOI GRANTS	$4,461,403	$2,230,702	$2,230,702
01B40	REVIEW OF LS	$372,000	$372,000	
01C--	CONDEMNATIONS			
01C20	BY LS	$0		
01C40	REVIEW OF LS	$0		
01E--	APPRAISALS			
1.00E+30	BY LS-FUTURE	$2,980,000		$2,980,000
1.00E+50	REVIEW OF LS	$920,000	$920,000	
01F--	PL 91-646 ASSISTANCE			
01F20	BY LS	$0		
01F40	REVIEW OF LS	$25,000	$25,000	
01G--	TEMPORARY PERMITS /LICENCES/RIGHTS-OF-ENTRY			
01G20	BY LS	$0		$0
01G40	REVIEW OF LS	$11,000	$11,000	
01G60	DAMAGE CLAIMS	$0		
01M00	PROJECTED RELATED ADMINISTRATION			
	REAL ESTATE REVIEW OF PCA	$10,000	$10,000	
01N00	UTILITY RELOCATION	$11,179,000		$11,179,000
	CONTINGENCY	$9,409,000		$9,409,000
2100	ADMINISTRATION	$241,000	$26,000	$215,000
01R--	REAL ESTATE PAYMENTS			
01R1	LAND PAYMENTS			
01R1B	BY LS-STATE	$215,082,939		$215,082,939
	BY LS-MITIGATION BANK CREDITS	$5,535,000		$5,535,000
	BY LS-FARM BILL	$49,863,165	$24,931,583	$24,931,583
	BY LS-LWCF	$29,699,211	$14,849,606	$14,849,606
01R2	PL 91-646 ASSISTANCE PAYMENTS			
01R2B	BY LS-STATE	$243,813		$243,813
	BY LS-DOI GRANTS	$1,053,732	$526,866	$526,866
TOTAL REAL ESTATE COST W/O CONTINGENCY		$355,189,162	$45,572,981	$309,616,480
INCREMENTAL REAL ESTATE COST		$30,948,821	$123,750	$30,825,071
REAL ESTATE CONTINGENCY		$15,082,710	$614,332	$14,468,378
TOTAL PROJECT REAL ESTATE COST		$401,220,993	$46,311,063	$354,909,930
TOTAL PROJECT REAL ESTATE COST (RD)		**$401,221,000**	**$46,311,000**	**$354,910,000**

D.26 MCACES COST ESTIMATES

TABLE D-3: MCACES COST ESTIMATE FOR C-11 IMPOUNDMENT

PROJECT: C-11 IMPOUNDMENT					**DATE: FEBRUARY 2012**	
LANDS AND DAMAGES:						
ESTATE	PARCELS	**ACRES**	**LAND COST**		**FEDERAL**	**SFWMD**
FEE						
FEE-FEDERAL COST SHARED- DOI FARM BILL	28	654.62	$24,705,790		$12,352,895	$12,352,895
FEE-FEDERAL COST SHARED- DOI LWCF BILL	7	277.70	$28,792,150		$14,396,075	$14,396,075
FEE-STATE FUNDED ONLY	34	591.61	$88,741,500			$88,741,500
FEE-STATE FUNDED NOT ACQUIRED	7	115.04	$17,256,000	*		$17,256,000
FEE- MITIGATION LANDS	4	191.78	$0			
SUBTOTAL	**80.00**	**1830.75**	**$159,495,440**		**$26,748,970**	**$132,746,470**
		NUMBER				
IMPROVEMENTS-FEDERAL COST SHARED-		1	$7,500		$3,750	$3,750
IMPROVEMENTS-STATE FUNDED ONLY		3	$383,489			$383,489
SEVERANCE:		0	$0			
MINERALS			$0			
TOTAL LANDS AND DAMAGES (RD)			$159,886,429		$26,752,720	$133,133,709
UTILITY RELOCATIONS			$256,000			$256,000
CONTINGENCY			$47,000			$47,000
ADMINISTRATION			$21,000	*	$6,000	$15,000
ACQ/ADMIN						
FED FUTURE			$495,000	*	$495,000	
NON-FED FUTURE			$1,935,000	*		$1,935,000
NON-FED PRIOR STATE			$16,558,547			$16,558,547
NON-FED FARM BILL COST SHARED			$1,627,293		$813,647	$813,647
NON-FED LWCF DOI COST SHARED			$4,404,536		$2,202,268	$2,202,268
PL 91-646						
NON-FED PRIOR FEDERAL COST SHARED			$1,022,032		$511,016	$511,016
SUBTOTAL			$186,252,837		$30,780,651	$155,472,187
INCREMENTAL REAL ESTATE COST			$14,955,864		$123,750	$14,832,114
CONTINGENCY 38.3% on $24,190,560*			$9,264,984		$191,883	$9,073,101
TOTAL ESTIMATED RE COSTS			**$210,473,685**		$31,096,284	$179,377,402
TOTAL ESTIMATED RE COSTS (ROUNDED)			**$210,473,000**		**$31,096,000**	**$179,377,000**

TABLE D-4: MCACES COST ESTIMATE FOR WCA 3A/3B SEEPAGE MANAGEMENT AREA

PROJECT: WCA3A/3B SEEPAGE MANAGEMENT					DATE: **FEBRAURY 2012**	
LANDS AND DAMAGES:						
ESTATE	**PARCELS**	**ACRES**	**LAND COST**		**FEDERAL**	**SFWMD**
FEE-GRANT FEDERAL COST SHARED-ACQUIRED-DOI FARM BILL	22	221.86	$4,343,685		$2,171,843	$2,171,843
FEE-GRANT FEDERAL COST SHARED-ACQUIRED-DOI LWCF	8	68.27	$446,561		$223,281	$223,281
FEE-STATE FUNDED ONLY ACQUIRED AFTER APRIL 1999	32	254.41	$23,089,250			$23,089,250
FEE-STATE FUNDED ONLY ACQUIRED PRIOR TO APRIL 1999	157	2331.52	$81,603,200			$81,603,200
SA-STATE	2	36.94	$1,847,000	*		$1,847,000
FEE-PUBLIC	4	56.44	$0			$0
FLOWAGE EASEMENT FPL	39	851.39	$0			$0
OTHER FDOT	2	42.00	$0			$0
OTHER	1	490.00	$0			
SUBTOTAL	267	4352.83	$111,329,696			
IMPROVEMENTS		0	$0			
SEVERANCE:						
MINERALS			$0			
TOTAL LANDS AND DAMAGES			$111,329,696		$2,395,123	$108,934,573
UTILITY RELOCATION			$10,923,000			$10,923,000
CONTINGENCY			$9,362,000			$$9,362,000
ADMINISTRATION			$220,000	*	$20,000	$200,000
ACQ/ADMIN						
FED FUTURE			$994,000	*	$994,000	
NON-FED FUTURE			$1,985,000	*		$1,985,000
NON-FED PRIOR STATE			$3,158,382			$3,158,382
NON-FED FARM BILL COST SHARED			$717,785		$358,893	$358,893
NON-FED LWCF DOI COST SHARED			$25,042		$12,521	$12,521
PL 91-646			$243,813			$243,813
SUBTOTAL			$138,958,718		$3,780,537	$135,178,182
INCREMENTAL REAL ESTATE COSTS			$11,767,242		$0	$11,767,242
CONTINGENCY 38.3% ON $5,249,170*			$2,010,432		$388,362	$1,622,070
TOTAL ESTIMATED RE COSTS			$152,736,392		$4,168,899	$148,567,494
TOTAL ESTIMATED RE COST (RD)			**$152,736,000**		**$4,169,000**	**$148,567,000**

TABLE D-5: MCACES COST ESTIMATE FOR C-9 IMPOUNDMENT

PROJECT: C-9 IMPOUNDMENT					DATE: **February 2012**	
LANDS AND DAMAGES:						
ESTATE	PARCELS	ACRES	LAND COST		FEDERAL	NON-FEDERAL
FEE						
FEE-FEDERAL STATE COST SHARED ACQUIRED- DOI FARM BILL	23	1113.01	$20,806,190		$10,403,095	$10,403,095
FEE-FEDERAL STATE COST SHARED ACQUIRED-DOI LWCF	1	10.01	$460,500		$230,250	$230,250
FEE-STATE FUNDED ONLY	3	17.3	$2,162,500	*		$2,162,500
PERPETUAL EASEMENT-MITIGATION LANDS BY PERMIT	2	667.07	$0			
MITIGATION BANK CREDITS			$5,535,000	*		$5,535,000
SUBTOTAL	30	1807.39	$28,964,190'			
IMPROVEMENTS		0	$0			
SEVERANCE:						
		0	$0			
SUBTOTAL		0	$0			
MINERALS						
TOTAL LANDS AND DAMAGES (RD)			**$28,984,190**		$10,633,345	$18,330,845
ACQ/ADMIN						
FED FUTURE			$89,000	*	$89,000	
NON-FED FUTURE			$90,000	*		$90,000
NON-FED PRIOR STATE			$255,818			$255,818
NON-FED FARM BILL COST SHARED			$515,373		$257,687	$257,687
NON-FED LWCF COST SHARED			$31,825		$15,912	$15,912
PL 91-646			$31,700		$15,850	$15,850
SUBTOTAL			$29,977,906		$11,011,794	$18,966,112
INCREMENTAL REAL ESTATE COST			$4,225,715		$0	$4,225,715
CONTINGENCY 38.3% ON $9,940,715			$3,807,294		$34,087	$3,773,207
TOTAL ESTIMATED RE COST			$38,010,915		$11,045,881	$26,965,034
TOTAL ESTIMATED RE COSTS ROUNDED			**$38,011,000**		**$11,046,000**	**$26,965,000**

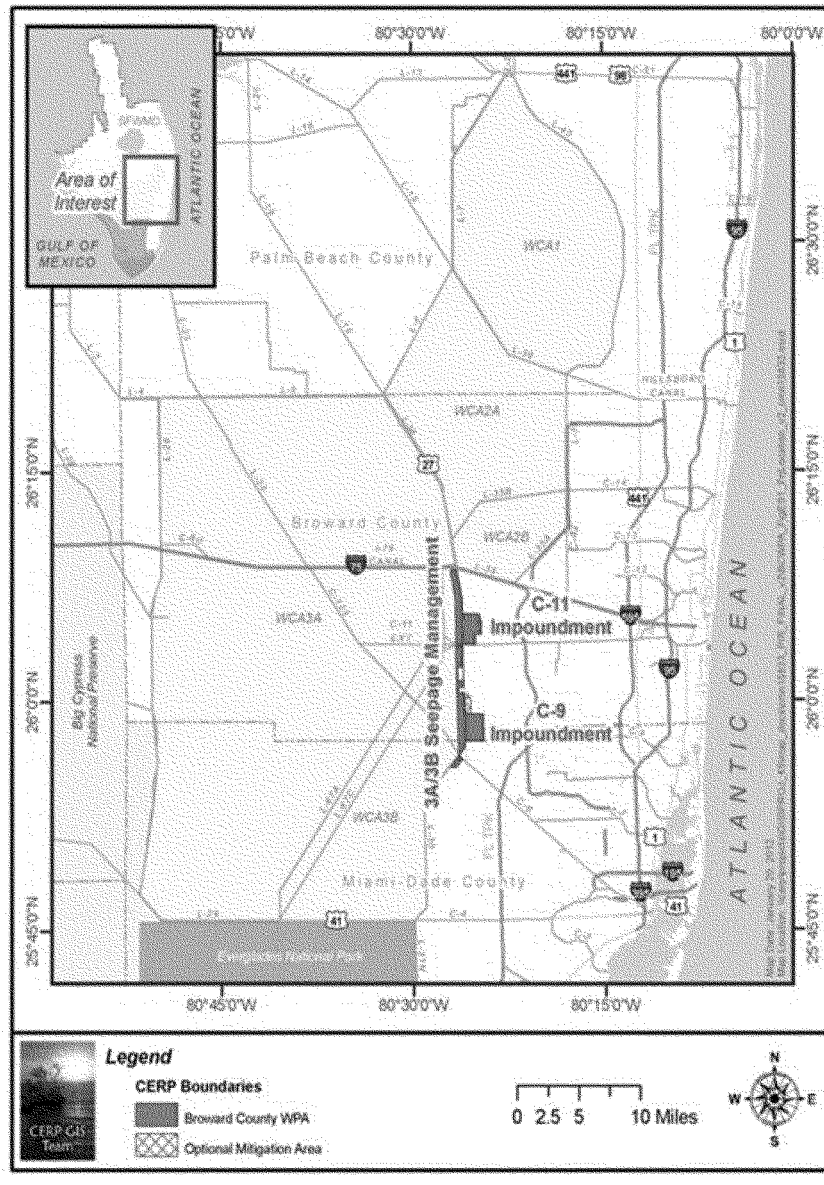

FIGURE D-1: PROJECT LOCATION MAP

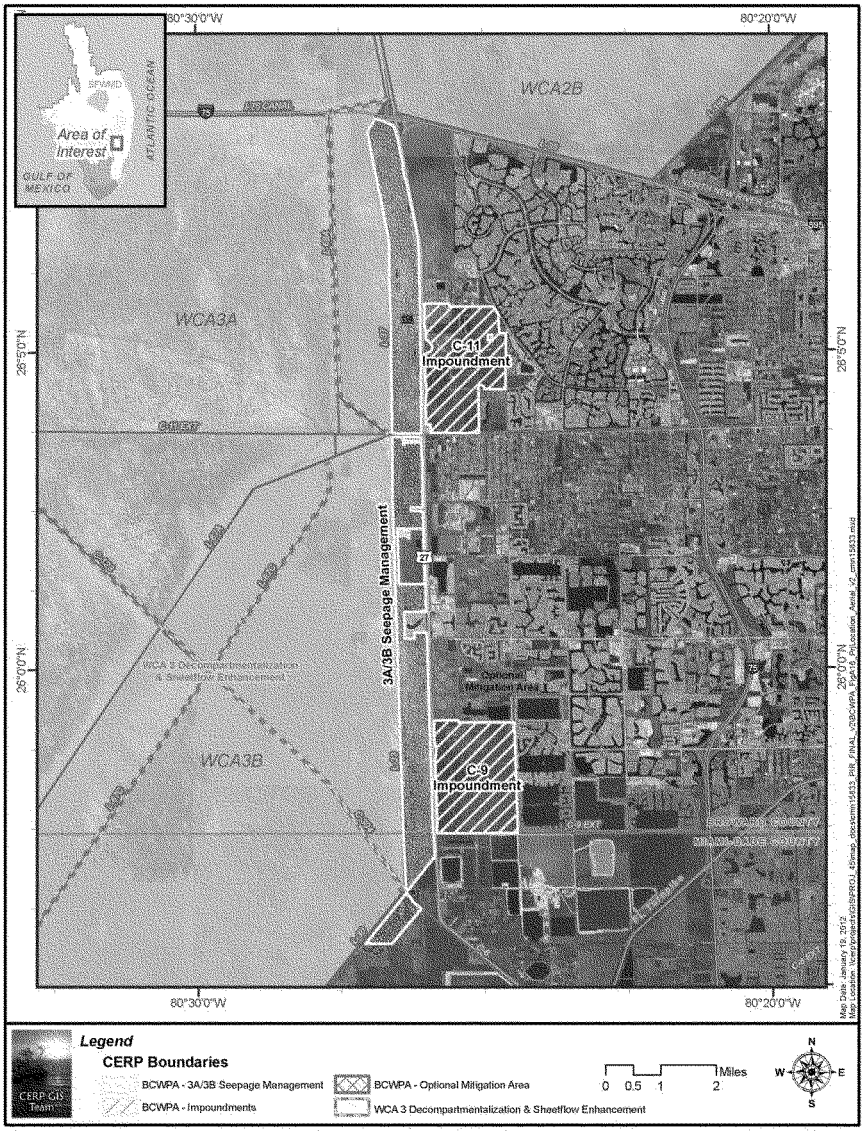

FIGURE D-2: THE SELECTED PLAN

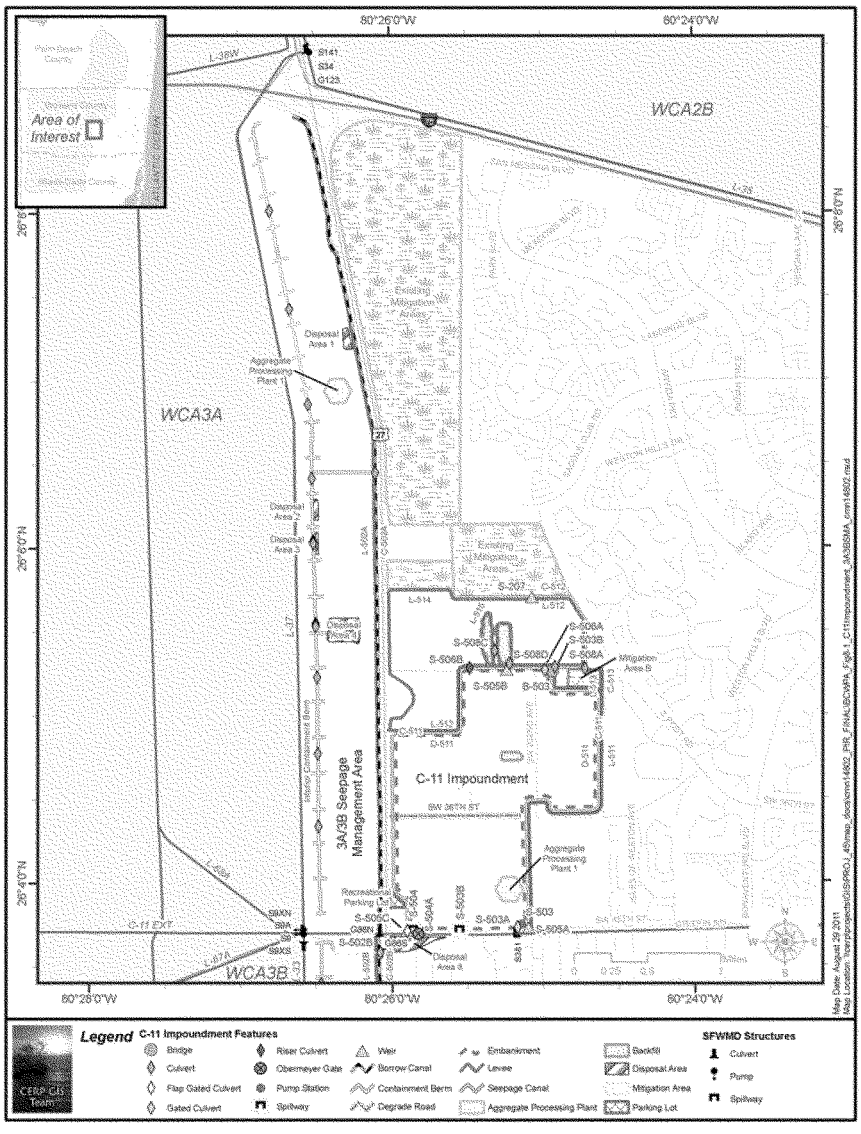

FIGURE D-3: C-11 IMPOUNDMENT AND WCA 3A/3B SMA

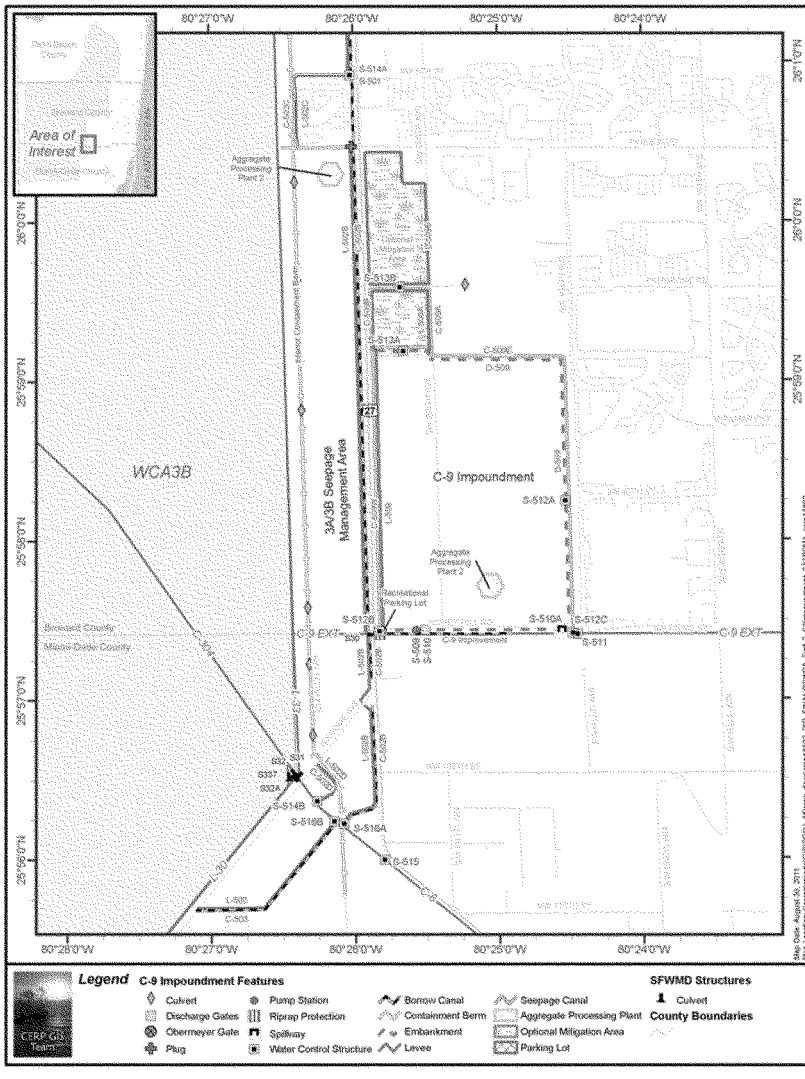

FIGURE D-4: C-9 IMPOUNDMENT AND WCA 3A/3B SMA

APPENDIX E

AGENCY AND PUBLIC COORDINATION

TABLE OF CONTENTS

E.0 AGENCY/PUBLIC COORDINATION E-1
E.1 PUBLIC INVOLVEMENT PROGRAM E-1
E.2 SCOPING for the BROWARD COUNTY WPA PROJECT E-1
E.3 OTHER REQUIRED COORDINATION E-1
E.3.1 U.S. Fish and Wildlife Service (USFWS) E-1
E.3.2 National Marine Fisheries Service (NMFS) E-2
E.3.3 Florida Fish and Wildlife Conservation Commission (FWC) E-2
E.3.4 Florida State Historic Officer E-2
E.4 ENVIRONMENTAL JUSTICE E-3
E.5 REVIEW OF THE PIR/EIS E-3
E.5.1 Comments Received and Responses E-3

E.0 AGENCY/PUBLIC COORDINATION

Public Outreach efforts for the Water Preserve Areas (WPA) began early in the reconnaissance phase of the Central and Southern Florida (C&SF) Project Comprehensive Review Study (Restudy). Due to the intense public, political, and media interest in restoration of the south Florida ecosystem, public participation has been a critical component of the development of this Project Implementation Report (PIR).

E.1 PUBLIC INVOLVEMENT PROGRAM

Public involvement is a process by which interested and affected individuals, organizations, agencies, and governmental entities are consulted and participate in the decision-making process. Public involvement in the BCWPA Project has two main functions: to inform the public about what the project team is planning and to generate input on key issues and concerns critical to resolving the challenges involved in the planning effort.

E.2 SCOPING FOR THE BROWARD COUNTY WATER PRESERVE AREAS PROJECT

A Notice of Intent (NOI) to produce an integrated BCWPA Draft Project Implementation Report and Environmental Impact Statement (PIR/EIS) was published in the Federal Register on July 30, 2004. A Scoping Letter asking for agency and public comment on the proposed BCWPA Draft PIR was sent out on September 18, 2004.

E.3 OTHER REQUIRED COORDINATION

In addition to the scoping required by the National Environmental Policy Act, coordination required by other Federal laws and regulations has been conducted with the following agencies:

E.3.1 U.S. Fish and Wildlife Service (USFWS)

Three Planning Aid Letters, dated September 30, 2003, March 31, 2004, and July 26, 2004 were received from the USFWS as part of the process for developing alternative plans. A draft Fish and Wildlife Coordination Act (FWCA) report was issued on July 1, 2005 and a final FWCA report was issued on June 9, 2006. A supplemental letter of transmittal for the final FWCA report was issued on December 4, 2006 which addresses the refinements in the project design. These letters and reports can be reviewed in ***Annex A***. This information

has been incorporated by the project team into the BCWPA PIR plan formulation process. The USFWS is a member of the project team.

Additionally, the BCWPA Project has been determined to be compliant with Section 7 of the Endangered Species Act. The U.S. Army Corps of Engineers (USACE) determined the BCWPA Project may affect, but is not likely to adversely affect the eastern indigo snake, wood stork, Everglade snail kite, bald eagle, West Indian manatee or the Florida panther. The Draft PIR/EIS served as the endangered species Biological Assessment. The USFWS concurred with the USACE's effect determination in letters dated April 7, 2006, and May 9, 2006. These letters are included in ***Annex A***.

E.3.2 National Marine Fisheries Service (NMFS)

Public law 104-208 reflects the Secretary of Commerce and Fishery Management Council authority and responsibilities for the protection of Essential Fish Habitat (EFH). Federal agencies that fund, permit, or carry out activities that may adversely impact EFH are required to consult with the NMFS regarding potential effects of their actions on EFH and federally managed fisheries. The USACE has determined the BCWPA Project would not adversely impact EFH or federally managed species and is therefore satisfied that the consultation procedures to implement the EFH provision of the Magnuson-Stevens Act have been met.

E.3.3 Florida Fish and Wildlife Conservation Commission (FWC)

Two Planning Aid Letters dated July 14, 2004 and January 20, 2005 have been received from the FWC and are included in ***Annex A***. This information has been used by the project team in the BCWPA PIR plan formulation process. The FWC is a member of the project team.

E.3.4 Florida State Historic Officer

Coordination has been ongoing with the State Historic Preservation Officer (SHPO) in accordance with the procedure of the Advisory Council on Historic Preservation. Three cultural resources sites have been identified within the C-11 Impoundment area. These sites are known to contain human remains and have been determined to be eligible for inclusion to the National Register of Historic Places. Affects to two of the sites will be avoided by redesign of the project. One site will be adversely affected by the project. The USACE, South Florida Water Management District (SFWMD), and the SHPO are developing a Memorandum of Agreement (MOA) to identify measures needed to mitigate the adverse affects to this site. Once the MOA is approved and signed by all parties

construction can commence. Further consultation with the SHPO, Native American Tribes and other interested parties will continue as the project proceeds towards more detailed design and construction.

E.4 ENVIRONMENTAL JUSTICE

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires the Federal government to achieve environmental justice by identifying and addressing disproportionately high adverse effects of its activities on minority and low-income populations. It requires the analysis of information such as the race, national origin, and income level for areas expected to be impacted by environmental actions. It also requires Federal agencies to identify the need to ensure the protection of populations relying on subsistence consumption of fish and wildlife, through analysis of information on such consumption patterns and communication to the public of associated risk. Refer to ***Section 6.9*** for further details on Environmental Justice.

E.5 REVIEW OF THE PIR/EIS

A Notice of Availability of the 2005 Draft PIR/EIS was published in the Federal Register on March 17, 2006 and of the 2007 Final PIR/EIS on May 4, 2007. The 2006 Draft PIR/EIS and 2007 Final PIR/EIS were sent to numerous local, State and Federal agencies, private interest groups, and interested public for review and comment in accordance with the Council on Environmental Quality's NEPA regulations and related USACE guidance. Public libraries in the project area were provided copies to maintain in the reference section of the libraries for public review. The documents were also posted on www.evergladesplan.org for web viewing. Comments received during the reviews were considered in preparing the final study documents.

E.5.1 Comments Received and Responses

Several comments were received in response to the 2006 Draft PIR/EIS and 2007 Final PIR/EIS. Matrices of the comments and responses, as well as copies of the correspondence, are provided in ***Annex B***.

APPENDIX F

ECONOMIC AND SOCIAL CONSIDERATIONS

TABLE OF CONTENTS

F.0 Economic and Social Considerations F-1
F.1 Socio-Economics F-1
F.1.1 Introduction F-1
F.1.2 Purpose of this Investigation F-1
F.1.3 Methodology F-2
F.1.4 Prior Studies F-6
F.1.5 Organization of Appendix F-6
F.2 Population and Economy F-6
F.2.1 Overview F-6
F.2.2 Study Area F-7
F.2.3 General F-17
F.2.4 Population F-17
F.2.5 Economy F-22
F.3 Municipal and Industrial Water Demand F-26
F.3.1 Overview F-26
F.3.2 Broward County Water Demand F-27
F.3.3 Agricultural Water Use F-31
F.3.4 Impacts of Selected Alternatives F-32
F.4 Flood Damage Reduction Impacts of Selected Alternatives F-33
F.5 Commercial Navigation F-33
F.6 Recreation F-33
F.6.1 Overview F-33
F.6.2 Recreation Benefits F-48
F.6.3 Recreational and Commercial Fishing F-49
F.7 Plan Evaluation F-50
F.7.1 Ecological Evaluation Methodology F-50
F.7.2 Planning Level Cost Estimates F-50
F.8 Comparison of Environmental Benefits and Costs of Alternative Plans F-52
F.8.1 Average Annual Benefits F-53
F.8.2 Average Annual Costs F-53
F.8.3 Cost Effectiveness Analysis F-55
F.8.4 Cost Effectiveness Analysis – Combined Habitat Units F-56
F.8.5 Incremental Cost Analysis – Combined Habitat Units F-58
F.8.6 Sensitivity Analysis – Normalized CE/ICA F-59
F.8.7 Cost Effectiveness Analysis – Normalized Combined Outputs F-63
F.8.8 Incremental Cost Analysis – Normalized Habitat Units F-64
F.8.9 Summary of Cost Effectiveness/Incremental Cost Analysis F-65
F.9 Regional Economic Impacts F-66
F.9.1 Overview F-66
F.9.2 Methodology F-66
F.9.3 IMPLAN Regional Economic Effects Results F-67
F.10 Other Social Effects F-69
F.10.1 Overview F-69
F.10.2 Potential Urban and Community Impacts F-70
F.11 Environmental Justice F-71

F.12 References F-73

LIST OF TABLES

Table F-1: Existing Western C-11 Basin Land Use F-8
Table F-2: 2002 Land Use in Broward County F-14
Table F-3: US, Florida and Broward County Populations 1950-2010 (1,000) F-15
Table F-4: Population Statistics for Nine County Region F-19
Table F-5: Population Statistics for Drainage Basin Study Area F-19
Table F-6: Nine-County Region Population F-20
Table F-7: Consolidated City Population Breakdown by Race F-21
Table F-8: County Population Estimates 2010-2030 ..... F-22
Table F-9: County Employment as a Percentage of State Employment F-23
Table F-10: Employment Breakdown of Three Major Counties F-23
Table F-11: Employment Sector Breakdown F-24
Table F-12: Per Capita Income - Median Income & Household Size F-25
Table F-13: Income Statistics for Study Area Cities and Towns F-25
Table F-14: Poverty Levels in Study Area Surrounding Counties F-25
Table F-15: Poverty Levels of Study Area Surrounding Towns and Cities F-26
Table F-16: SGS Estimated Total Water (MGD) Use for Selected Counties, 2000 Excluding Mining and Power Generation F-28
Table F-17: Service Area 2 M&I Conservation-Adjusted Water Use and Distribution F-30
Table F-18: South Florida (Region 11) Estimated Demand & Need for Outdoor Recreation Resources & Facilities, 2005 & 2010 ..... F-36
Table F-19: Counties Within SCORP Planning Regions Potentially Affected by Alternative Restoration Plans F-37
Table F-20: Regional Outdoor Recreational Facilities in Region 11 ..... F-38
Table F-21: Participation Rates for Selected Recreational Activities by U.S. Population 16 Years or Older, 1994-1995 ..... F-40
Table F-22: Trends in U.S. Recreation Participation, 1982-1994 ..... F-41
Table F-23: Total U.S. Wildlife Watching Participation, 1996 ..... F-42
Table F-24: U.S. Wildlife Watching Activity, 1996 ..... F-43
Table F-25: U.S. Nonresidential Wildlife Watching by Species, 1996 ..... F-44
Table F-26: Participants in Wildlife-Related Recreation in Florida, 1996 ..... F-44
Table F-27: Florida Wildlife Watching Expenditures, 1996 ..... F-45
Table F-28: Demand for Selected Recreation Activities in Florida User-Occasions (Thousands), 1992 ..... F-46
Table F-29: Participation Rates for Selected Recreational Activities (1985, 1992) F-46
Table F-30: Demand and Facility Needs (2005 and 2010) Selected Recreation Activities, Treasure Coast (SCORP Region 11) F-47
Table F-31: Summary of Costs and Benefits F-49
Table F-32: Initial Cost of Construction, Real Estate and O&M.. ..... F-51
Table F-33: Average Annaul Habitat Units F-53
Table F-34: Planning Level Construction and Investment Cost of Alternative Plans F-55
Table F-35: Costs and Outputs Used in CE/ICA F-56
Table F-36: Cost Effectiveness Analysis: All Plans Arrayed by Increasing Output for Each Output Category –Combined habitat Units F-57

Table F-37: Incremental Cost Analysis: Cost Effectiveness and Best Buy Plans for Combined Habitat Units F-59
Table F-38: Normalized snail kite and ridge and slough habitat units F-62
Table F-39: Costs and Outputs Used in Normalized CE/ICA F-63
Table F-40: Results of Cost Effectiveness Analysis: All Plans Arrayed by Increasing Output for Each Output Category–Combined Habitat Units F-63
Table F-41: Incremental Cost Analysis: Cost Effectiveness and Best Buy Plans for Normalized Habitat Units F-64
Table F-42: Results of CE/ICA F-65
Table F-43: Direct, Indirect and Induced Impacts on Regional Output as a Result of IMPLAN Model Runs F-68
Table F-44: Direct, Indirect and Induced Impacts on Employee Compensation as a Result of IMPLAN Model Runs F-68
Table F-45: Direct, Indirect and Induced Impacts on Employment as a Results of IMPLAN Model Runs (2006 Dollars) F-68
Table F-46: 2005 Broward County Socio-Economic Vulnerability Profile F-71

LIST OF FIGURES

Figure F-1: Project Site Land Use – East Coast Buffer Strip F-10
Figure F-2: Broward County 2000 Existing Land Use F-11
Figure F-3: Urban Service Area Boundary F-12
Figure F-4: Broward County Wetlands F-13
Figure F-5: Future Land Use Determination F-16
Figure F-6: Distribution of USGS Estimated 2000 Total and M&I Water Use, by County F-29
Figure F-7: Distribution of Total Conservation-Adjusted M&I Water Use, by Service Area, 2000 and 2050, Most-Likely Population Scenario F-30
Figure F-8: Conservation-Adjusted Forecast by Water Use Sector F-31
Figure F-9: Cost Effectiveness of Combined Habitat Units F-58
Figure F-10: Incremetnal Analysis of Combine Habitat Units F-59
Figure F-11: BCWPA Performance Measure Distribution Map F-61
Figure F-12: CE/ICA On Normalized Habitat Units F-64
Figure F-13: Incremental Analysis of Normalized Habitat Units F-65

F.0 ECONOMIC AND SOCIAL CONSIDERATIONS

F.1 SOCIO-ECONOMICS

F.1.1 Introduction

The Broward County Water Preserve Area (BCWPA) recommended plan is an important piece of the south Florida ecosystem improvement efforts that together make up the overall Comprehensive Everglades Restoration Plan (CERP). This part of the BCWPA Project Implementation Report (PIR) is concerned with the socio-economic issues of plan implementation. The primary effects of the project are the costs of implementation, and the ecosystem restoration and improvement effects. The net national project cost (National Economic Development (NED) cost) represents the largest monetarily expressed impact of plan implementation. Project costs have regional impact dimensions as well, as expenditures on the project can cause changes in local and regional earnings, sales, and employment, due to the ripple effect of project spending throughout the regional economy. The most significant beneficial effect of the project is the ecosystem improvement expected to result from the plan. This major benefit is not expressed in monetary terms, in accordance with policy. A Cost Effectiveness/Incremental Cost Analysis (CE/ICA) is utilized to determine the alternative that provides least unit cost per unit of benefits.

F.1.2 Purpose of this Investigation

This investigation assesses the economic effects of the alternative ecosystem restoration plans formulated in the feasibility phase of the BCWPA Project. The economic evaluation of the alternative restoration plans includes five principal elements:

Socio-economic Profile of the Study Area: This profile includes population and economic forecasts for the region, as well as projections of future water demand.

Anticipated Effects of Alternative Plans on the National Economic Development (NED) Account: Alternative plans could result in positive or negative effects on net national economic efficiency due to project-induced impacts on the following economic activities in south Florida:

- Agricultural water supply;
- Municipal and industrial (M&I) water supply;
- Flooding potential;
- Recreation; and
- Commercial and recreational fishing.

Evaluation of Project Costs: Project costs include all expenditures required to implement the alternative plans. The Federal government and the State of Florida will share these costs. Project costs include those for initial construction; lands; relocations; rights of way; rehabilitation, replacement, and repair; and operations and maintenance (O&M) (including the costs of post-construction monitoring and adaptive management).

Regional Economic Development (RED) Effects: The potential RED effects of the selected plan include changes in income, employment, or economic output of the region.

Other Social Effects (OSE): The potential social effects of the selected plan include effects on minority, elderly, and disadvantaged groups, population displacement, and effects on community cohesion.

The economic analysis for the BCWPA Project was conducted consistent with Federal statutes and USACE policy. Procedures for estimating NED and RED effects are specified in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (U.S. Water Resources Council, 10 May 1983), Engineering Regulation (ER) 1105-2-100 (22 April 2000), and other USACE guidance.

F.1.3 Methodology

A number of factors were considered prior to developing the methodologies used to evaluate the economic effects of the alternative restoration plans. These factors include: available analytical tools, economic theory, Federal policy, obtainable data, and time and budgetary constraints. These factors are discussed below.

F.1.3.1 Without-Plan and With-Plan Conditions

Proper definition of the without and with-plan conditions are critical to the planning process. The without-plan condition is the most likely condition expected to exist in the future in the absence of a proposed project. The future without plan condition (2050) is the benchmark against which alternative future with-plans are evaluated. National and regional socio-economic parameters considered include income, employment, population, and other aggregate projections such as land use trends, water supply, and water demand. Comparisons of conditions with the implementation of alternative plans to future without-plan conditions were performed to identify the beneficial and adverse effects of the proposed plans. Depending on the alternative and the type of economic impact changes resulting from implementation of a restoration plan, it may be desirable or undesirable when compared to the future without-plan condition. For example, alternatives that include modifications to the current

system to provide additional water storage areas may result in fewer economic losses associated with agricultural (irrigation) water shortages. This would be a desirable ancillary benefit of restoration.

F.1.3.2 Sources and Causes of Economic Effects

The potential economic impacts of the alternative restoration plans are secondary consequences of the environmental improvements and hydrologic changes that are expected to result from the proposed structural and operational modifications to the BCWPA study area. These projected impacts are contingent upon the successful implementation and operation of restoration plans and subsequent outputs and therefore, subject to the uncertainties inherent in those ecosystem restoration activities. Due to the challenges inherent in quantifying NER benefits, quantifying the resulting NED benefits is also a challenge. Nonetheless there are methods for evaluating the economic efficiencies of alternative restoration plans.

F.1.3.3 Methodology for Conducting Economic Analysis

Consistent with U.S. Army Corps of Engineers Guidance, a benefit-cost analysis is not required for national ecosystem restoration plans. For ecosystem restoration projects, a plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective shall be selected. The methodologies used to conduct economic analysis studies for the project were based on a combination of factors, including: economic theory, U.S. Army Corps of Engineers' ecosystem restoration and economic evaluation policies, and the characteristics of methodologies used by economists to value ecosystem benefits. For this study, the alternative restoration plans were compared using information in monetary and non-monetary units. The economic analysis of BCWPA alternative restoration plans include: (1) the NED costs (in monetary terms), (2) the anticipated environmental benefits resulting from restoration measures (in non-monetary terms), (3) the NED benefits and impacts attributable to the following: agricultural water supply, municipal and industrial water supply, commercial navigation, recreation, and commercial fishing (in monetary and non-monetary terms) and (4) the positive and adverse regional economic effects (RED) resulting from project implementation.

This section of the report addresses items (1), (3), and (4) above. The economic basis for making policy decisions about whether to invest public funds in ecosystem restoration for BCWPA is comparing monetary costs and non-monetary benefits in order to determine whether the expenditure is justified and to select the plan which minimizes the cost of obtaining ecosystem benefits. The costs of ecosystem restoration projects include: initial construction costs; major rehabilitation and repair costs; operations and maintenance (O&M) costs; post

construction monitoring costs; and adverse RED effects. Typically, these costs can be expressed in monetary (i.e., dollar) terms.

The principal challenge of ecosystem restoration economics is estimating the value of restoration benefits. The primary purpose of each alternative plan is ecosystem restoration. The benefits of ecosystem restoration are usually expressed by ecologists in non-monetary units, such as acres of specific habitat created, indices of biological productivity associated with habitat improvement, or increased abundance and/or diversity of particular species of plants or animals. For decision-making purposes, it would be desirable to express ecosystem restoration benefits in monetary terms, in order to compare them with project costs. Expressing the costs and benefits of alternatives in a common, monetary metric would facilitate selection of the best restoration plan for a given site. However, calculating the monetary value of environmental amenities is both difficult and controversial. Environmental amenities are public goods that are generally not exchanged in the marketplace. For marketable commodities (i.e., items that people buy and sell), the demand and prices paid for these goods can be used as "proxies" for determining their value to consumers. In the absence of data on consumers' expenditures for environmental amenities, resource economists have attempted to develop techniques that can be used to estimate their value using indirect indicators of consumers' "willingness to pay" for ecosystem restoration. For goods and services that are not purchased in the marketplace, non-market valuation approaches must be used to infer their value to the public. There are direct and indirect use values for these goods and services. Use values refer to the value consumers obtain from using a good that is related to an environmental amenity. For example, recreational fishermen obtain direct use value from the freshwater fisheries. The fishermen also obtain indirect use values from the ecosystem, since it provides ecological functions that contribute to the productivity of the fisheries. Use values can be either consumptive or non-consumptive. Consumptive use values refer to the cases for which the good is consumed by the user and is no longer available to others, such as waterfowl hunting. Non-consumptive use values refer to the value obtained by a user in cases for which the good remains to be used by others in the future, such as catch-and-release fishing or bird watching. It is reasonable to expect that the alternative restoration plans will generate additional use values to the public. Non-market activities that would benefit from restoration plans include recreational fishing, subsistence activities, and a variety of eco-tourism related activities (e.g., bird watching, hiking, canoeing, etc.).

Non-use values include the values the public obtains from simply knowing that the good or resource is available, even if they have not used it previously. Individuals may value a good simply from knowing it exists (existence value) or because they may want to have the opportunity to use it at some future time (option value). Again, it is reasonable to expect that the alternative restoration

plans will generate additional non-use values to the public. The tremendous interest in and support for ecosystem restoration, not just in south Florida but throughout the country (and the world), is an indication that a broad segment of society values the ecosystem, even though most have never experienced the area first hand.

Theoretically, it should be possible to determine the value of restoring the BCWPA ecosystem by asking people what they would be willing to pay for different levels and types of restoration projects, or by observing what they spend on ancillary costs (e.g., travel, subsistence, equipment, etc.) when they engage in these non-market experiences. Economists have developed a variety of techniques to estimate society's willingness to pay for these types of non-marketable environmental amenities. These economic valuation techniques include market-based, surrogate market, and non-market methodologies (see Freeman, 1993). Market-based approaches estimate the value of environmental resources using information generated in the marketplace. These approaches include changes in factors of production, valuation of complimentary goods and services, defensive expenditures, and market valuation of the next best alternative. Surrogate-market techniques estimate value based on preferences revealed in surrogate markets. These techniques include the travel cost method and hedonic valuation. The contingent valuation method (CVM) is the most widely accepted non-market valuation methodology. CVM is perceived as the most effective technique to determine society's willingness to pay for environmental protection and/or restoration and is the only technique able to estimate non-use (i.e., option and existence) values. This method is based on carefully designed surveys that solicit respondent's willingness to pay for a specific environmental resource in a given condition. The survey is intended to reveal both users' and non-users' willingness to pay for the resource.

Unfortunately, these surrogate-market techniques, including CVM, have significant shortcomings that lead to concerns about their reliability and validity. They are especially problematic in cases for which respondents are unfamiliar with the environmental amenity, when the issue is controversial, or where it generates strong reactions, based on ethical, rather than economic motivations. Most importantly for the BCWPA effort, the reliability and validity of these techniques are especially questionable in situations in which the actual changes that would result from the restoration efforts are difficult to precisely describe or visualize. Finally, stated preference methods, such as CVM, can be expensive to implement, especially when multiple alternatives are being evaluated.

As specified in U.S. Army Corps of Engineers ecosystem restoration policy (EC 1105-2-210: Ecosystem Restoration in the Civil Works Program), ecosystem restoration projects are not subject to traditional benefit-cost analyses. An

ecosystem restoration proposal must still be justified by comparing the monetary costs and non-monetary benefits of restoring degraded ecosystems. USACE ecosystem restoration evaluation procedures focus on the non-monetary benefits of restoration, comparing these benefits to monetary costs using cost effectiveness and incremental cost analysis procedures.

F.1.4 Prior Studies

This study relied on the use of prior studies and other secondary information to the extent possible. These studies are contained in the reference list presented at the end of this appendix. The SFWMD has previously conducted a wide variety of studies that directly or indirectly support this investigation. Interviews with SFWMD staff and review of SFWMD reports have contributed greatly to this investigation.

F.1.5 Organization of Appendix

The sections that follow evaluate the economic impacts of the alternative restoration plans. ***Section F.2*** develops a socio-economic profile for the region, and ***Section F.3*** contains the water demand forecasts for the region. The following sections develop the basis for critical physical and socio-economic effects of the future conditions, with-plan and without-plan. The regional economic effects and other social effects of the alternative plans are explored in ***Sections F.9*** and ***F.10***, respectively.

F.2 POPULATION AND ECONOMY

F.2.1 Overview

This section of the appendix includes a description of the local economy and demographics of the study area. This descriptive information provides insight into the study area's socio-economic characteristics, and provides part of the basis for different facets of the economic impact evaluation work in the rest of this appendix.

The people who live in the study area, and the economic activity, in which they are engaged, comprise important components of the area's total environment. In addition to the direct use of this data for the water use projections and other social effects mentioned above, they represent the socio-economic environment for the other impact topics of flooding, water use shortages, fishing, recreation, and navigation.

Any course of action forthcoming from this study will have effects throughout an economic system as well as the natural ecosystem(s), the health and sustenance of which are the impetus for this investigation. The economic system is

connected with the natural ecosystem and in general is ultimately dependent upon it for survival. This connection is especially strong in the study area. Adverse changes in the health and condition of the natural system can cause severe negative impacts on the economic system, particularly in the study area for this feasibility study. Conversely, in this study area, beneficial changes to the natural system are expected to have a strong positive effect on the economic system. It is significant, therefore, to describe and understand the general economic and social environment within which such changes could take place. Although the main focus of economic impact evaluation efforts undertaken for this study has been to describe the economic impacts and benefits of alternatives being considered for implementation, describing the broader context for these evaluation efforts is also necessary and important.

F.2.2 Study Area

This study focused on the BCWPA Project area of the Lower East Coast region of south Florida, located in Broward County. The study area for this study will be broadly defined as the nine county region of southern Florida consisting of Palm Beach County, Broward County, Miami-Dade County, Monroe County, Lee County, Martin County, Glades County, Hendry County and Okeechobee County. These counties are hydraulically connected by a complex system of canals and waterways and would subsequently be affected by the retention of water in the system.

A study area definition encompassing the C-11 and C-9 drainage basins will be utilized to indicate areas that are directly impacted by the retention of water in the system. The C-11 and C-9 drainage basins are located entirely within a section of Broward County west of Fort Lauderdale. These two drainage basins approximate the cities of Weston, Davie, Southwest Ranches, Cooper City, Pembroke Pines and Miramar.

The proposed project site is to be located from the northern boundary of the North New River Canal to the southern boundary of the C-6 Canal. The BCWPA Project is composed of the C-11 Impoundment, the C-9 Impoundment, and the Water Conservation Area 3A/3B Seepage Management Area (WCA 3A/3B SMA), which includes a portion of North New River.

F.2.2.1 Existing and Forecasted Land Use

F.2.2.1.1 Existing Land Use

Existing land use patterns within the boundaries of the nine county region depict usage ranging from agriculture and conservation to dense concentrations of residential, commercial and industrial. Several national and state parks occupy large tracts of land in this study area. Everglades National Park (ENP),

Biscayne National Park, and Big Cypress National Preserve are under federal protection, and Lake Okeechobee, Biscayne Bay, and numerous WCAs in the westernmost reaches of the study area are under protection of the state. Urban development is concentrated along the eastern coast of the Florida peninsula with the highest densities in Broward, Palm Beach, and Miami-Dade counties. Contained within these three largely urban counties is a considerable amount of land devoted to agricultural pursuits: Palm Beach County contains 605,000 acres of agricultural land, Miami-Dade County has 85,000, and Broward County has 31,000. Most of the arable land of these three counties is concentrated along the western end of the study area, an area corresponding to the six cities primarily impacted by the proposition of the project.

Current patterns of land use in the six cities of Pembroke Pines, Southwest Ranches, Davie, Weston, Cooper City, and Miramar suggest a low concentration of population in areas east of the project site and south of I-75. Areas east of the project site but adjacent to I-75, an area defined as northeastern Weston, exhibit high concentrations (4,729 – 5,938 persons/Sq Mile) of population. South of Weston but north of the Miami-Dade Broward County line the persons per square mile begins to rise as you move east away from the project site and towards the Atlantic Ocean.

Table F-1 depicts the 2002 land use for the western C-11 Basin including all of Weston and Southwest Ranches and parts of Davie, Cooper and Pembroke Pines. Developed land accounts for 58 percent of the 72 square miles of land. Agriculture accounts for 18 percent of the land use. Wetlands, rangeland or forested uplands account for 24 percent of the area in the western C-11 Basin.

TABLE F-1: EXISTING WESTERN C-11 BASIN LAND USE

Land Use	Total Square Miles	Percent of Area
Developed	42	58
Agriculture	13	18
Wetlands, Rangeland or Forested Uplands	17	24

Source: Regulatory Action Strategy Status Report. South Florida Water Management District, August 2002.

Land in Weston is largely developed and is comprised of commercial, residential, and light industrial uses. Weston also contains large tracts of land set aside for conservation, recreation and agriculture. Development patterns in Southwest Ranches and Pembroke Pines depict a decidedly rural community. Southwest Ranches zoning regulations require residential lots to be in excess of one-acre, thus preserving a more rural, agricultural setting. Concentrations of heavy development are exhibited throughout Davie, Miramar, and Cooper City at the eastern edge of the study area.

The heaviest residential concentrations closest to the project area are communities in the northeast corner of Weston along I-75. A large concentration of office space and light industrial is located along the eastern edge of the city, south of the residential community. Current patterns of land use in the city of Weston suggest that the city is built-out, and that there is no land available for development. Over the past two years, construction of housing in Weston has been pushed west; no additional lands have been zoned for development.

South Florida Water Management District (SFWMD) currently owns a large portion of the undeveloped vacant lands in the southwest portion of Broward County. These lands are known as the Everglades East Coast Buffer Area and consist of approximately 7,400 acres (***Figure F-1***). This land was acquired by the SFWMD for the purpose of developing the BCWPA Project for ecological improvements in Water Conservation Areas 3A and 3B. Prior to the purchase, many of these parcels were designated for residential development (5,795 units) and classified as agriculture and vacant lands on the Broward County 2000 Existing Land Use Map (***Figure F-2***). (Broward County Evaluation and Appraisal Report, 2004 and Accommodating Population Growth in Broward County, 2000 to 2030, August 2003) The Urban Service Area Boundary Map (***Figure F-3***) illustrates these parcels as areas available for development in the urbanized area of Broward County. Development is not allowed in the conservation areas. The "proposed" urban service area boundary line runs adjacent to the conservation area levee. It is no different than the "current" urban service area and is not anticipated to change. The line on the map is "proposed" only as a new mapping line to define the separation of the conservation and urbanized areas. The parcels of the Everglades East Coast Buffer Area are predominantly freshwater wetlands (***Figure F-4***).

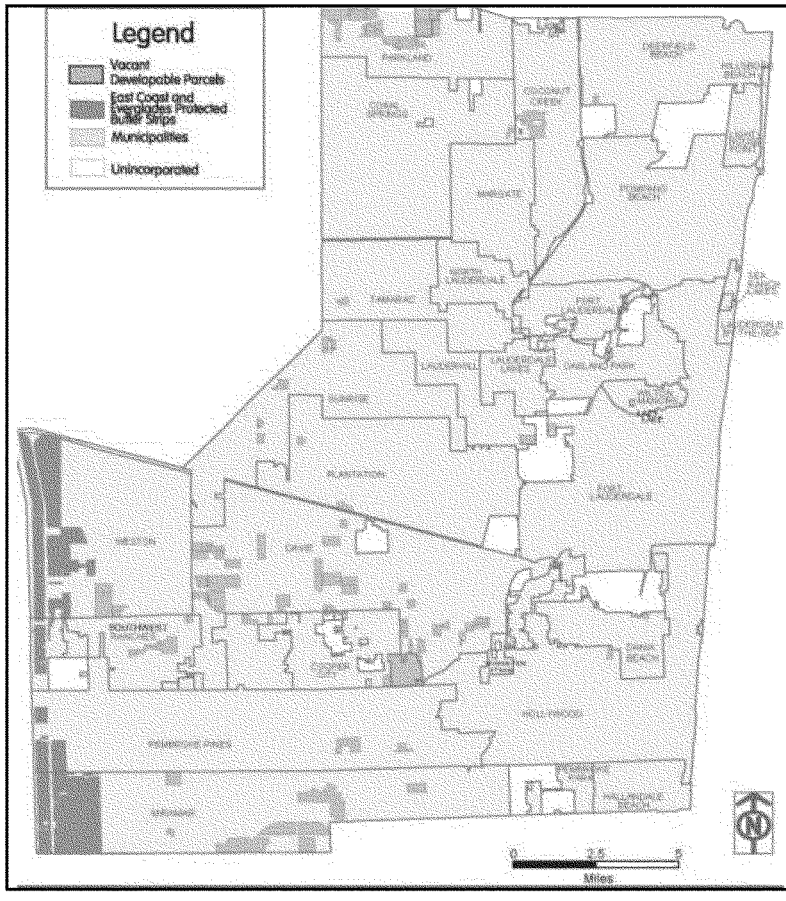

FIGURE F-1: PROJECT SITE LAND USE – EAST COAST BUFFER STRIP

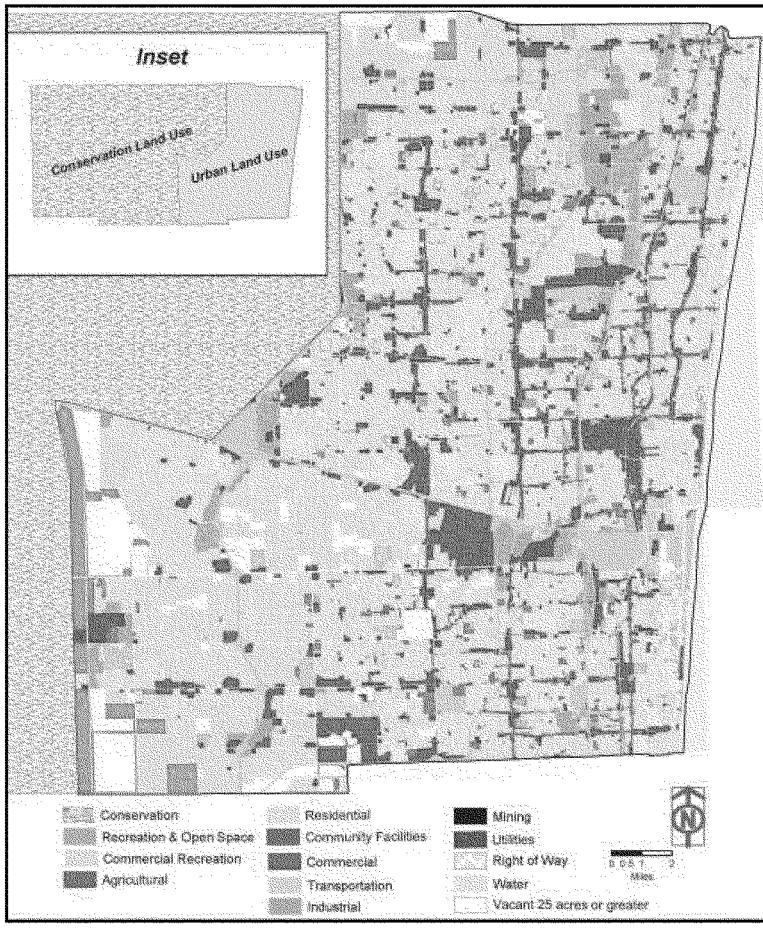

FIGURE F-2: BROWARD COUNTY 2000 EXISTING LAND USE

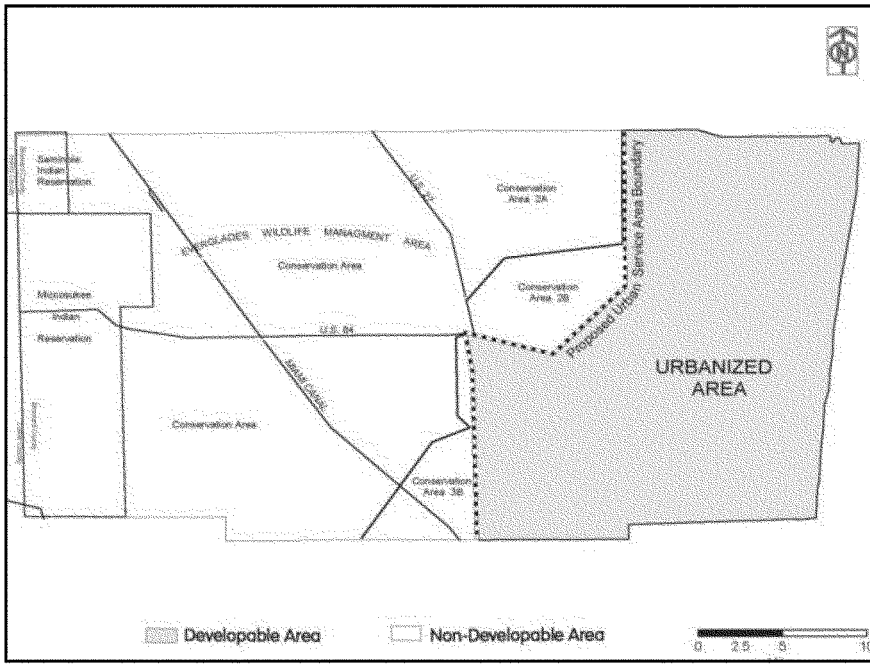

FIGURE F-3: URBAN SERVICE AREA BOUNDARY

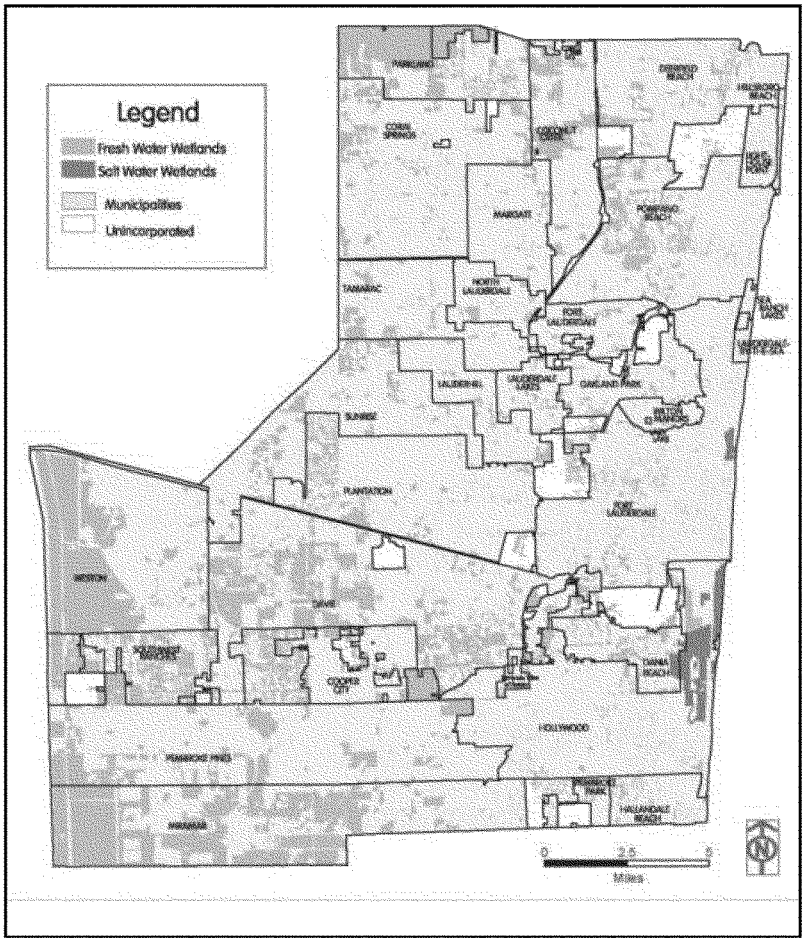

FIGURE F-4: BROWARD COUNTY WETLANDS

As indicated in ***Table F-2***, residential development and available lands zoned for residential construction account for 63 percent of total developed areas and 61 percent of total vacant lands, respectively. Commercial, industrial and municipal concerns account for 27 percent of existing development while 36 percent of available lands are zoned for this purpose. Lands utilized for agricultural, recreation or conservation purposes represent 11 percent of the total lands but only four percent of undeveloped lands have been set aside for recreation, conservation or agriculture.

TABLE F-2: 2002 LAND USE IN BROWARD COUNTY

Land Use	Total Acres	% of Total	Vacant Acres	% of Total	Water Preserve	% of Total	Developed Area	% of Total
Conservation	3,423		-		1,151		2,272	
Recreation, Open Space	10,948		137		56		10,755	
Commercial Recreation	7,828		87		-		7,741	
Agriculture	12,018		1,243		8,655		2,121	
Sub-total	34,217	12.9%	1,467	3.9%	9,862	85.6%	22,889	10.5%
Rural Ranches	5,617		1,916		-		3,701	
Rural Estate	1,437		520		-		918	
Estate	17,548		6,982		-		10,566	
Residential	135,824		13,093		1,302		121,428	
Sub-total	160,426	60.3%	22,511	60.6%	1,302	11.3%	136,613	62.8%
Municipal	16,283		3,113		2		13,168	
Commerical	22,177		4,647		17		17,513	
Transportation	14,295		426		24		13,845	
Utilities	2,045		155		319		2,123	
Industrial	16,797		4,828		-		11,418	
Sub-total	71,597	26.9%	13,169	35.5%	362	3.1%	58,067	26.7%
Total	266,240		37,147		11,526		217,569	

Source: Broward County Office of Urban Planning and Redevelopment, "Accommodating Population Growth in Broward County 2000 to 2030," August 2003

F.2.2.1.2 Future Land Use

The nine counties that make up the study region, as well as the cities that define the study area, are expected to continue to grow both in population and in the development that population demands. As depicted in ***Table F-3***, both Florida and the counties of the nine county region are expected to grow at a rate exceeding the national expected growth rate. But the rate of growth in the nine county region is expected to diminish in the future, as is the rate of growth of Florida. This is consistent with the concept of urban sprawl. As most highly demanded real estate is developed and an area becomes built-out, its ability or willingness to absorb additional population growth through more intense

methods of development becomes limited. Counties that have traditionally grown at a rate exceeding the rate of growth of the state will slow, and the most intense future growth in population will occur in other counties (***Figure F-5***).

TABLE F-3: US, FLORIDA AND BROWARD COUNTY POPULATIONS 1950-2010 (1,000)

Area	1950	1960	1970	1980	1990	2000	2010	% change (1950-2010)
U.S.	152,271	180,671	205,052	227,224	249,464	281,400	308,700	202%
Florida	2,771	4,952	6,789	9,746	12,938	15,982	18,801	678%
Broward County	84	334	1,018	620	1,255	1,623	1,748	2,080%

Source: U.S. Census 2010

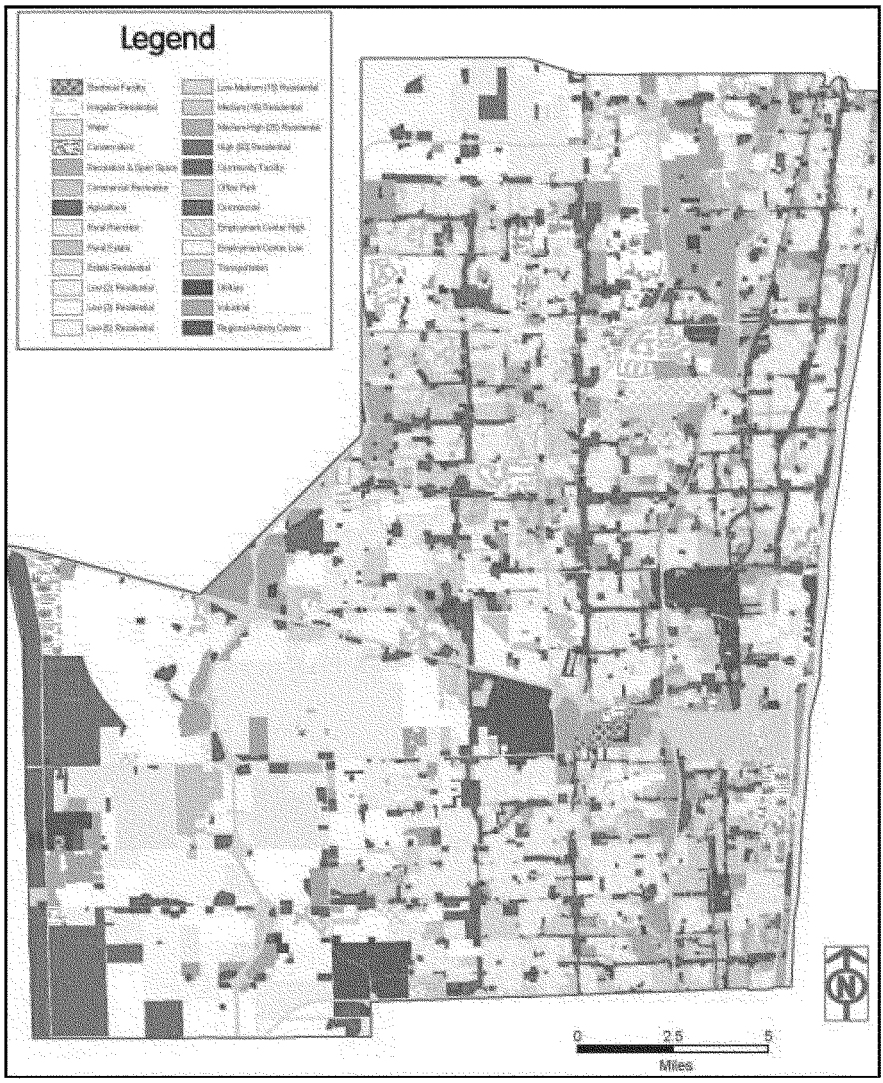

FIGURE F-5: FUTURE LAND USE DETERMINATION

Growth beyond available developable land will require changes in land use and possible rezoning of existing land. Within the study area there is land that could be developed but is not currently zoned for development. Future land use maps indicate that Weston does not foresee rezoning areas now classified as

agricultural or conservation. The Broward County Wide Future Land Use Map (***Figure F-5***) illustrates the footprint of the project site area as agriculture. However, it is currently owned by the SFWMD for the purpose of developing the BCWPA Project for improving the ecosystem of conservation areas 3A and 3B.

At this time, intensive development of land within cities of the study area is possible but unlikely. Population intensive development in either Pembroke Pines or Southwest Ranches would result in destruction of the rural, agricultural lifestyle that the city is trying to maintain. Likewise in Weston, development of population intensive structures is unlikely due to affluence of the city. The continued urban sprawl of the Miami area will likely pressure the citizens of the cities to rezone and redevelop available lands.

F.2.3 General

Socioeconomic and demographic data for the study area indicate higher than average income when compared to the rest of the State and Nation, and much greater economic and population growth than for the rest of the Nation. Additional characteristics of the study area include a strong service sector, fishing, tourism, and recreation. Florida's economy is generally characterized by strong wholesale and retail trade, government and service sectors. Florida's warm weather and extensive coastline attract vacationers and other visitors and helps to make the State a significant retirement destination for people from all over the country. Easily developed land, accessible water supply, abundant natural resources, and the aesthetic beauty of the region are the fundamental building blocks of the local economy. Relative to the national economy, the manufacturing sector has played less of a role in Florida, including the study area. However, high technology manufacturing has begun to emerge as a significant sector in the State over the last decade.

F.2.4 Population

F.2.4.1 Population: Historic Trends and Existing Condition

From 1950 to 2000, Florida achieved dynamic change in population. In relation to the remainder of the United States, Florida outgrew the other states by almost 500%. This growth can be attributed to Florida's ideal climate and historically low property costs. Broward County experienced the largest increase in the Lower East Coast as population increased 2,082% in the 50-year span while Miami-Dade County only grew by 504%. Broward County population increased from 84,000 to 1,748,000. Due to a more established community, Miami-Dade County achieved less growth than Broward County, or the State as a whole. As seen in ***Table F-4*** Florida grew by almost 500% in the 50-year span. For the nine county region, population statistics for the past fifty years are

presented in ***Table F-4***. Population statistics for areas of the C-11 and C-9 drainage basin areas are presented in ***Table F-5***.

A subset of Florida population, the summed total of these nine counties comprises a constant percentage of the Florida population. Even though the populations of the counties have been increasing in absolute numbers, their share of Florida's population has not changed over time. Alternatively, the proportional share of the population inside the nine country area has changed over the fifty year time period. The number of persons residing in each county has increased over the fifty-year period but at different rates. The share of the nine county population residing in Glades, Hendry, and Okeechobee counties has remained relatively constant at or around 0.2%, 0.6%, and 0.6% respectively. . Miami-Dade County's share of the nine country total population has declined from 65% in 1950 to 43.5% in 2010. In contrast, Palm Beach County's and Lee County's share of the nine county population has increased four and a half percent over the fifty-year period; most dramatically Broward County's share of the nine county population has increased 20% over the last fifty years. While each county has seen an increase in their populations the growth in population has been increasingly concentrated in Broward, Palm Beach and Lee counties.

TABLE F-4: POPULATION STATISTICS FOR NINE COUNTY REGION

Area	2010		2000		1990		1980		1970		1960		1950	
Florida	18,801,310		15,982,378		12,937,926		9,746,324		6,789,443		4,951,560		2,771,305	
	Population	%	Population	%	Population	%	Population	%	Population	%	Population	%	Population	%
Glades	12,884	0.2%	10,576	0.2%	7,591	0.2%	5,992	0.2%	3,669	0.1%	2,950	0.2%	2,199	0.3%
Hendry	39,140	0.7%	36,210	0.6%	25,773	0.6%	18,599	0.5%	11,859	0.5%	8,119	0.5%	6,051	0.8%
Lee	618,754	10.8%	440,888	7.7%	335,113	7.2%	205,266	5.7%	105,216	4.3%	54,539	3.3%	23,404	3.1%
Martin	146,318	2.6%	126,731	2.2%	100,900	2.2%	64,014	1.8%	28,035	1.1%	16,932	1.0%	7,807	1.0%
Miami-Dade	2,496,435	43.5%	2,253,362	39.3%	1,937,094	41.8%	1,625,781	45.2%	1,267,792	51.8%	935,047	57.2%	495,084	64.6%
Monroe	73,090	1.3%	79,589	1.4%	78,024	1.7%	63,188	1.8%	52,586	2.1%	47,921	2.9%	29,957	3.9%
Broward	1,748,066	30.5%	1,623,018	28.3%	1,255,488	27.1%	1,018,200	28.3%	620,100	25.3%	333,946	20.4%	83,933	10.9%
Okeechobee	39,996	0.7%	35,910	0.6%	29,627	0.6%	20,264	0.6%	11,233	0.5%	6,424	0.4%	3,454	0.5%
Palm Beach	1,320,134	23.0%	1,131,184	19.7%	863,518	18.6%	576,863	16.0%	348,753	14.2%	228,106	14.0%	114,688	15.0%
County SubTotal	6,494,817	40.6%	5,737,468	35.9%	4,633,128	35.8%	3,598,167	36.9%	2,449,243	36.1%	1,633,984	33.0%	766,577	27.7%

Source: 2010 U.S. Census.

TABLE F-5: POPULATION STATISTICS FOR DRAINAGE BASIN STUDY AREA

	2010	2003	2002	2001	2000
Weston	65,333	62,243	61,384	56,980	50,815
Southwest Ranches	7,345	7,280	7,269	7,207	7,134
Cooper City	28,547	28,853	28,802	28,339	27,992
Davie	91,992	80,364	79,629	78,523	76,268
Pembroke Pines	154,750	148,927	146,228	141,955	138,317
Mirimar	122,041	96,646	90,105	82,136	74,605
City Sub Total	470,008	424,313	413,417	395,140	375,131

Source: 2000 & 2010 U.S. Census.

Population change in the drainage basin study area shows a disproportional increase in the populations of the cities of Miramar and Weston. The cities of Southwest Ranches, Cooper City, Davie and Pembroke Pines grew at approximately the same rate as Florida approximately 4.6%. Demographics suggest that Palm Beach and Broward counties are growing a rate exceeding that of Florida and other counties in the nine county region. Population growth within the study area exceeds the state average by some fifteen percent in Weston and Miramar. Population growth in the study areas seems to be concentrated in those areas to the east and north of the project site, in Broward and Palm Beach counties and in the cities of Weston and Miramar.

Of the total population of Florida, approximately 17% classify themselves as African Americans while 22.5% classify their heritage as Hispanic or Latino (***Table F-6***).

TABLE F-6: NINE-COUNTY REGION POPULATION BREAKDOWN BY RACE & ETHNICITY

County	White	African-American	Other	Total	Hispanic or Latino (of any race)
Florida	77.1%	17.0%	5.9%	100%	22.5%
Glades	72.4%	12.7%	14.9%	100%	21.1%
Hendry	62.1%	14.0%	23.9%	100%	49.2%
Lee	84.8%	9.1%	6.1%	100%	18.3%
Martin	88.6%	5.9%	5.5%	100%	12.2%
Miami-Dade	75.6%	19.9%	4.5%	100%	65.0%
Monroe	91.1%	6.3%	2.6%	100%	20.6%
Okeechobee	79.2%	8.6%	12.2%	100%	23.9%
Palm Beach	75.2%	18.3%	6.5%	100%	19.0%
Broward	65.1%	28.2%	6.7%	100%	25.1%

Source: 2010 U.S. Census.

In the nine county region, the populations of Miami-Dade and Broward counties contained some 49% of the Florida Latino population and some 31% of the Florida African American population. As a percentage, Hendry County' Latino population was almost double that of the Florida state average but the county has a significantly smaller population when compared to Miami-Dade and Broward counties.

As exhibited by ***Table F-7*** the cities corresponding to the study area of immediate impact have African-American and Latino concentrations that are above the state average.

TABLE F-7: CONSOLIDATED CITY POPULATION BREAKDOWN BY RACE

City	White	African-American	Other	Total	Hispanic or Latino (of any race)
Davie	82.6%	9.2%	8.2%	100%	29.1%
Miramar	43.2%	47.9%	8.9%	100%	36.9%
Pembroke Pines	69.9%	21.4%	8.7%	100%	41.4%
Weston	87.8%	5.1%	7.1%	100%	44.9%

Source: 2010 U.S. Census.

F.2.4.2 Population Projections

The future will see a continuation of above average population growth until saturation and, thereafter, a general decline in growth rates. Also to be expected is a shift of income and employment from Miami-Dade County to the surrounding counties of Broward and Palm Beach.

It is expected that the nine counties that make up the study region as well as the cities that define the study area will continue to grow both in population and in the development that population demands. As depicted in ***Table F-8*** the growth rate in the nine-county region is expected to diminish in the future as is the rate of growth of the state of Florida. In Florida and within the nine-county region, population growth rates are expected to decline over a twenty-year period. While absolute populations of the counties will continue to increase, the rate at which individuals are added to those populations will not be as great as historic growth rates. This is to be expected and is consistent with the concept of urban sprawl. As the most demanded real estate is developed and an area becomes built-out, its ability or willingness to absorb additional population growth through more intense methods of development becomes limited. Counties that have traditionally grown at a rate exceeding the rate of growth of the state will slow and it is to be expected that the most intense growth in population will occur in other, less-populated counties.

Population in Broward County is expected to increase 9.6% percent from 2010 to 2030. Florida, as a whole, is projected to grow 27% by 2030. The projected growth of the South Florida Nine-County area is anticipated to be just over 20% over the same 20-year period.

TABLE F-8: COUNTY POPULATION ESTIMATES 2010-2030

County	2010 (Actual)	2015	2020	2025	2030
Broward	1,748,066	1,788,172	1,834,533	1,877,659	1,916,182
Glades	12,884	13,702	14,656	15,584	16,456
Hendry	39,140	40,244	41,547	42,831	44,068
Lee	618,754	694,224	779,823	863,320	942,747
Martin	146,318	154,060	163,312	172,227	180,480
Miami-Dade	2,496,435	2,600,932	2,722,889	2,841,371	2,952,762
Monroe	73,090	72,248	71,210	70,209	69,289
Okeechobee	39,996	41,940	43,735	45,479	47,120
Palm Beach	1,320,134	1,394,293	1,482,851	1,568,458	1,648,012
County Sub Total	6,494,817	6,799,815	7,154,556	7,497,138	7,817,116
Florida	18,801,310	19,974,411	21,326,797	22,641,336	23,877,889
Nine County Percentage of Florida Population	34.54%	34.04%	33.55%	33.11%	32.74%
Florida Growth (over 5-year period)		6.24%	6.77%	6.16%	5.46%
Nine County Growth (over 5-year period)		4.70%	5.22%	4.79%	4.27%

Source: 2010 U.S. Census and University of Florida, Bureau of Economic and Business Research, Florida Population Studies, Volume 44, Bulletin 159, June 2011

F.2.5 Economy

Generally, a strong wholesale and retail trade, government and service sectors characterize Florida's economy. Florida's warm weather and extensive coastline attracts vacationers and other visitors and helps make the state a significant retirement destination for people all over the country. Agricultural production is also an important sector of the state's economy, and is especially significant to portions of the study area. Compared to the national economy, the manufacturing sector has played less of a role in Florida, but high technology manufacturing has begun to emerge as a significant sector in the State over the last decade.

Of the nine counties of the study region the three largest, Broward, Miami-Dade and Palm Beach employ approximately 35% of Florida's work force and account for approximately 33% of state income (***Table F-9***).

TABLE F-9: COUNTY EMPLOYMENT AS A PERCENTAGE OF STATE EMPLOYMENT

County	Number of Wage & Salary Employees	Annual Wage & Salary Disbursements ($1,000)	Employee Percentage	Annual Salary Percentage
Florida	7,632,084	323,659,342	100%	100%
Glades	1,938	66,153	0.03%	0.02%
Hendry	14,224	418,654	0.19%	0.13%
Lee	208,538	8,238,828	2.73%	2.55%
Martin	59,631	2,378,068	0.78%	0.73%
Miami-Dade	1,038,010	48,445,712	13.60%	14.97%
Monroe	37,959	1,513,204	0.50%	0.47%
Okeechobee	11,016	364,625	0.14%	0.11%
Palm Beach	542,388	25,182,540	7.11%	7.78%
Broward	745,587	33,403,592	9.77%	10.32%
Study Area Subtotal	2,659,291	120,011,376	35%	37%

Source: 2010 U.S. Bureau of Economic Analysis data

Table F-10 indicates the importance of relatively low paying employment in the three counties of greatest economic impact. The results coincide with state averages across employment sectors and reflect the relative importance of industry related to tourism (retail, food service), the aged populations of Florida (health care) and the growth experienced in Florida (construction) (***Table F-11***). In contrast to the nine county study region are the employment patters of the study area. Employment in the Davie and Miramar – Pembroke Pines CCDs exhibit a slight tendency towards higher paying professional jobs and fewer low paying service jobs compared to South Florida County-level data.

TABLE F-10: EMPLOYMENT BREAKDOWN OF THE THREE MAJOR COUNTIES

Industry	Broward County	Miami-Dade County	Palm Beach County	Three-County Total	Percentage of Employment by Industry
Health Care & Education	171,463	217,787	123,750	513,000	21%
Retail Trade	112,360	130,845	81,326	324,531	13%
Professional & Administration	108,344	134,619	81,209	324,172	13%
Food Service & Hospitality	86,607	112,057	63,721	262,385	11%
Construction	49,957	74,255	39,760	163,972	7%
Manufacturing	40,905	54,937	22,709	118,551	5%
Major Industry Sub-Total	398,173	506,713	288,725	1,193,611	48%
Total	826,452	1,075,625	577,572	2,479,649	100%

Source: 2010 U.S. Census Bureau American Community Survey.

TABLE F-11: STUDY AREA CITIES EMPLOYMENT SECTOR BREAKDOWN

Industry	Davie	Miramar	Pembroke Pines	Weston	Industry Percentage of Total
Educational, Health and Social Services	10,545	16,481	16,077	5,849	23.29%
Retail	6,747	6,044	10,825	2,469	12.41%
Professional	4,293	6,114	8,771	6,052	12.00%
Accomodation and Food Service	4,028	4,758	6,330	4,062	9.12%
Finance, insurance, real estate	4,097	4,917	5,463	2,761	8.20%
Sub-Total of Major Industries	29,710	38,314	47,466	21,193	65%
Total Emploment in Study-Area Cities	46,984	58,836	73,820	30,544	100%

Source: 2010 U.S. Census and American Community Survey

While food service employment represents more than ten percent of employment in the three-county metropolitan region it is under represented in the study area, at just over nine percent. Additionally, areas of employment such as F.I.R.E (finance, insurance and real estate) and professional or scientific services, which did not constitute significant percentages of employment in the three-county metropolitan region are significant in the study area, representing over eight percent of total employment in the immediate study area.

Of the three largest counties Broward and Palm Beach exhibit per capita incomes and median household incomes that are above Florida state average (***Table F-12*** and ***Table F-13***). Miami-Dade County exhibits per capita income and median household incomes that are significantly smaller than the Florida state average, due in part to the larger average household size of Miami-Dade County. The disparity in income is further reflected in the unemployment statistics and poverty level statistics exhibited in ***Table F-14*** and ***Table F-15***. Affluence of the immediate study area in Weston and Pembroke Pines relative to that of the surrounding counties is further exhibited when comparing disparities in income and poverty statistics between the two areas.

TABLE F-12: PER CAPITA INCOME - MEDIAN INCOME & HOUSEHOLD SIZE

County	Per Capita Income ($)	Median Household Income ($)	Household Size	Percentage of State Per Capita Income
Florida	24,272	44,409	2.48	100%
Broward	26,373	48,063	2.52	108.66%
Lee	24,699	43,936	2.35	101.76%
Martin	32,253	48,311	2.23	132.88%
Miami-Dade	20,970	40,219	2.83	86.40%
Monroe	30,146	50,619	2.18	124.20%
Palm Beach	30,735	49,879	2.39	126.63%

Source: 2010 U.S. Census and American Community Survey

TABLE F-13: INCOME STATISTICS FOR STUDY AREA CITIES AND TOWNS

City/Town	Per Capita Income ($)	Median Household Income ($)	Percentage of County Per Capita Income
Davie	26,567	58,175	115%
Miramar	23,836	61,474	103%
Pembroke Pines	28,600	61,163	123%
Weston	38,754	78,030	167%
Broward County	26,373	48,063	100%

Source: 2010 U.S. Census and American Community Survey

TABLE F-14: POVERTY LEVELS IN STUDY AREA SURROUNDING COUNTIES

County	Percentage of Persons Below Poverty	Unemployment Percentage
Florida	12.0%	8.0%
Broward	11.4%	9.2%
Lee	11.3%	8.8%
Martin	4.4%	7.4%
Miami-Dade	16.4%	8.0%
Monroe	8.0%	5.3%
Palm Beach	9.9%	8.4%

Source: 2010 U.S. Census and American Community Survey

TABLE F-15: POVERTY LEVELS OF STUDY AREA SURROUNDING TOWNS AND CITIES

City/Town	Poverty Levels	Unemployment	Poverty Levels as a percent of Broward County
Davie	15.1%	7.1%	132.5%
Miramar	10.5%	10.0%	92.1%
Pembroke Pines	5.7%	7.7%	50.0%
Weston	7.7%	N/A	67.5%
Broward County	11.4%	9.2%	100.0%

Source: 2010 U.S. Census and American Community Survey.

The three most significant employment sectors in the Broward County economy are health care and education, retail trade, and administrative support. In 2010, health care and education in Broward County employed 171,463 retail trade employed 112,360, and administrative support employed 108,344.

The unemployment rate for Florida is 12.0 percent, while the unemployment rate for Broward County is 11.4 percent.

Per capita income in Florida is $24,272 (2010). Broward County recorded a higher per capita income level at $26,373. With a per capita income of $20,970, Miami-Dade county is below the state average, while Palm Beach County is significantly above the state average, at $30,735.

The 2010 median household income in Florida was $44,409. In Broward and Miami-Dade counties, the median household incomes were $48,063 and $40,219, respectively. Average household size in Florida is 2.51 persons (2010). In the Lower East Coast, Palm Beach County had 2.39 persons per household, Miami-Dade County had 2.83 and Broward County had 2.52.

In 2010, it was reported that 12.0% of Florida's population lived below the poverty level, while 9.9% of Palm Beach County were below the poverty level. In the rest of the LEC, Broward County had 11.4% living below the poverty threshold, while Miami-Dade County had 16.4%.

F.3 MUNICIPAL AND INDUSTRIAL WATER DEMAND

F.3.1 Overview

Future water demands for urban and agricultural areas that utilize the C&SF Project were projected for the study area. For a comprehensive discussion of projected water demands that are assumed to be in place in the future without plan condition refer to Section 4.8 of the *Central and Southern Florida Project*

Comprehensive Review Study, Final Integrated Feasibility Report and Programmatic Environmental Impact Statement, dated April 1999.

In summary, the LEC urban area was subdivided into four service areas: North Palm Beach, Service Area 1, Service Area 2, and Service Area 3. The BCWPA Project is contained in Service Areas 2. Service Area 2 includes central and southern Broward County and a small portion of northern Miami-Dade County. Service Area 3 is made up of the remainder of northern, central, and southern Miami-Dade County and Monroe County. For urban areas of the LEC, IWR-MAIN water demand forecasting software was used to make projections. Underlying population and economic growth assumptions used a combination of the University of Florida (UF) Bureau of Economic and Business Research (short-term) and Bureau of Economic Analysis, U.S. Department of Commerce (long-term) growth projections. For Service Area 2, public water demands that were used are those contained in *Final Report Municipal and Industrial Water Use Forecast Lake Okeechobee Regulation Schedule Study* (USACE, 1996). These included the UF Economic and Business Research unrestricted demand set, which reflected UF Bureau of Economic and Business Research population projections. In Service Area 2, municipal and industrial water demands in the Future Without Condition are projected to increase from 299.2 MGD in 2000 to 450.5 MGD in 2050, a 50.6% percent increase. All projected service area demands were reduced by 11 percent to account for the expected implementation of the SFWMD's mandatory water conservation program (e.g., implementation of ultra-low flow fixtures and lawn sprinkler restrictions in residential and commercial land use). Future irrigation demands in the LEC Service Area were based on projected land use and average annual permitted allocation.

F.3.2 Broward County Water Demand

In the study area, surficial aquifers supply the majority of water for urban use. Rainfall is the primary supporter of the agriculture water demanded in south Florida. Surficial waters (canals, shallow groundwater, and ponds) provide the majority of the irrigation demands in the watershed. Salinity intrusion is becoming a predominant problem for water supply. In the Lower East Coast area, salinity intrusion has resulted from two major events. The first is the lowering of the ground water table in the area due to drainage and reduced recharge as well as the increased withdrawal of water by pumping. The second reason is the construction of numerous drainage and navigation canals from inland areas to the coastal waters. Currently, water shortages and restrictions are implemented during low rainfall periods or droughts.

F.3.2.1 Existing Municipal and Industrial Water Usage

The U.S. Geological Survey (USGS) estimates annual water withdrawals for Florida at the county-level every five years. The most recent publication of

water use data was published by the USGS Florida Water Science Center for the year 2005 for the nine counties included in this analysis. These uses are distributed as public-supply, domestic self-supply (residential), commercial-industrial-mining, recreational irrigation, and agricultural water use estimates. ***Table F-16*** presents the USGS estimated 2005 water use for the nine-county area, excluding power generation water use. Total public-supply water use for the region is estimated at 1,003.35 million gallons per day (MGD), and sub-total municipal and industrial (M&I) water use is estimated at 1,249.95 MGD. The addition of the 1,511.13 MGD of agricultural water use (which will not be forecast in this analysis) increases total water demand for the region to 2,761.08 MGD. Agricultural water use accounts for 55 percent of the total use, and all M&I uses accounts for 45 percent of total use.

On the county-level, the largest water user in the study area in 2005 was Palm Beach County, mainly because of the large Everglades Agricultural Area (EAA). Palm Beach County used a total of 1,105.47 MGD, or 40 percent of the total regional water use. Of this amount, 792.51 MGD (72%) was agricultural use and 312.96 MGD was M&I water use. Broward County used a total of 308.90 MGD, which is over 11 percent of the total regional water use. Of this amount, 7.66 MGD (2.5%) was agricultural use and 301.24 MGD was M&I water use. The county's public supplied water use ranked second-highest within the region.

TABLE F-16: USGS ESTIMATED TOTAL FRESH WATER USE (IN MGD) FOR SELECTED COUNTIES, 2005, EXCLUDING POWER GENERATION

	Municipal & Industrial						
County	**Public Supply**	**Domestic Self-Supply**	**Commercial-Industrial-Mining**	**Recreational Irrigation**	**Municipal & Industrial Sub-Total**	**Agricultural Irrigation**	**County Total**
Broward	263.57	0.43	0.25	36.99	301.24	7.66	**308.90**
Glades	1.01	0.48	9.21	0.39	11.09	93.34	**104.43**
Hendry	6.22	1.23	0.70	1.94	10.09	385.99	**396.08**
Lee	64.53	5.59	20.97	25.85	116.94	33.37	**150.31**
Martin	19.30	2.37	2.84	10.27	34.78	90.12	**124.90**
Miami-Dade	400.01	2.78	40.08	13.40	456.27	58.06	**514.33**
Monroe	0	0	0.04	1.63	1.67	0.05	**1.72**
Okeechobee	2.04	1.44	0.43	1.00	4.91	50.03	**54.94**
Palm Beach	246.67	9.22	6.36	50.71	312.96	792.51	**1,105.47**
Total	**1,003.35**	**23.54**	**80.88**	**142.18**	**1,249.95**	**1,511.13**	**2,761.08**

Notes: Figures represent total fresh water withdrawals, including ground water and surface water sources. Values in million gallons per day; some values may differ from those published by the water management districts. Recreational irrigation self-supply water use includes golf course irrigation.
Source: U.S. Geological Survey, Florida Water Science Center, 2007-2008.

Figure F-6 presents the distribution of USGS estimated 2005 total and M&I water use, by county in the Lower East Coast.

Combined, total water use in the four counties of the LEC -- Broward, Miami-Dade, Monroe, and Palm Beach -- was 1,930.42 MGD, which accounted for 70 percent of the nine-county region. The LEC M&I water use was estimated at 1,072.14 MGD, or 86 percent of the region's total M&I water use.

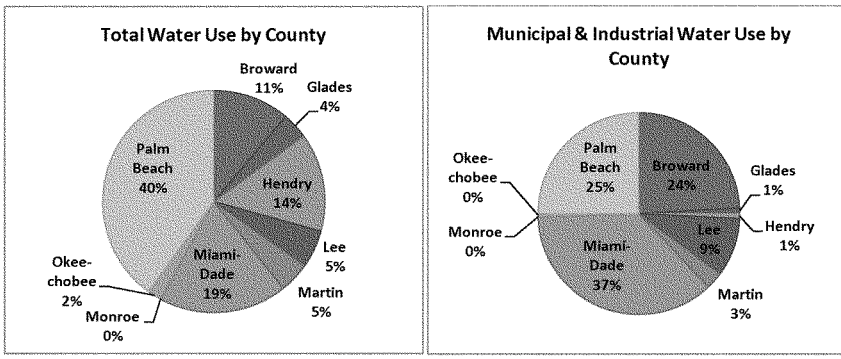

FIGURE F-6: DISTRIBUTION OF USGS-ESTIMATED 2005 TOTAL AND M&I WATER USE, BY COUNTY

F.3.2.2 Projected Municipal and Industrial Water Usage

In the Lower East Coast Region groundwater is the predominant source of water for municipal and industrial uses. With this trend expected to continue in the future, the groundwater levels will likely continue to decrease, leading to increased shortages of water and increased salinity levels in wells in the study area. With more persons drawing water and less water available for recharge, shortages to wells and wellfields would become more prevalent.

The Lower East Coast Region municipal and industrial water demand forecast is shown in the following table. Figures are derived from the University of Florida Bureau of Economic and Business Research population and employment projections, and were collected for the 2000 Initial CERP Update. The section of the Initial CERP Update that applies to the BCWPA study area is Service Area 2, which includes central and southern Broward County. Water demand projections as depicted in ***Table F-17*** indicate conservation–adjusted water use in 2050 at 450.5 MGD. This accounts for 28.1% of the entire Lower East Coast study area (***Figure F-7***).

TABLE F-17: SERVICE AREA 2 M&I CONSERVATION-ADJUSTED WATER USE AND DISTRIBUTION

End Use	2000 Demand	2050 Demand
Service Area 2	299.2	450.5

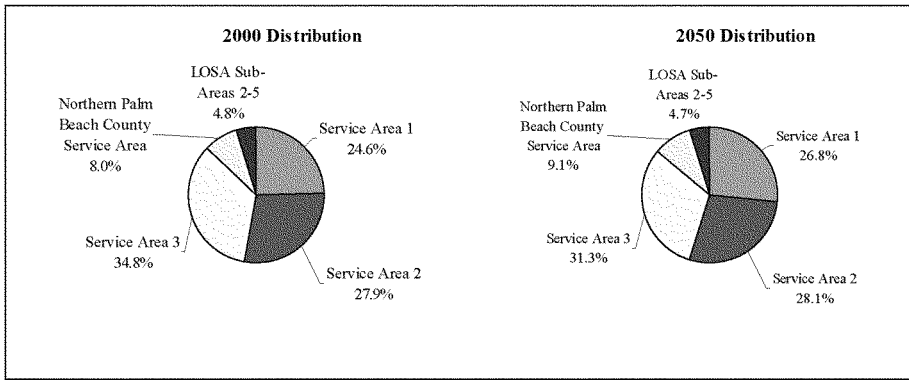

FIGURE F-7: DISTRIBUTION OF TOTAL CONSERVATION-ADJUSTED M&I WATER USE, BY SERVICE AREA, 2000 AND 2050, MOST-LIKELY POPULATION SCENARIO

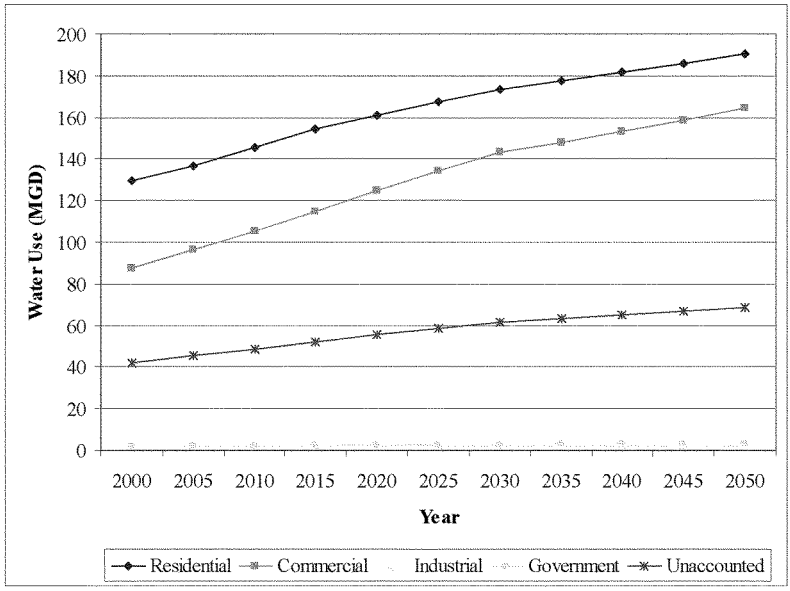

FIGURE F-8: CONSERVATION-ADJUSTED FORECAST BY WATER USE SECTOR

The SFWMD requires the development of water conservation plans as a prerequisite for water utilities to obtain a water use permit. With the implementation of conservation plans, water demand should change. Most conservation plans incorporate passive water conservation measures that include increasing block rate structures, the required use of ultra-low flow water fixtures on new or renovated construction, restrictions on lawn watering, required use of rain sensors on automatic sprinkler systems, a leak detection program, and public education concerning water conservation measures.

F.3.3 Agricultural Water Use

Agriculture is a significant irrigated land user of the Lower East Coast region. Agricultural land use represents less than one-quarter of the land use in the service area, and in many areas will be virtually non-existent in the future.

Rainfall is the primary supporter of the agriculture water demand in south Florida-approximately 59 inches per year along the Lower East Coast. Surficial waters (canals, shallow groundwater, and ponds) provide the majority of the irrigation demands in the watershed. Unfortunately surficial supplies are inadequate at some time nearly every year. During droughts, agricultural water

users have higher irrigation water demands; however, water supplies are usually at their lowest levels during droughts. Consequently, water shortage management policies are implemented which restricts use of water so that agricultural water users do not always receive as much water as they need. This can lead to reduced crop yields and economic damages.

The LEC receives significant groundwater recharge via easterly seepage from the Water Conservation Areas under the north-south levee system; however, during prolonged droughts, significant volumes of water from Lake Okeechobee can be required by the LEC to supplement local water supplies and prevent saltwater intrusion into well-fields.

F.3.4 Impacts of Selected Alternatives

During droughts, the existing and anticipated water demands may exceed available and anticipated supplies. In such situations the SFWMD may use its regulatory powers and implement water restrictions on users to cut back on the amount of water pumped and thus forestall impacts such as salt water intrusion into wellfields. These cutbacks and restrictions have economic impacts on urban and agricultural users. Urban water users demonstrate a willingness to pay for water not received during shortages to avoid effects on water-related activities. If shortages are prevalent, there may be actual economic costs to M&I water users associated with: new sources of supply, additional water treatment or more aggressive water conservation.

In the Restudy, the South Florida Water Management Model (SFWMM) was the foundation tool for estimating performance of the without project conditions, the alternatives and the recommended plan. It was also the tool that was used in evaluating water supply performance. Key outputs regarding water supply performance from the SFWMM included the number and durations of water shortages by region affected; the reductions in water use due to the water shortages and, for crops and landscapes, the reductions in evapotranspiration resulting from the reductions in water withdrawals. Performance measures based on the physical measures (frequency, duration and severity of water restrictions) were used in evaluating alternatives. An examination of the SFWMM and the Seepage Mitigation Analysis for the BCWPA impoundments shows no significant additional water would be made available for the wellfields in the vicinity of the study area during times of shortages or restrictions. The models use a series of triggers relating to storage levels in Lake Okeechobee and groundwater levels along the coast that determine when water is in such short supply as to warrant restrictions being imposed. Both models compared these triggers to with and without project conditions and found no measurable changes in these indicators of water shortage problems. It is likely that the extra water made available from the BCWPA impoundments is utilized more immediately to improve environmental conditions and is not added to storage in quantities

sufficient to shorten or eliminate the necessity of restrictions. Since restrictions are not reduced, the extra supply of water is not estimated as providing economic benefits to M&I water.

The BCWPA impoundments reduce demands on the natural system while affording users no less supply than they were receiving prior to the implementation of the BCWPA impoundments. The water supplied by the BCWPA impoundments that would otherwise have been lost to tide at the wrong times of the year.

F.4 FLOOD DAMAGE REDUCTION IMPACTS OF SELECTED ALTERNATIVES

A key design criterion and goal throughout the development of the BCWPA components has been that flooding of developed areas will remain the same or improved with the plan implemented as compared to without the plan in place. No flooding of residential or commercial properties will be caused by implementation of the plan.

F.5 COMMERCIAL NAVIGATION

Commercial navigation in the study area is nonexistent due to the canals limited size, limited length, and inaccessibility to other bodies of water. Navigation will not be negatively impacted by the implementation of the BCWPA Project.

F.6 RECREATION

F.6.1 Overview

This section examines the potential effects of the Selected Plan on outdoor recreation in the study area. Outdoor recreation in Florida includes many different activities. A common way of differentiating outdoor recreation activities is to classify them based as "user-oriented" or "resource-based" activities. User-oriented activities, such as individual and team sports, are not dependent on any natural resource setting and can be located, space permitting, on any open site. These facilities are provided for the convenience of the user. For example, a basketball court can be added to a playground. Resource-based activities, such as hunting and fishing, depend on the existence and quality of supporting natural or historical resources. The economic value of resource-based recreation is determined by the users' willingness to pay for a recreation occasion. The willingness of current and potential users to pay for resource-based recreation of specific quantity and quality constitutes the demand for that type of recreation. The interaction of demand with the quantity and quality of recreation resources available determines the recreation use or "participation" levels for that resource-based activity. When the quantity or quality of

recreation resources is modified by a project, such as the alternative restoration plans, the change in value of resource-based recreation is based on the difference in the willingness of users to pay under the with- and without-project conditions.

The BCWPA impoundments provide a unique and extensive natural resource-based recreational resource. The restoration of the ecosystem could potentially have important impacts on the value of outdoor recreation in the study area. The hydrologic changes associated with the alternative restoration plans have been designed to improve the structure and function of the ecosystems. These improvements can be expected to provide resource-based recreational opportunities compatible with the protection of the natural systems. Many tourists and residents recreate in the natural areas surrounding the study area. If the alternative restoration plans improve the ecology of the study area, the quality of the study area related recreation and/or the number of people who participate in study area related recreation could increase as well. Consequently, the value of outdoor recreation in the study area could also substantially increase.

However, precisely estimating the future value of recreation in the study area is problematic, and anticipating the incremental changes in value associated with restoration is even more challenging. There are four principal uncertainties that challenge forecasting the future quantity and quality of outdoor recreation under with- and without project conditions. Perhaps the most important uncertainty concerns the timing and character of the ecological changes that are expected to result from the alternative restoration plans. At this time, the outcomes of the restoration actions cannot be predicted. Consequently, secondary effects, such as associated changes in recreation patterns and the resulting effect on industries supporting recreation (e.g., marine industry) cannot be accurately quantified.

Another uncertainty regarding the future value of recreation is the marketing of tourism and study area related recreation. If the restored ecosystem is used to market tourism and recreation in the study area, the value of recreation could change dramatically relative to the without-project future conditions.

A third uncertainty is the degree to which recreational facilities and recreational access would be developed as part of a restoration plan. Recreation facilities and access, such as visitor centers, scenic overlooks, nature trails, and roads, can greatly affect participation levels.

Finally, there are a variety of economic factors at the national level that can influence tourist and resident recreation demand. These factors include the health of the national economy, levels of disposable income, and the availability and costs of competing recreation opportunities. As described in the 2000

Florida Statewide Comprehensive Outdoor Recreation Plan (SCORP) (Draft): "The states 1996 tourist population (44.7 million) is expected to increase to 57 million visitors, a 25% increase, by 2005. However, Florida tourism and its economic implications are sensitive to national economic and energy policies. The dynamic nature of the industry causes uncertainty in tourism forecasting, making it difficult to accurately project visitation levels for more than one or two years at a time" (Florida Department of Environmental Protection, 2000). As evidence of the challenges of tourism and recreation forecasting, the Florida Tourism and Industry Marketing Corporation limits its tourism forecasts to three years, and the most recent SCORP (2000) used a ten-year forecast horizon (to the year 2010).

F.6.1.1 Recreation Resources

The study area lies in the South Florida Region (Region 11), as defined by the Florida State Comprehensive Outdoor Recreation Plan (SCORP). This region encompasses more than 4,200 square miles in Broward, Dade and Monroe counties. The primary urban centers are Fort Lauderdale, Hialeah, Key West, and Miami. This region offers excellent opportunities for camping, hiking, swimming, bicycling, fishing, boating, and saltwater beach activities. Currently, saltwater beach activities, bicycle riding, and picnicking are the most popular resource-based activities. Swimming pools and golf courses attract the most user-oriented activity in this South Florida Region.

The various recreation activities that are legally allowed in this region area include: waterfowl hunting (permitted in some areas), fishing, wild life viewing, hiking, biking and boating. Boating and fishing are the most popular activities, with two adjacent boat ramps and air boating facilities. A myriad of species of game fish (largemouth bass, bluegill, catfish and several species of exotic fish) make this area attractive to sportsmen. In addition to the game fishing provided in the Everglades Wildlife Management Area, the canal system helps preserve a habitat for smaller fishes during periods of drought. These fish are prey for many species of wading birds.

Table F-18 indicates the various activities in Region 11 that require additional resource needs to meet current and future demands. The resource-based activities in which demands are projected to exceed supply are bicycle riding, camping (tent), freshwater beach activities, freshwater fishing (non-boat), hiking, hunting, nature study, and saltwater beach activities.

TABLE F-18: SOUTH FLORIDA (REGION 11) ESTIMATED DEMAND & NEED FOR OUTDOOR RECREATION RESOURCES & FACILITIES, 2005 & 2010

Recreational Activity	2005		2010	
	Demand (User Occasions)	Resource Needs (Units)	Demand (User Occasions)	Resource Needs (Units)
Archaeologic/ Historic Site	3,750,011	0 Sites	4,120,126	0 Sites
Bicycle Riding	22,432,994	1,470.77 Miles	24,089,784	1,607.60 Miles
Camping (RV/Trailer)	2,562,521	0 Sites	2,779,565	0 Sites
Camping (Tent)	1,043,150	201 Sites	1,136,981	317 Sites
Freshwater Beach Activities	1,564,085	1.38 Miles	1,654,262	1.59 Miles
Freshwater Boat Ramp Use	180,639	0 Lanes	201,078	0 Lanes
Freshwater Fishing	868,971	10,685.56 Feet	924,095	12,051.24 Feet
Hiking	1,524,454	351.87 Miles	1,672,767	413.11 Miles
Horseback Riding	2,036,790	0 Miles	2,189,849	0 Miles
Hunting	733,076	178,480.96 Acres	772,849	235,427.65 Acres
Nature Study	1,784,927	21.72 Miles	1,988,143	0 Miles
Picnicking	4,652,960	0 Tables	5,137,669	0 Tables
Saltwater Beach Activities	39,556,285	25.51 Miles	44,168,645	36.33 Miles
Saltwater Boat Ramp Use	1,496,558	0 Lanes	1,616,760	0 Lanes
Saltwater Fishing	2,379,441	0 Feet	2,639,736	0 Feet

Source: Florida Department of Environmental Protection, 2000

F.6.1.2 Recreation Demand

The SCORP provides information on recreation demand and supply at the state and regional scales. It divides the state into 11 planning regions, each with clusters of counties. As indicated in ***Table F-19***, Region 11 is the planning region that encompasses this study area.

TABLE F-19: COUNTIES WITHIN SCORP PLANNING REGIONS POTENTIALLY AFFECTED BY ALTERNATIVE RESTORATION PLANS

Region	Counties
Region 11	Broward
	Dade
	Monroe

Source: Florida Department of Environmental Protection, 2000

The SCORP organizes outdoor recreation in Florida into 47 categories that encompass a variety of recreation activities including team sports (e.g., basketball and baseball), individual sports (e.g., golf and tennis), hunting, fishing, swimming, and boating. ***Table F-20*** presents descriptive information on the recreation facilities in SCORPs Region 11 for study area specific recreation categories. These resource-based categories were selected as those that could potentially be affected by the hydrologic changes or ecological changes associated with the alternative restoration plans. This table also includes percentages of the statewide totals for the recreation categories.

TABLE F-20: REGIONAL OUTDOOR RECREATIONAL FACILITIES IN REGION 11

Resource / Facility	Region 11	% of State Total	State Total
Outdoor Recreation Areas	2080	16%	13,097
Land Acres	1,831,363	20%	9,077,004
Water Acres	1,207,112	68%	1,773,900
Total Outdoor Recreation Acres	3,038,476	28%	10,850,904
Total Hunting Acres	871,151	14%	6,168,716
Hunting Land Acres	869,573	14%	6,046,955
Hunting Water Acres	1,578	1%	121,761
RV / Trailer Camp Sites	10,603	8%	138,576
Tent Camp Sites	1081	11%	10,214
Hiking Trails (miles)	278	7%	3,904
Horseback Riding Trails (miles)	92	6%	1,443
Nature Trails (miles)	107	10%	1,043
Freshwater Catwalks	40	5%	748
Canoe Trails (miles)	296	11%	2,587
Freshwater Boat Ramp Lanes	114	6%	1,973
Freshwater Marinas	6	1%	511
Freshwater Slips / Moorings	303	3%	11,758
Saltwater Marinas	366	33%	1123
Saltwater Marina Slips	14,470	32%	45,839

Source: Florida Department of Environmental Protection, 2000.

Profiles of existing and future recreation demand in the study area can be developed by drawing on a variety of information at the national, state, regional, and local levels. The discussions begin with the results of two national surveys on outdoor recreation. These illustrate the participation and expenditures of participants in outdoor recreation activities that could potentially be affected though BCWPA restoration.

F.6.1.3 National Recreation Trends

National trends in recreation may help to identify potential or expected changes in the demand for Florida recreation as the result of ecosystem restoration. Two recent national surveys of outdoor recreation have particular relevance for this investigation.

F.6.1.4 National Survey of Recreation and the Environment

The Outdoor Recreation Coalition of America conducted a National Survey of Recreation and the Environment in 1994 and 1995. Approximately 17,000 Americans were interviewed in a random sample telephone survey, providing information regarding their participation in 62 recreational activities organized into 13 broad categories.

Table F-21 presents 1994-1995 participation rates for 26 of the 62 surveyed recreational activities. The activities in this table were selected as those that potentially could be affected by the selected plan. Of the selected activities, the three most popular groups of activities were outdoor viewing, fitness activities, and outdoor social activities that had participation rates of 76.2 percent, 68.3 percent and 67.8 percent, respectively. Walking was identified as the most popular activity with approximately 134 million participating (66.7 percent of the population). Approximately 124 million recreationists (62.1 percent) enjoy visiting a beach or other waterside and gathering outdoors with family. Sightseeing also had a high level of participation (56.6 percent). Other very popular activities include hiking and backpacking, fishing, boating and camping.

The Outdoor Recreation Coalition conducted a similar national survey of recreation and the environment in 1983-1984. ***Table F-22*** compares the results of the two surveys. The categories are somewhat different than in ***Table F-21*** due to differences in the surveys.

TABLE F-21: PARTICIPATION RATES FOR SELECTED RECREATIONAL ACTIVITIES BY U.S. POPULATION 16 YEARS OR OLDER, 1994-1995

Recreational Activity	Participants (millions)	Percent of U.S. Population
Fitness	136.9	68.3%
Walking	133.7	66.7%
Viewing / Studying	152.6	76.2%
Nature Centers	93.1	46.5%
Visitor Centers	69.4	34.6%
Bird Watching	54.1	27.0%
Wildlife Viewing	62.6	31.3%
Fish Viewing	27.4	13.7%
Other Wildlife Viewing	27.5	13.7%
Sightseeing	113.4	56.6%
Visiting Beach / Waterside	124.4	62.1%
Water-based Nature Study	55.4	27.7%
Camping	52.8	26.4%
Developed Area	41.5	20.7%
Primitive Area	28	14.0%
Hunting	18.6	9.3%
Big Game	14.2	7.1%
Small Game	13	6.5%
Migratory Bird	4.3	2.1%
Fishing	57.8	28.9%
Freshwater	48.8	24.4%
Saltwater	19	9.5%
Warm water	40.8	20.4%
Anadromous	9.1	4.5%
Catch and release	15.5	7.7%
Boating	58.1	29.0%
Canoeing	14.1	7.0%
Kayaking	2.6	1.3%
Rowing	8.4	4.2%
Outdoor Adventure	73.6	36.7%
Hiking	47.8	23.9%
Off-Road Vehicle Driving	27.9	13.9%
Horseback Riding	14.3	7.1%

Source: Outdoor Recreation Coalition of America, 1997

TABLE F-22: TRENDS IN U.S. RECREATION PARTICIPATION, 1982-1994

Recreational Activity	1983-1984 (millions)	1994-1995 (millions)	% Change
U.S. POPULATION	234,868 (January '84)	261,575 (January '95)	11.4%
Fitness			
Walking	93.6	133.7	42.8%
Viewing Studying			
Bird watching	21.2	54.1	155.2%
Sightseeing	81.3	113.4	39.5%
Camping (overall)	42.4	52.8	24.5%
Camping, developed	30	41.5	38.3%
Camping, primitive	17.7	28	58.2%
Hunting	21.2	18.6	-12.3%
Fishing	60.1	57.8	-3.8%
Boating	49.5	58.1	17.4%
Swimming			
Pool Swimming	76	88.5	16.4%
River/lake/ocean Swimming	56.5	78.1	38.2%
Outdoor Adventure			
Hiking	24.7	47.8	93.5%
Backpacking	8.8	15.2	72.7%
Off-Road Driving	19.4	27.9	43.8%
Horseback Riding	15.9	14.3	-10.1%

Source: Outdoor Recreation Coalition of America, 1997

Table F-22 contains numbers of participants, not participation rates. As indicated in this table, there has been an increase in the number of participants for almost all activities. The 11.4% increase in U.S. population during this period explains some of the change in number of participants. However, some activities are clearly undergoing an increase in participation rates. For example, birdwatching has the largest increase (155 percent) in number of participants from 1984 to 1995. Hiking and backpacking also experienced large increases in participation, 93.5 and 72.7 percent respectively. Walking activity increased 42 percent from 94 million to 134 million participants. Also, since 1984 there has been an increasing interest in specialized outdoor adventure activities such as orienteering, mountain climbing, rock climbing, caving, and special types of wildlife viewing.

In general, the variety of recreational interests in the U.S. appears to be increasing along with recreational participation rates. As future recreation needs and interests develop, it is important to recognize that participation in specific types of recreational activities is often linked to demographic factors

such as age and income. For example, participation in activities requiring vigorous exercise is considerably higher for young people than for senior citizens. However, the elderly population has increasing recreation participation because of the growing awareness of the importance of physical fitness. Participation in most activities is low for those with family incomes below $25,000 per year. Interestingly, participation is also low for those with family incomes greater than $100,000 per year. Most outdoor recreational activities appear to be enjoyed largely by the middle class, those with family incomes between $25,000 and $75,000 per year.

F.6.1.5 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation

The U.S. Fish and Wildlife Service conducted the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation in 1996. As part of this survey, 22,578 anglers and hunters and 11,759 wildlife watchers were interviewed. The purpose of the survey was to gather information regarding participation and expenditures for wildlife-related activities, including fishing, hunting, and wildlife watching. National participation and expenditure data for sportsmen and wildlife watchers are presented in ***Table F-23***. The survey revealed that 77 million Americans aged 16 or older (40 percent of the adult population) enjoyed some form of wildlife-related recreation in 1996 with total expenditures exceeding $101 billion.

Wildlife watching activities primarily included observing, photographing and feeding wildlife for two types of participants: residential and nonresidential. The residential category included those activities that occurred within one mile of the residents' homes, while the nonresidential group included those who took trips or outings for the primary purpose of observing, photographing, or feeding wildlife. Based on the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, in 1996 over 62.9 million people in the U.S. participated in wildlife watching. This figure is consistent with the 1995 participation of 62.6 million wildlife watchers reported in the National Survey of Recreation and the Environment.

TABLE F-23: TOTAL U.S. WILDLIFE WATCHING PARTICIPATION, 1996

Category	Participants	Expenditures
Residential	60.8 million	
Nonresidential	23.7 million	
Total*	62.9 million	$29 billion

Source: U.S. Fish and Wildlife Service, 1996.

The sum of residential and nonresidential subcategories does not equal the total due to an overlap in participation. ***Table F-24*** presents residential and nonresidential participation in various wildlife-watching activities. Among all

wildlife-watching participants, 97 percent (60.8 million) watched wildlife within 1 mile of their home (residential). The most popular residential activities included feeding and observing wildlife, 54.1 and 44.1 million participants, respectively. Approximately 23.7 million people (38 percent of all wildlife-watchers) spent 314 million days in 1996 taking trips for the primary purpose of enjoying wildlife. Of all nonresidential wildlife watchers, 68 percent participated only within their home state, 13 percent traveled only to other states and 19 percent took wildlife watching trips in both their state of residence as well as in other states. Survey results indicated that wildlife-watching trips were evenly distributed among male and female participants. The types of sites visited by nonresidential wildlife watchers included woodlands (77 percent), lakes or streamside (69 percent), open field (63 percent), brush covered (59 percent), wetland marsh or swamp (44 percent), manmade area (39 percent) and oceanside (27 percent). Of the 23.7 million nonresidential participants, 22.9 million enjoyed observing wildlife. Observing birds and land mammals was favored by 75 percent of wildlife observers.

TABLE F-24: U.S. WILDLIFE WATCHING ACTIVITY, 1996

Category	Participants (millions)	Average Days / Year (millions)	Average Days / Participant
Total Wildlife Watching*	62.9 (100%)		
Residential*	60.8 (97% of total)		
Observed Wildlife	44.1		
Photographed Wildlife	16.0		
Fed Wildlife	54.1		
Maintained Plantings/Natural Areas	13.4		
Visited Public Areas	11.0		
Nonresidential*	23.7 (38% of total)	314	13.2
Observed Wildlife	22.9	279	12.2
Photographed Wildlife	12.0	79	6.6
Fed Wildlife	10.0	90	9.0

Source: U.S. Fish and Wildlife Service, 1996.

Table F-25 presents a profile of wildlife observed by nonresidential participants by type. Waterfowl and songbirds were among the most popular species watched.

TABLE F-25: U.S. NONRESIDENTIAL WILDLIFE WATCHING BY SPECIES, 1996

Category	Participants (millions)	% of Total
Nonresidential	23.7	
Birds	17.7	75%
Waterfowl	14.3	
Songbirds	12.9	
Birds of Prey	10.6	
Other Shorebirds	9.5	
Other Birds	6.5	
Land Mammals	17.7	75%
Fish	8.4	35%
Marine Mammals	3.5	15%
Other	11.5	49%

Source: U.S. Fish and Wildlife Service, 1996

The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation also contains state-level information on recreation participation and expenditures. In 1996, approximately 3,642,000 of Florida's 11,239,000 residents (32 percent) participated in wildlife-related recreation with the following distribution: 2,840,000 wildlife watching (25 percent of the state population) and 1,988,000 hunting/fishing (18 percent of the state's population). According to the survey, 79 percent of the time spent wildlife watching by Florida residents is spent within the State of Florida.

As indicated in ***Table F-26***, there were an estimated 1,846,000 participants in wildlife-watching activities in Florida in 1996. Approximately 1,050,000 (57 percent) of these participants were Florida residents and the remainder (796,000 or 43 percent) was from outside the state. Together, the in-state and out-of-state participants spent a total of 14,658,000 days watching wildlife in Florida.

TABLE F-26: PARTICIPANTS IN WILDLIFE-RELATED RECREATION IN FLORIDA, 1996

Participant	Residents	% of Total	Non-residents	% of Total	Total
Anglers	1,878,000	(66%)	986,000	(34%)	2,864,000
Hunters	170,000	(92%)	14,000	(8%)	184,000
Wildlife Watchers	1,050,000	(57%)	796,000	(43%)	1,846,000

Source: U.S. Fish and Wildlife Service, 1996

Table F-27 presents estimated expenditures associated with wildlife watching in Florida during 1996. As indicated in this table, in-state and out-of-state participants spent over $1.6 billion in 1996 on wildlife watching. This includes

trip-related expenditures and equipment expenditures. Wildlife watching equipment includes binoculars, film, bird food, and special clothing. Auxiliary equipment expenditures accounted for items such as tents and backpacking equipment. Other expenditures include magazines and books, membership dues and contributions, land leasing and ownership, and plantings.

TABLE F-27: FLORIDA WILDLIFE WATCHING EXPENDITURES, 1996

Expenditure Category	Total Expenditures (millions)	% of Total
TOTAL EXPENDITURES	$ 1,677.2	100%
Trip-Related Expenditures	$ 754.7	45%
Food and Lodging	$ 439.7	26%
Transportation	$ 189.4	11%
Other Trip Costs	$ 125.6	7%
Total Equipment Expenditures	$ 767.6	46%
Wildlife-Watching Equipment	$ 286.9	17%
Auxiliary Equipment	$ 65.4	4%
Other Expenditures	$ 154.8	9%

Source: U.S. Fish and Wildlife Service, 1996

F.6.1.6 State Recreation Trends

The Florida SCORP supplements the results of the two national recreation surveys described above with estimates of current and future recreation demand at the state and regional scales. Recreation demands were developed for the SCORP through surveys of residents and tourists. The Division of Recreation and Parks, State of Florida conducts periodic surveys of resident and tourist participation in recreation activities to estimate outdoor recreation in Florida. The Division of Recreation and Parks, State of Florida did not have funds to conduct a new participation survey for the latest SCORP so the recreation participation information was derived from the 1992-1993 surveys conducted by the University of Florida, Department of Recreation, Parks, and Tourism. Participation in outdoor recreation activities is expressed in terms of user-occasions, which occur each time an individual participates in a single outdoor recreation activity. The number of user-occasions was calculated for each planning region as well as the entire state by type of activity. Demand was estimated for 1997, 2000, 2005 and 2010 by applying the per capita participation rates to population projections.

Table F-28 presents 1992 statewide resident and tourist demand in Florida for selected outdoor recreation activities. The activities were chosen based on their potential for being affected by the alternative restoration plans. As indicated in this table, over 45 million residents and tourists participated in these activities

in 1992. Hiking, recreational vehicle (RV) camping, and nature study were popular with residents and tourists. With the exception of RV camping, participation by residents outnumbered tourist participation.

TABLE F-28: DEMAND FOR SELECTED RECREATION ACTIVITIES IN FLORIDA USER-OCCASIONS (THOUSANDS), 1992

Activity	Resident	Tourist	Resident & Tourist	% of Total
Hunting	1,656	34	1,690	4%
RV Camping	2,992	5,659	8,651	19%
Tent Camping	1,260	825	2,086	5%
Hiking	5,220	3,668	8,887	20%
Horseback Riding	3,155	491	3,647	8%
Nature Study	4,645	2,215	6,859	15%
Canoeing	846	555	1,401	3%
Total	27,235	18,271	45,506	100%

Source: Florida Department of Environmental Protection, 1994.

Table F-29 presents participation rates for the same set of recreation activities during 1985 and 1992. In general, residents have higher participation rates than tourists, and participation rates for both groups have declined from 1985 to 1992.

TABLE F-29: PARTICIPATION RATES FOR SELECTED RECREATIONAL ACTIVITIES (1985, 1992)

	% of Residents Participating		% of Tourists Participating	
Activity	1985	1992	1985	1992
Hunting	11%	2%	0%	0%
RV / Trailer Camping	8%	3%	4%	5%
Tent Camping	10%	3%	1%	1%
Hiking	10%	6%	3%	3%
Horseback Riding	8%	3%	0%	0%
Nature Study	17%	5%	4%	3%
Canoeing	10%	3%	1%	1%

Source: Florida Department of Environmental Protection, 1994

Table F-30 present projected 2005 and 2010 demands for the selected recreation activities in SCORP Planning Region 11. This table includes user-occasions as well as facility/resource needs. As part of the without-project conditions, all of the regions are expected to have significant increases in demands for the

selected recreation activities with a commensurate need to increase development of the regions' recreation resources and facilities.

TABLE F-30: DEMAND AND FACILITY NEEDS (2005 AND 2010) SELECTED RECREATION ACTIVITIES, TREASURE COAST (SCORP REGION 11)

Activity	Units	Demand (user-occasions)		Resources / Facility Needs	
		2005	2010	2005	2010
Hunting	Acres	733,076	772,849	178,481	235,428
RV / Trailer Camping	Camp Sites	2,562,521	2,779,565	0	0
Tent Camping	Camp Sites	1,043,150	1,136,981	201	317
Hiking	Miles	1,524,454	1,672,767	352	415
Freshwater Fishing	Feet	868,971	924,095	10,686	12,051
Nature Study	Miles	1,784,927	1,988,143	0	0
Bicycle Riding	Miles	22,432,994	24,089,784	1,471	1,608

Source: Florida Department of Environmental Protection, 2000

F.6.1.7 State Tourism Trends

As described in the SCORP, 49 million domestic and international visitors to Florida per year comprise a significant portion of the overall demand for outdoor recreation resources in Florida. Their participation in resource-based recreation and their relatively high incomes (compared to resident recreationists) make tourists a significant component of BCWPA-related recreation in the study area. The Comprehensive Review Study detailed the importance of tourism on the recreation in Florida.

F.6.1.8 Potential Changes in Value of Recreation

The BCWPA impoundments can support a significant amount of outdoor recreation in the Lower East Coast of Florida, with a significant portion of expenditures coming from tourists. Based on the recent adverse effects related to environmental damage of the ecosystem, it may be concluded that improving the environmental quality of the BCWPA ecosystem will substantially support and sustain local recreation-based businesses. Given the potential levels of expenditures and consumer surplus in the future, a small percentage increase in the quantity or quality of BCWPA-related recreation could represent an increase in recreation value.

There are potential recreation resources that will be associated directly with the construction of the impoundment. The uses presently considered compatible with resource protection and passive recreation include: freshwater fishing, horseback riding, hiking, off-road bicycling, wildlife viewing and nature study.

F.6.2 Recreation Benefits

Appendix G contains a conceptual plan of recreational features proposed for the BCWPA Project. Since this plan is the same for all alternatives, this recreation plan will not influence the plan selection process. The recreational plan was prepared in coordination with the non-Federal sponsor (SFWMD).

The recreation plan includes three sites within the BCWPA Project footprint. The following types of multiple purpose trails are planned at each site: at WCA 3A/3B SMA, a 13-mile improved surface trail; at C-11 Impoundment, a 9-mile looped natural trail; and at C-9 Impoundment, a 7-mile looped natural trail. Other amenities include vaulted toilets, benches, parking lots, land bridges, canoe launches, and information kiosks. The total cost of the three recreation sites are estimated at $6,446,000.

The national economic development (NED) benefit evaluation procedures contained in ER 1105-2-100 (22 Apr 00), Appendix E, Section VII, include three methods of evaluating the beneficial and adverse NED effects of project recreation: travel cost method (TCM), contingent valuation method (CVM), and unit day value (UDV) method.

The UDV method was selected for estimating recreation benefits associated with the creation of the BCWPA Impoundment. The UDV approach in recreation benefit analysis consists of two parts: determining value per visit and estimating visitation. Application of the selected value to estimate annual use over the project life, in the context of the with- and without-project framework of analysis, provides the estimate of recreation benefits.

The without project condition in this analysis has no recreation value since the BCWPA impoundments would not exist and the land would not be open to the public. It is presumed that the impoundment must be open to the public in order to realize the recreation benefits being claimed. The with-project condition will be the expected value of the recreational activity based on the UDV method.

Economic justification is determined by examining the benefit to cost ratio and net benefits of the proposed recreation sites. The economic justification of the proposed recreation sites can be examined by comparing the equivalent average annual costs with the estimate of the equivalent average annual benefits that would be realized over the period of analysis. These average annual recreation benefits and costs are summarized in ***Table F-31.***

Engineering Regulation 1105-2-100 (The Planning Guidance Notebook) provides economic evaluation procedures to be used in all Federal water resources

planning studies. The guidelines specified in the ER 1105-2-100 dated 22 April 2000 were observed in preparing this cost analysis. The Fiscal Year 2012 Federally mandated project evaluation interest rate of 4.0 percent, an economic period of analysis of 38 years and FY 2012 prices were used to evaluate the economic feasibility of the BCWPA recreation sites.

The value of a day of general recreation was computed at $7.45. The number of visits per year was estimated at 184,690. Average annual benefits were estimated at $1,376,000. Average annual cost was estimated at $748000. A summary of the economic feasibility is shown in ***Table F-31***. A benefit to cost ratio of 1.8 to 1 and net annual benefits equaling $628,000 were calculated based on the conceptual plan.

TABLE F-31: SUMMARY OF COSTS AND BENEFITS

Benefit	
Unit Day Value (FY2011)	$7.45
Average Annual Daily Users	506
Average Annual Users	184,690
Average Annual Benefit (rounded)	**$1,376,000**
Cost	
Total Recreation Initial Cost	$6,446,000
Interest during PED and Construction	$53,000
Total Investment Cost	$6,499,000
Average Annual Cost	$336,000
Annual O&MRR&R Cost	$412,000
Average Annual Cost	**$748,000**
Benefit to Cost Ratio	1.84
Average Annual Net Benefits	$628,000

This analysis concludes that there are 1.84 times the benefits to costs. The average annual net benefit for the BCWPA recreation sites is estimated at $628,000. Therefore, the BCWPA recreation sites are economically justified.

F.6.3 Recreational and Commercial Fishing

Fishing in the study area is recreational. The existing canals in the BCWPA study area do not provide opportunities for commercial fishing. Recreation fishing is very popular and abundant in this area. Shore fishing, as well as canoes and small trolling boats are used in the canals for recreational purposes. The boat ramps that are currently in existence will remain open. It can be noted

that recreational fishing benefits will not cause a negative impact on the local economy, but the additional benefits will in all likelihood, be too minimal to measurably impact the economy.

F.7 PLAN EVALUATION

Upon identification of the final array of alternatives, each alternative plans benefits were quantified using performance measures; and costs were calculated for each plan. An analysis was conducted using Cost Effectiveness and Incremental Cost Analysis (CE/ICA) which maximizes environmental benefits compared to costs and resulted in the identification of the National Ecosystem Restoration (NER) plan.

F.7.1 Ecological Evaluation Methodology

USACE ecosystem restoration studies typically measure the ecosystem benefits of alternative plans in terms of physical dimensions (number of acres of wetlands, for example), or population counts (number of wading birds, for example), or various habitat-based scores (habitat units [HU] based on the FWS's Habitat Evaluation Procedures [HEP], for example). The BCWPA team utilized three Performance Measures to quantify the ecological output of alternatives. These Performance Measures were evaluated with spreadsheet tool that utilizes hydrologic modeling results, management measure size and operation, and available hydrologic data to derive a HU score that represents the ecological lift achieved by each alternative. This method evaluated benefits within three major indicator zones present within the project area (cattail/sawgrass marsh, snail kite foraging and ridge and slough).

F.7.2 Planning Level Cost Estimates

The cost estimate for the alternatives includes construction, lands, easements, right-of-ways, and relocation (LERR), pre-construction, engineering and design (PED) costs, and construction management. Data for initial construction/implementation, land acquisition, monitoring, and periodically recurring costs for OMRR&R, have been developed through engineering design and cost estimation, and real estate appraisal efforts

F.7.2.1 Real Estate Costs

A detailed analysis of the real estate requirements of the final array of alternatives was completed. Each parcel required for construction or restoration activities was identified, characterized, and a value calculated. The real estate was valued in fee, however, lesser estates and interests in land could be considered. See Appendix D for detailed real estate information.

F.7.2.2 Construction Costs

Data for initial construction/implementation, land acquisition and periodically recurring costs for operation, maintenance, repair, replacement and rehabilitation (OMRR&R), have been developed through engineering design and cost estimation, and real estate appraisal efforts. Details of that data development are explained and discussed elsewhere in this report. The main issues requiring economic evaluation attention include equivalent time basis calculations, price levels, and timing of project spending. (Refer to ***Appendix B - Cost Estimates*** for details of data development for cost estimates).

Costs represent the difference between conditions without any plan (the "base condition" or "without project condition") and with a plan or alternative. For purposes of this report and analysis, NED costs (National Economic Development costs, as defined by federal and USACE policy) are expressed in 2010 price levels. Costs of a plan represent the value of goods and services required to implement and operate/maintain the plan. The costs presented in ***TABLE F-32*** are total initial costs of construction and real estate. The operation and maintenance (O&M) cost are annual estimates for fully implemented components.

TABLE F-32: INITIAL COST OF CONSTRUCTION, REAL ESTATE AND O&M

BROWARD COUNTY WATER PRESERVE AREA COSTS				
	A1	**A4**	**F1**	**F4**
Construction	**$527,300,000**	**$502,800,000**	**$371,600,000**	**$344,700,000**
C-11	$267,540,000	$240,600,000	$267,540,000	$240,605,000
SMA	$104,080,000	$104,100,000	$104,075,000	$104,100,000
C-9	$155,680,000	$158,100,000	$0	$0
Total Construction				
Real Estate	**$368,737,000**	**$361,900,000**	**$347,950,000**	**$339,790,000**
C-11	$203,546,000	$195,386,000	$203,546,000	$195,386,000
SMA	$144,400,000	$144,400,000	$144,400,000	$144,400,000
C-9	$20,789,000	$22,120,000	$0	$0
Total Initial Cost	**$896,037,000**	**$864,700,000**	**$719,550,000**	**$684,490,000**
Annual OMRR&R	**$3,050,000**	**$1,620,000**	**$3,030,000**	**$1,540,000**

*Costs are planning level costs based on a rough order of magnitude and do not coincide exactly with the detailed costs of the TSP presented in other sections of the report.

F.8 COMPARISON OF ENVIRONMENTAL BENEFITS AND COSTS OF ALTERNATIVE PLANS

This analysis is based on and follows guidance from the U.S. Army Corps of Engineers Institute for Water Resources publication, Evaluation of Environmental Investment Procedures Manual, Interim: Cost Effectiveness and Incremental Analyses, May 1995, IWR Report #95-R-1. Costs are based initially on a rough order of magnitude (ROM) and include pre-construction engineering and design (PED) and construction costs, Interest During Construction, as well as operations and maintenance costs after construction. The most feasible cost effective plans reflect estimates based on ROM quantities. Benefits are based on the result of the certified ecological performance measure analysis and are presented in an average annual form.

As per this guidance, CE/ICA analysis compares the alternative plans' average annual costs against the appropriate average annual habitat unit estimates. The average annual outputs are calculated as the difference between with-plan and without-plan conditions over the period of analysis (through year 2050). The following sections present the average annual costs, average annual benefits and the results of cost effectiveness and incremental cost analysis for the alternative plans

The purpose of a CE/ICA is to evaluate and compare the production efficiency of a given set of alternatives, thus helping to identify the plan that reasonably maximizes ecosystem restoration, which is considered the NER plan. Cost effectiveness analysis begins with a comparison of the costs and outputs of alternative plans to identify the least cost plan for every level of output considered. Alternative plans are compared to identify those that would produce greater levels of output at the same cost, or at a lesser cost, as other alternative plans. Alternative plans identified through this comparison are the cost effective alternative plans. Next, through ICA, the cost effective alternative plans are compared to identify the most economically efficient alternative plans, that is, the "Best Buy" alternative plans that produce the "biggest bang for the buck." Cost effective plans are compared by examining the additional (incremental) costs for the additional (incremental) amounts of output produced by successively larger cost effective plans. The plans with the lowest incremental costs per unit of output for successively larger levels of output are the best buy plans. The results of these calculations and comparisons of costs and outputs between alternative plans provide a basis for addressing the decision question "Is it worth it?" i.e., are the additional outputs worth the costs incurred to achieve them?

F.8.1 Average Annual Benefits

CE/ICA requires a comparison of average annual costs and average annual benefits. The average annual outputs were calculated as the difference between with-plan and without-plan conditions over the period of analysis (through year 2050). Costs and output used for the CE/ICA are displayed in ***TABLE F-32***. The period of analysis for benefit amortization that was utilized is 40 years. The base year, or the first year benefits begin to accrue, is in 2010 (period of analysis at the time of evaluation assumed advance construction by the local sponsor). The average annual HU lift is calculated as subtracting the future without project HUs from the future with project HUs for each year and averaging over the life of the project, which in this case is 40 years. Note that the output values shown reflect the differences between without project and with project on an average annual basis (i.e., ecological "lift" provided by each of the alternatives). In order to calculate the average annual lift associated with each alternative per community, it is important to project the anticipated time it will take to realize the benefits. The annual lift is calculated by measuring the delta between the no action alternative and each respective alternative for each year of the period of analysis. Since the full benefits are not achieved in the first year of construction, it becomes important to project the expected lift for each year and average each year over the period of analysis, to account for the temporal aspect of the benefits.

The following table ***(TABLE F-33)*** includes the average annual lift when taking into account the ecological response time.

TABLE F-33: AVERAGE ANNUAL HABITAT UNITS

	ALT A1	ALT A4	ALT F1	ALT F4
PM 1. Cattail Reduction (TP Loading Reduction)	8,235	8,618	4,150	4,149
PM 2. Snail Kite Habitat	119,021	129,772	119,021	129,772
PM 3. ENP Ridge and Slough Benefits	24,920	27,821	24,920	27,821

F.8.2 Average Annual Costs

For purposes of this report and analysis, NED costs (NED costs, as defined by Federal and USACE policy), are expressed in 2010 price levels and are based generally on costs estimated to incur over a 40-year period of economic analysis, depending on the length of construction. These costs are included in ***TABLE F-32*** and were used in the cost effectiveness analysis of the alternatives.

The timing of a plan's costs is important. Construction and other initial implementation for component costs cannot simply be added to periodically recurring costs for project operation, maintenance and monitoring. Construction costs incurred in a given year of the project cannot simply be added to construction costs incurred in other years if meaningful and direct comparisons of the costs of the different components are to be made. A common practice of equating sums of money across time with their equivalent at an earlier single point in time is the process known as discounting. Through this mathematical process, which involves the use of an interest rate (or discount rate) officially prescribed by Federal policy for use in water resource planning analysis (currently set at 4.125 percent per year), the cost time stream for the alternative plans were mathematically translated into an equivalent time basis value.

There is some uncertainty as to how any of the plans, if approved and adopted, would be implemented. It is recognized that any of the plans would likely be implemented over a considerable length of time. For purposes of this evaluation, construction costs are assumed to incur on an equal monthly basis during the implementation of the alternative plans as defined.

ER 1105-2-100 requires that interest during construction be computed, which represents the opportunity cost of capital incurred during the construction period. Interest was computed for pre-construction, engineering and design costs from the middle of the month in which the expenditures were incurred until the first of the month following the estimated construction completion date. Interest during construction was computed for both real estate and construction costs. Interest during construction was computed for the total real estate cost starting from the month prior to construction commencing. The cost of a project is the investment incurred up to the beginning of the period of analysis. The investment cost at that time is the sum of construction and other initial cost such as real estate and pre-construction, engineering and design cost plus interest during construction. ***TABLE F-34*** summarizes the total investment cost and total annual equivalent costs of each alternative plan.

TABLE F-34: PLANNING LEVEL CONSTRUCTION AND INVESTMENT COST OF ALTERNATIVE PLANS

BCWPA INVESTMENT COST				
	Alternative A1	Alternative A4	Alternative F1	Alternative F4
Total Construction	$527,300,000	$502,800,000	$371,600,000	$344,700,000
Real Estate	$368,737,000	$361,900,000	$347,950,000	$339,790,000
Total Initial Cost	$896,037,000	$864,700,000	$719,550,000	$684,490,000
IDC Construction	$26,614,300	$25,377,700	$18,755,700	$17,397,900
IDC Real Estate	$41,970,000	$41,190,000	$39,600,000	$38,670,000
TOTAL INVESTMENT	$964,621,300	$931,267,700	$777,905,700	$740,557,900
O&M	$3,050,000	$1,620,000	$3,030,000	$1,540,000
Amortized Cost (40 Years)	$49,646,000	$47,930,000	$40,040,000	$38,110,000
Average Annual Cost	$52,696,000	$49,550,000	$43,070,000	$39,650,000

*Note – Final Costs of Selected Plan will be revised based on additional engineering and design. NER costs do not include Recreation Cost for Plan Formulation

*Costs are planning level costs based on a rough order of magnitude and do not coincide exactly with the detailed costs of the TSP presented in other sections of the report.

The total cost of CERP is not included in these project costs. The cost of the balance of the CERP features, those not included in the BCWPA alternatives, is the same for all the BCWPA alternatives. As such, including it in this analysis does not bring any additional insight or differentiation between alternatives. For this analysis, the difference between the alternatives can be shown through a display of the outputs and costs of each BCWPA alternatives without the cost of the "other CERP" features.

F.8.3 Cost Effectiveness Analysis

Cost effectiveness analysis begins with a comparison of the annual costs and annual outputs of alternatives to identify the least cost plan for every level of output considered. Alternative plans are compared to identify those that would produce greater levels of output at equal or lower costs than other alternative plans. The three criteria for cost effectiveness screening:

1. The same output level could be produced by another plan at less cost;
2. A larger output level could be produced at the same cost; or
3. A larger output level could be produced at less cost.

Sometimes it is difficult to summarize the results of CE/ICA when the analyses are performed separately on HUs for distinct species or communities. This phenomenon often occurs simply because the project benefits relating to differing ecological attributes have differing types, scales or significance. This is the case for the BCWPA, in which certain features or alternatives provide greater benefits to different communities of the WCA and the greater everglades. It was determined that the main functions of reducing seepage and reducing nutrient loading were of equal importance to ecological attributes, while the spatial impacts of the performance measures functions were substantially different. It was also believed that a combined HU score, calculated by summing all three performance measures' outputs, while not appropriately representing the significance of each community, would provide a valuable cumulative impact analysis for determining the plan which best meets the needs of the watershed. However, without a normalized comparison, the benefits to one community may significantly overshadow another when subjected to a comparative economic analysis. Therefore a sensitivity analysis incorporating normalized results has also been conducted to provide support for identifying the National Ecosystem Restoration (NER) Plan.

This sensitivity analysis is displayed following the CE/ICA analysis on combined results.

F.8.4 Cost Effectiveness Analysis – Combined Habitat Units

CE/ICA was conducted for all four of the BCWPA alternative plans. The analyses compared the alternative plans' average annual costs against its corresponding average annual HU estimates. The average annual outputs were calculated as the mean difference between with-plan and without-plan conditions over the period of analysis (through year 2050). A summary of the average annual lift calculations and average annual costs used in the CE/ICA analysis are provided in ***TABLE F-35***.

TABLE F-35: COSTS AND OUTPUTS USED IN CE/ICA

Alternative	Annual Cost	Combined Habitat Units
A1	$52,696,000	152,176
A4	$49,550,000	166,211
F1	$43,070,000	148,091
F4	$39,650,000	161,742

TABLE F-36 and ***Figure F-9*** show that Alternative F4 and Alternative A4 are the only alternatives that are cost effective in the production of combined habitat. Alternative F4 has the lowest annual cost per unit of output. Alternative A4 has about 3% more combined habitat units than Alternative F4, while costing approximately 25% more. As can be noted from earlier discussion, the increase in Habitat Units when comparing the A-series and F-series alternatives is solely due the greater capacity of the A-series to capture excess storm water runoff and thereby reduce cattail spread by a greater extent. Even though the total aggregated benefits only increase by 3% from the F-Series to the A-Series, when considered independently, the cattail benefits increase by more than 50%, hence the requirement for additional analysis using normalized average.

TABLE F-36: COST EFFECTIVENESS ANALYSIS: ALL PLANS ARRAYED BY INCREASING OUTPUT FOR EACH OUTPUT CATEGORY –COMBINED HABITAT UNITS

Alternative	Annual Cost	Combined Habitat Units	Cost Per HU	Cost Effective
No Action Plan	$0	0		
F1	**$43,070,000**	148,091	$291	No
F4	**$39,650,000**	161,742	$245	Yes/Best Buy
A1	**$52,696,000**	152,176	$346	No
A4	**$49,550,000**	166,211	$298	Yes/Best Buy

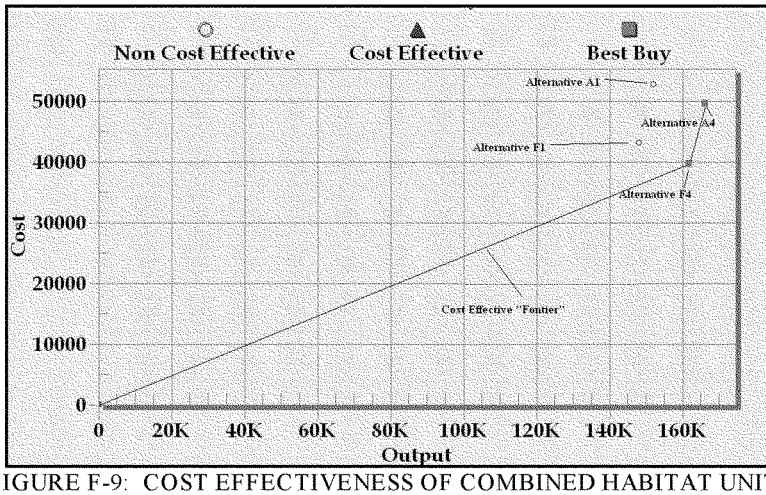

FIGURE F-9: COST EFFECTIVENESS OF COMBINED HABITAT UNITS

F.8.5 Incremental Cost Analysis – Combined Habitat Units

The plan with the lowest incremental costs per unit of output of all plans is the first best buy plan. After the first best buy plan is identified, all larger cost effective plans are compared to the first best buy plan in terms of increases in (increments of) cost and increases in (increments of) output. The alternative plan with the lowest incremental cost per unit of output (for all cost effective plans larger than the first best buy plan) is the second best buy plan.

Table F-38 and ***Figure F-10*** present the results of the incremental cost analysis for the Broward County Water Preserve Area for the Combined Habitat Units. There are two plans that are identified as Best Buy plans; Alternative F4 and Alternative A4. As shown in ***Figure F-10*** there is a large increase in incremental costs. In light of this cost jump, and in order to fully understand whether Alternative A4 warrants consideration for recommendation, it is important to examine what is actually being gained from the marginal lift, and how the Alternatives compare when the output of the performance measures is normalized.

TABLE F-37: INCREMENTAL COST ANALYSIS: COST EFFECTIVE AND BEST BUY PLANS FOR COMBINED HABITAT UNITS

	Average Annual Cost	Output	Average Cost Per Unit of Output	Incremental Average Annual Cost	Incremental Output	Incremental Cost Per unit of Output
Combined Habitat Units						
Without Plan	$0	0	N/A	N/A	N/A	N/A
F4	**$39,650,000**	**161,742**	**$245**	**$39,650,000**	**161,742**	**$245**
A4	**$49,550,000**	**166,211**	**$298**	**$9,900,000**	**4,469**	**$2,215**

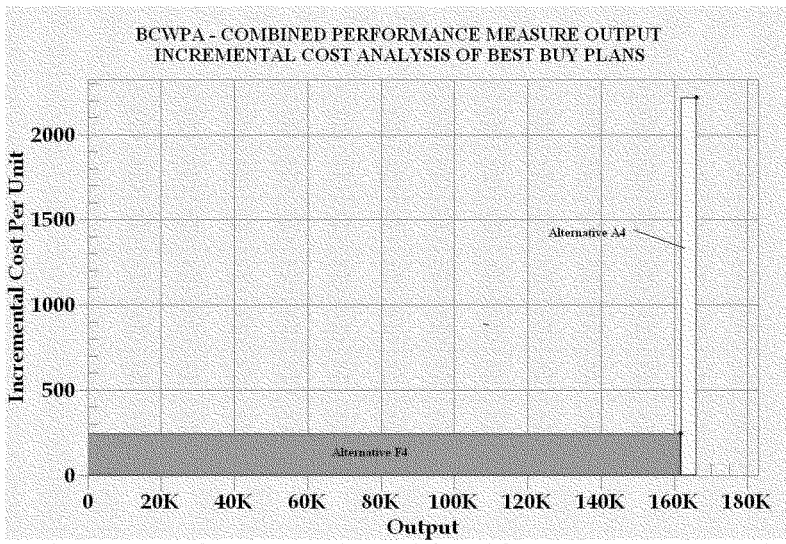

FIGURE F-10: INCREMENTAL ANALYSIS OF COMBINED HABITAT UNITS

F.8.6 Sensitivity Analysis – Normalized CE/ICA

As can be noted from the preceding table and figure resulting from the combined performance measure analysis, there are two best buy alternatives. The decision to identify the National Ecosystem Restoration plan from among these plans centers around the question "Is it worth it?" In order to estimate total benefits for each of the various alternatives, it was desirable to be able to perform

CE/ICA on a metric that combines all the objective performance measures. However, simply adding habitat units can prove problematic in determining how well each of the objectives are being met, because the habitat units for the performance measures are at vastly different scales (i.e., there is approximately an order of magnitude difference just in the geographic areas occupied by each resource) and represent very different metrics (i.e., the habitat units for the different resource categories represent quantity and quality of very different ecosystem resources).

In order to reflect the individual importance and relative value in achieving project objectives, it was beneficial to normalize the results of the performance measures. There are many different techniques for normalizing results: percent of target, percent of max, percent of total, unit vector analysis, and other statistical approaches. The percent of max is typically the approach that is utilized, and was incorporated into the BCWPA analysis, in lieu of the spatial ratio approach. The habitat units resulting from the performance measure calculations were divided by a common variable to cancel out the scale effect on the data and allow the underlying characteristics of the data sets to be compared.

The BCWPA Project is needed primarily to perform two equally important goals: (1) reduce seepage loss from WCA 3A and WCA 3B and (2) capture and store excess surface water runoff from the Western C-11 Basin that is currently discharged untreated into the WCA 3, thus reducing nutrient loading to the natural system, and results of project actions are measured through three Performance Measures. The function of reducing seepage loss is mainly attributed to the WCA 3A/3B SMA and principally influences the benefits captured in Performance Measures 2 and 3 (Snail Kite and Ridge and Slough). The function of capturing surface water runoff is the predominant factor in predicting the output from Performance Measure 1 (cattail expansion rate reduction).

Cattail Habitat Unit calculations were performed for an acutely specific area within WCA3. This area is projected to become a monoculture of cattails in the future without project condition, and would be dominated by only one type of habitat. Areas of potential effect are clearly noted spreading out from major canals and water conveyance structures and dispersal areas and are expected to be directly overwhelmed by cattail. As such, the acreage utilized in the Habitat Suitability Index is relatively well-defined compared to the whole of WCA3. The cattail habitat unit calculations were applied to an area that is approximately 25,000 acres.

The Snail Kite performance measure was applied across the area of WCA3 that was not included in PM 1 (557,000 acres); and the Ridge and Slough performance measures was applied across a large landscape of the greater

everglades (193,000 acres). Compared to the monoculture of cattail in PM 1, these areas are composed of heterogeneous plant communities and landscape types, thus it is nearly impossible to separate out specific areas to characterize precise Snail Kite or Ridge and Slough benefits. Hydrologic targets served as the metric for establishing benefits throughout the entire influence zone, but in some places the direct ecological impact of PM 2 or 3 may be as small as 10%, while in other areas it may be as much as 80%. Since the acreage for the entire area was included in the Habitat Suitability Index for the benefit calculations it is not appropriate to directly compare the habitat units for cattails versus Snail Kite and Ridge and Slough on an even basis.

As can be seen in the above PM descriptions and following figure, ***Figure F-11***, there is a large scale difference between the geographic areas where the PM's are being addressed, yet the importance of each performance measures to the project objectives is considered equal.

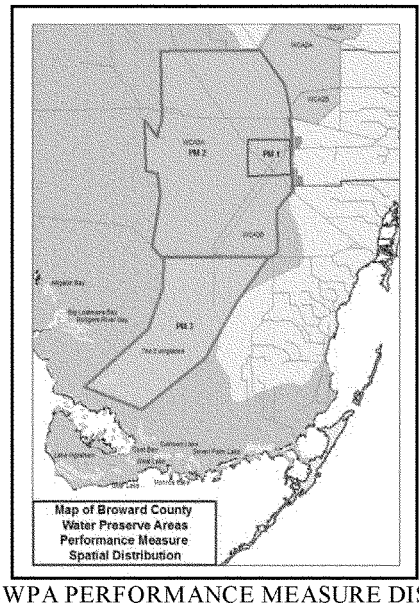

FIGURE F-11: BCWPA PERFORMANCE MEASURE DISTRIBUTION MAP

The normalization method used was "percent of maximum", in which the maximum output achieved for each performance measure for each of the alternatives was assigned a "1", and the output values for other alternatives for that same performance measure were scaled as a percentage of that maximum (between 0 and 1). The three performance measures were then averaged to produce a combined normalized index. For example, value of 1 would thus be

assigned to an alternative that provides the maximum output value for all habitat unit categories, while a value of 0.5 would equate to the output value for an alternative that only provides 50% of the maximum output provided by the "largest" alternative (a hypothetical "largest" alternative in terms of delivering the maximum output of every habitat type). While other normalization techniques exist (e.g., percent of range, percent of total, unit vector), the percent of maximum is the most widely used technique and is usually the default method. Thus, a combined, normalized metric was calculated to perform CE/ICA on all outputs provided by alternatives.

The formula used to calculate the combined normalized index is expressed as:

Combined Index $Alt_i = (Alt_i\ (PM1Alti/PM1_{max}) + Alti(PM2_{Alti}/PM2_{max}) + Alti(PM3_{Alti}/PM3_{max}))/3$

Where:
Alt_i = Alternative i through n
PMi_{max} = maximum HU's produced by any single Alternative i through n for respective performance measure

TABLE F-38: NORMALIZED SNAIL KITE AND RIDGE AND SLOUGH HABITAT UNITS

	ALT A1	ALT A4	ALT F1	ALT F4
PM 1. Cattail Reduction HU	8,235	8,618	4,150	4,149
Normalized PM 1. HU	0.96	1.00	0.48	0.48
PM 2. Snail Kite HU	119,021	129,772	119,021	129,772
Normalized PM 2. HU	0.92	1.00	0.92	1.00
PM 3. ENP Ridge and Slough HU	24,920	27,821	24,920	27,821
Normalized PM 3. HU	0.90	1.00	0.90	1.00
Combined Normalized Index	**0.92**	**1.00**	**0.76**	**0.83**

Note: Numbers may not add up exactly due to rounding.

TABLE F-39: COSTS AND OUTPUTS USED IN NORMALIZED CE/ICA

Alternative	Annual Cost	Normalized Output
A1	$52,696,000	0.92
A4	$49,550,000	1.00
F1	$43,070,000	0.76
F4	$39,650,000	0.83

F.8.7 Cost Effectiveness Analysis – Normalized Combined Outputs

TABLE F-42 and ***Figure F-12*** show that similarly to the combined analysis, Alternatives F4 and Alternative A4 are cost effective when examining the total normalized habitat unit production. However, when normalization of performance measures is taken into account, the output increases 20% (as opposed to 3% without normalization) while the average annual cost increases 25%.

TABLE F-40: RESULTS OF COST EFFECTIVENESS ANALYSIS: ALL PLANS ARRAYED BY INCREASING OUTPUT FOR EACH OUTPUT CATEGORY– COMBINED HABITAT UNITS

Name	Annual Cost	Normalized HU's	Cost Per HU	Cost Effective
No Action Plan	0	0		
F1	$43,070,000	0.76	$56,671,052	No
F4	$39,650,000	0.83	$47,771,084	Yes
A1	$52,696,000	0.92	$57,575,000	No
A4	$49,550,000	1.00	$49,550,000	Yes

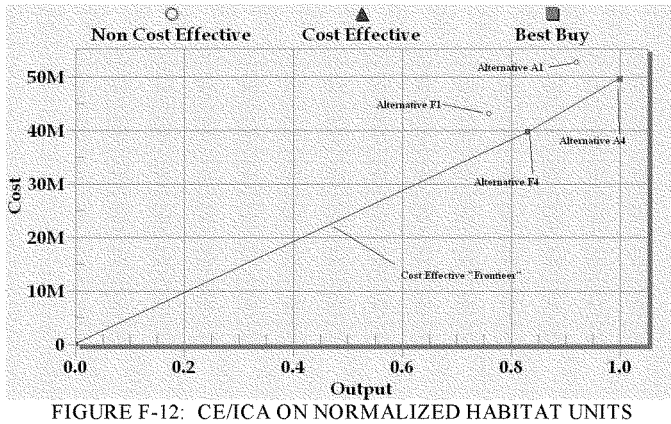

FIGURE F-12: CE/ICA ON NORMALIZED HABITAT UNITS

F.8.8 Incremental Cost Analysis – Normalized Habitat Units

TABLE F-41 and ***FIGURE F-13*** present the results of the incremental cost analysis for the Broward County Water Preserve Area for the Normalized Habitat Units. Similarly to the combined (non-normalized) analysis, there were two alternatives identified as "best buy" plans, Alternative F4 and A4, but as noted in the normalized cost effectiveness analysis, there is a much lower marginal increase in cost per unit of output.

TABLE F-41: INCREMENTAL COST ANALYSIS: COST EFFECTIVE AND BEST BUY PLANS FOR NORMALIZED HABITAT UNITS

	Average Annual Cost	Output	Average Cost Per Unit of Output	Incremental Average Annual Cost	Incremental Output	Incremental Cost Per unit of Output
Combined Habitat Units						
Without Plan	$0	0	N/A	N/A	N/A	N/A
F4	**$39,650,000**	**0.83**	**$47,771,084**	**$39,650,000**	**0.83**	**$47,771,084**
A4	**$49,550,000**	**1.00**	**$49,550,000**	**$9,900,000**	**0.17**	**$58,235,294**

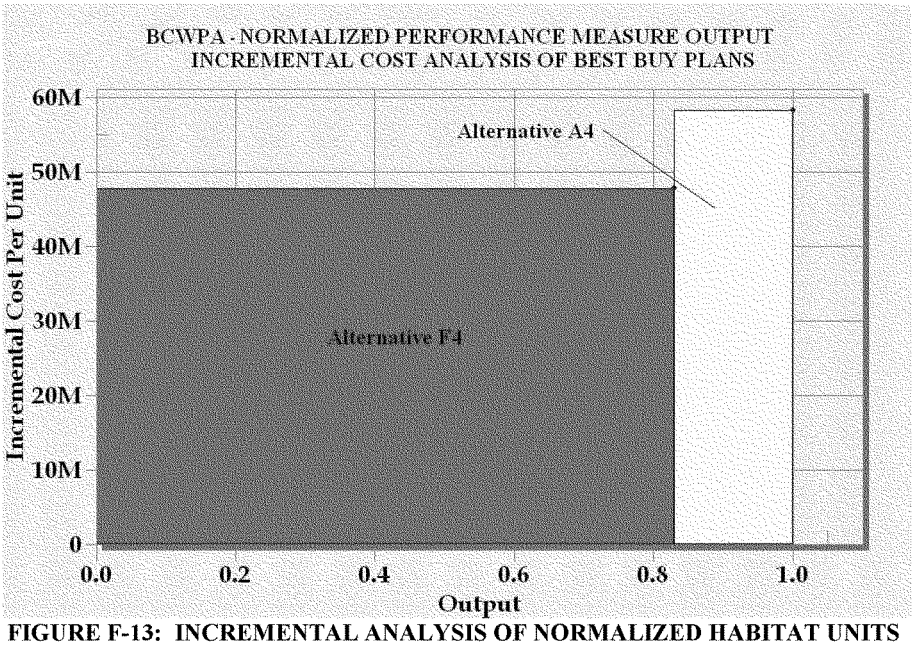

FIGURE F-13: INCREMENTAL ANALYSIS OF NORMALIZED HABITAT UNITS

F.8.9 Summary of Cost Effectiveness/Incremental Cost Analysis

As can be seen in the following summary table, Alternative A4 is a cost effective and best buy plan when examining the results of both the combined and normalized analyses. Alternative F4 was identified as a best buy plan only when normalization was not considered.

TABLE F-42: RESULTS OF CE/ICA

	Alternative F1	Alternative F4	Alternative A1	Alternative A4
Combined Habitat Units		Cost Effective/Best Buy		Cost Effective/Best Buy
Normalized Habitat Units		Best Buy		Cost Effective/Best Buy

Assumptions regarding variables impact the conclusions drawn from an analysis. As such, there is a degree of uncertainty surrounding variables and

the potential for inconsistent results. A sensitivity analysis provides a reasonable way of addressing uncertainties. In regards to BCWPA benefit calculations, a normalized and non-normalized combined method of examining production efficiencies of alternatives was conducted and the results of both methods support Alternative A4 as a best buy plan.

While addressing the marginal lift each component provides, it can be demonstrated the interdependence of components. As previously noted, the WCA 3A/3B SMA is the primary feature that leads to hydrologic improvement, thereby meeting ecological targets, for Performance Measures 2 and 3. The WCA 3A/3B SMA alone would negatively impact the WCA by causing increased ponding, and since the impoundments cannot function without the WCA 3A/3B SMA acting to offset the impoundments reduction in water deliveries to the WCA, it proves useful to compare the two impoundments direct impact on cattail reduction holding the WCA 3A/3B SMA constant. The C-9 Impoundment cannot operate without the C-11 Impoundment, so the logical first increment to examine is the C-11 Impoundment. The C-11 Impoundment costs approximately $530,000,000 and provides ~4,000 acres of cattail reduction. Including the C-9 Impoundment increases the costs by approximately 35% while providing a larger than 100% increase in cattail benefits (~8,500 acres of cattail reduction). These results clearly highlight the increasing marginal utility of the C-9 Impoundment.

F.9 REGIONAL ECONOMIC IMPACTS

F.9.1 Overview

This chapter examines the potential effects of the SAP on the RED account. The RED account registers indirect and secondary effects to the region that are expected to result from the direct economic effects of the alternative plans. Direct economic effects represent the impacts of economic stimuli in terms of changes in regional industrial output, earnings, or employment. Indirect economic impacts represent the resultant economic changes in the industries that support and rely upon the industries directly affected by the stimuli. In addition, induced economic impacts are those impacts experienced by all local industries as direct and indirect effects alter household income and ultimately change local household spending patterns.

F.9.2 Methodology

A regional input-output model, IMPLAN, was used to estimate the RED effects of the BCWPA Recommended Plan. Regional input-output (I-O) analysis provides the classic tool for tracing economic impacts throughout the regional economy. Based on the region's industrial structure, I-O analysis tracks the expected inter-industry flow of goods and services. For the RED analysis, the regional economy was defined as encompassing Broward County using IMPLAN.

Using county-level economic data, which was procured from the software vendor, the model was used to estimate the economic effects of the SAP on wages, employment, and production output (sales). Specifically, IMPLAN was employed in a four-part methodology to: (1) describe the study area economy, (2) create economic scenarios, (3) introduce economic changes, and (4) estimate resulting direct, indirect, and induced economic effects.

F.9.2.1 Real Estate and Effects of Other Land Acquisitions

Real estate sales may result in various impacts to the local economy. The sale of land may be regarded as a simple change in which the owner held the value in real estate and now holds an equal value in cash. If the cash is spent locally or reinvested in regional enterprise, then new economic activity might be stimulated in the region and even more funds might be leveraged by the enterprise.

Alternatively, a real estate transaction resulting in a transfer of funds into a regional bank may experience a general economic expansion in the region as supported through the banking multiplier if the funds are invested locally. If, however, there is foreign or corporate land ownership, then the expansionary effects of large transfers of funds may not occur in the study area. A similar result would occur if funds were held in a foreign bank. Additionally, if the land is owned by a governmental agency, then it may just be a land transfer resulting in very little regional economic effect.

Due to the ambiguity of the ultimate use of real estate funds, the expenditures on land were not input into the IMPLAN model. Therefore, the regional impacts of real estate purchases were assumed to be minimal and not calculated. If it were possible to know more about the future use of these funds, expenditures for land, commissions, leases, appraisal fees, title fees, and other administrative activities involved with real estate, those values could be used in the IMPLAN analysis or another model. However, even with a higher degree of certainty regarding the future of this knowledge, it is anticipated that the financial inputs would be marginal, and any regional impact model would have significant reliability concerns.

F.9.3 IMPLAN Regional Economic Effects Results

The direct economic effects and aggregated indirect and induced economic effects are presented for the final array of alternatives. RED effects have only been calculated for construction expenditures and not for changes resulting from impacts to navigation, water usage, flood control or real estate expenditures. Economic impacts to total industry output and employee compensation are expected to persist through each year of construction. Wages include salaries,

non-wage compensation, and benefits. Employment is measured as the number of jobs, not necessarily full-time equivalents.

TABLE F-43 and ***TABLE F-44*** present the IMPLAN output for direct, indirect, and induced impacts of the final array on regional output (sales) and employee compensation and

TABLE F-45 provides an indicator of the employment effects of the construction expenditures. These impacts account for less than one percent of total economic activity in each of the different output categories.

TABLE F-43: DIRECT, INDIRECT AND INDUCED IMPACTS ON REGIONAL OUTPUT AS A RESULT OF IMPLAN MODEL RUNS

	Direct	Indirect	Induced	Total
Alternative F1	$527,300,000	$159,984,453	$195,693,015	$882,977,468
Alternaitve F4	$344,700,000	$104,583,047	$127,926,005	$577,209,052
Alternative A1	$527,300,000	$159,984,453	$195,693,015	$882,977,468
Alternative A4	$502,800,000	$152,551,077	$186,600,508	$841,951,585

TABLE F-44: DIRECT, INDIRECT AND INDUCED IMPACTS ON EMPLOYEE COMPENSATION AS A RESULT OF IMPLAN MODEL RUNS

	Direct	Indirect	Induced	Total
Alternative F1	$266,434,894	$64,290,079	$81,752,443	$412,477,416
Alternaitve F4	$247,147,761	$59,636,142	$75,834,411	$382,618,314
Alternative A1	$378,070,828	$91,227,553	$116,006,628	$585,305,009
Alternative A4	$360,504,480	$86,988,837	$110,616,599	$558,109,916

TABLE F-45: DIRECT, INDIRECT AND INDUCED IMPACTS ON EMPLOYMENT AS A RESULT OF IMPLAN MODEL RUNS (2006 DOLLARS)

	Direct	Indirect	Induced	Total
Alternative F1	1,584	977	1,143	3,703
Alternative F4	1,469	906	1,060	3,435
Alternative A1	2,247	1,386	1,621	5,255
Alternative A4	2,143	1,322	1,546	5,011

F.10 OTHER SOCIAL EFFECTS

F.10.1 Overview

The Other Social Effects (OSE) account considers the effects of alternative plans in areas that are not already contained in the NED and RED accounts. The categories of effects contained within the OSE account include:

- Urban and community impacts;
- Life, health, and safety factors;
- Displacement;
- Long-term productivity; and
- Energy requirements and energy conservation.

The BCWPA Project alternative restoration plans could result in beneficial and adverse OSE within the study area. As is evident throughout this appendix, a variety of positive and adverse NED impacts on water supply, flood damage reduction and recreation are expected to result from BCWPA restoration. Similarly, the alternative restoration plans could have positive or adverse OSE impacts on the study area associated with (1) plan implementation, including land acquisition, project construction, and operations and maintenance (O&M) activities, and (2) operation of the modified C&SF system. As in the case of the NED effects, the OSE account is concerned with the net effects of the alternative plans (i.e., the differences between the with- and without-project future conditions).

Some of the potential OSE impacts would occur primarily at the regional scale, and others would have more localized effects. At both scales, there may be some individuals and communities that are positively affected by BCWPA restoration, some that are adversely affected, and many that are not affected at all. Relative to the size of the regional or local economies, the OSE effects may be minimal. However, if these effects occur predominantly within a limited geographic area, or affect a relatively small or vulnerable population, then the impacts can be disproportionately large. Therefore, the purposes of OSE analysis include not only determining the total magnitude of potential impacts, but also identifying the population (and its characteristics) that would be affected by any proposed action.

Some of the categories of effects typically included in the OSE account do not pertain to the alternative restoration plans. For example, the alternative plans are not expected to affect energy use or energy conservation in the study area. As will be noted, other categories of potential OSE impacts have been addressed previously in this appendix.

F.10.2 Potential Urban and Community Impacts

An urban and community impact is the principal category of potential OSE impacts associated with the alternative restoration plans. This category of impacts includes effects on income distribution, employment distribution, population distribution and composition, and quality of community life. Some urban and community impacts have previously been addressed in this appendix. For example, regional income effects and fiscal impacts were discussed in the Regional Economic Development analysis. In addition, the impacts of agricultural water supply and municipal and industrial water supply were discussed in detail in earlier sections. The OSE assessment of urban and community impacts considers both the potential for exposure to the effects of the alternative restoration plans and the degree of vulnerability to potential impacts. Exposure refers to whether an individual or community is subject to the other social effects of the alternative plans. Vulnerability refers to the ability of that individual or community to respond or adjust to those effects.

Potential urban and community impacts of the alternative restoration plans could result from: (1) land acquisition and potential relocation of populations for reservoir and other project construction features, (2) reduced agricultural activity associated with taking the reservoir lands out of cultivation, and (3) construction activity associated with plan implementation. In general, construction activity is considered to have positive impacts. At the local scale, construction and O&M activities associated with the alternative restoration plans can have positive effects to local residents and communities by providing jobs, increasing local wages, increasing local sales, increasing tax revenues and generally benefiting the local economy.

There are a variety of social and economic factors that are important determinants of an individual or community's ability to cope with adversity. One of the most important economic factors in the ability of individuals and groups to respond is the number of employment alternatives available locally. The ability to find another job depends on the education and training of the work force as well as the needs of local economic concerns, such as other farms, agricultural-related services, or some other local business. The socio-economic makeup of the community is also an important consideration of the ability of individuals and the community at large to cope with the adverse effects of large-scale agricultural land conversion. Some groups in society are recognized as having less opportunity to respond to adversity. These groups include ethnic and racial minorities, the elderly, and the poor. ***Table F-46*** presents a socio-economic vulnerability profile for Broward County. This profile contains information that indicates the ability of the county population to respond to social and economic adversity. It is important to recognize that the county scale may not accurately reflect the ability of any given community or groups within a community to accommodate potential changes associated with the alternative

restoration plans. More detailed studies of individual communities are not warranted until the potential reservoirs have been sited.

Table F-46 contains the racial/ethnic mix of each of the study area counties, as well as population over 65 years of age, 2000 unemployment, per capita income, and the expected changes in employment and income.

Broward County has a wide range of ethnic compositions, proportions of elderly population, unemployment rates, and per capita incomes. These socio-economic characteristics suggest that the rural counties of the study area – those that are expected to provide locations for new storage reservoirs – are areas that are least able to accommodate the associated economic and social effects on local communities. However, in these rural areas the affected populations should be relatively small.

Although the restoration of the BCWPA ecosystem is a unique undertaking, there have been other projects and programs with similar goals and socio-economic contexts. One study conducted by the U.S. Department of the Interior assessed the national and regional economic impacts of not allowing timber harvests in certain old-growth forests in Oregon in order to protect the northern spotted owl. One aspect of this study investigated the re-employment of timber workers who had been displaced by the cessation of local logging activities. Surveys of displaced loggers suggested that they found that 57% of displaced workers reported post-displacement wages equal to or above their previous wages. According to the bureau of labor statistics, 92% of displaced workers find new jobs within one year, and the remaining 8% find jobs within two years.

TABLE F-46: 2005 BROWARD COUNTY SOCIO-ECONOMIC VULNERABILITY PROFILE

Asian	White	Black	American Indian	Hispanic	Other	Population Over 65 (2000)	Unemployment Rate (2000)	2000 Per Capita Income**	Percent of Population Below Poverty Level
3.1	51.2	21.3	0.2	20.8	3.4	4.6	3.3	107.48	11.5

Source: Fedstats.gov
*** (% relative to state average)*

F.11 ENVIRONMENTAL JUSTICE

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires the Federal Government to achieve environmental justice by identifying and addressing high, adverse and disproportionate effects of its activities on minority and low-

income populations. E.O. 12898, Environmental Justice, states that the proposed action would not result in adverse human health or environmental effects. Any impacts of the action would not be disproportionate towards any minority or low-income population. The activity does not (a) exclude persons from participation in, (b) deny persons the benefits of, or (c) subject persons to discrimination because of their race, color, or national origin. The activity would not impact "subsistence consumption of fish and wildlife." It requires the analysis of information such as the race, national origin, and income level for areas expected to be impacted by environmental actions. It also requires Federal agencies to identify the need to ensure the protection of populations relying on subsistence consumption of fish and wildlife, through analysis of information on such consumption patterns, and the communication of associated risks to the public.

The BCWPA Project will provide benefits to quality of life by improving the natural environment we live in. The BCWPA Project's feature of wetland restorations and improved water discharge, which by design, are in locations remote from urban populations such that negative impacts are eliminated for all communities. The BCWPA Project is a congressionally approved project funded with Federal and State dollars to make improvements to hydrology for man and the environment.

The BCWPA Project does not present any environmental impacts that are high, adverse and disproportionate to low income, minority or Tribal populations. Through the public participation process of the outreach and NEPA scoping no high and adverse impacts became known. There was sufficient public input to feel confident that scoping was successful and that the breadth of the potential impacts were communicated and understood by the public. Therefore with no high and adverse impacts there is nothing that would require a disproportionate impact analysis. Thus this NEPA process has found no evidence of high, adverse and disproportionate impacts.

Project sites are located based upon hydrologic characteristics, land availability and interconnection to existing canals and structures to optimize operations. Furthermore, in the consideration of the project site, urban areas are avoided to eliminate the negative impacts typically associated with site location of large projects. Through "willing seller agreements" a variety of land rights have been or will be acquired that allow the use of land for the resulting improvements to the human quality of life and the intended environmental benefits intended by the BCWPA Project.

These environmental benefits provide quality of life improvements to all people and primarily to people in the communities within the BCWPA study area. By the nature of design, this operating procedure will maintain if not improve flood

damage reduction. This will improve the quality of human life by providing increased wildlife activity; a special bonus for those who appreciate seeing increases in fish and bird populations. This logically translates to the increased benefits in enjoyment, aesthetics, and economics for recreational activities.

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APPENDIX G

RECREATION

TABLE OF CONTENTS

G.0 RECREATION G-1
G.1 AUTHORIZATION G-1
G.2 INTRODUCTION G-1
G.3 RECREATION FEATURES AND COSTS G-3
G.3.1 Study Area G-3
G.3.2 C-9 Impoundment Recreation Site G-5
G.3.3 C-11 Impoundment Recreation Site G-7
G.3.4 Water Conservation Area 3A/3B Seepage Management Area (WCA 3A/3B SMA) Recreation Site G-10
G.3.5 Total and Average Annual Costs of All Recreation Sites Combined G-12
G.4 RECREATION BENEFITS G-13
G.4.1 Determining Value per Visit G-13
G.4.2 Estimating Visitation G-17
G.5 ECONOMIC JUSTIFICATION G-20

LIST OF TABLES

Table G-1: Recreation Features of C-9 Impoundment G-6
Table G-2: Recreation Features of C-11 Impoundment G-9
Table G-3: Recreation Features of 3A/3B SMA G-11
Table G-4: Total and Average Annual Costs G-13
(October 2010 Price Levels) G-13
Table G-5: Guidelines for Assigning Points for General Recreation G-15
Table G-6: Conversion of Points to Dollar Values FY11 ..... G-17
Table G-7: Estimated Visitation for Biking and Hiking: SCORP Resource Capacity Approach G-18
Table G-8: Estimated Visitation Using Physical Capacity Approach G-19
Table G-9: Summary of Costs and Benefits G-21

LIST OF FIGURES

Figure G-1: BCWPA Project Study Area Map G-4
Figure G-2: C-9 Impoundment Recreation Features G-7
Figure G-3: C-11 Impoundment Recreation Features G-10
Figure G-4: 3A/3B SMA Recreation Features G-12

G.0 RECREATION

G.1 AUTHORIZATION

The Comprehensive Everglades Restoration Plan (CERP), authorized by the Water Resources Development Act of 2000 (WRDA 2000), will involve modifying the Central and Southern Florida (C&SF) Project, which was constructed with extensive Congressional authorizations from the 1944 Flood Control Act to the Water Resources Development Act of 1996. The Federal Water Project Recreation Act (P.L. 89-72) and the Water Resources Development Act of 1986 (P.L. 99-662) provide additional guidance. Recreation features proposed for this project must be compatible with the authorized project purposes, affordable within project limits, and easily operated and maintained. Further specific CERP design guidance was signed on May 12, 2000, in the form of the Department of the Army and South Florida Water Management District Design Agreement for Everglades and South Florida Ecosystem Restoration Project.

Additional authorization and guidance for the proposed ancillary recreation resources development is contained in CECW-AG, 11 June 1998 Memorandum, Policy Guidance Letter No. 59, Recreation Development at Ecosystem Restoration Projects and EP 1165-2-502. Despite austere budgets and policy requirements, recreational developments can and do contribute to community health and well being (CECW, 1998). The recreation resources that are being proposed as part of the CERP Broward Water Preserve Area (BCWPA) Project will comply with the philosophy and inclusion of the check list of new facilities which may be provided in recreation developments at Corps water resources projects, will be economically justified, and will fall within ten percent of the total project costs. The proposed recreation is recommended for approval to be implemented under existing Section 103 authority will be cost shared for construction 50-50 and Operation, Maintenance, Repair, Rehabilitation and Replacement (OMRR&R) is a 100% Non-Federal Sponsor (NFS) responsibility.

G.2 INTRODUCTION

This appendix contains a description of the conceptual recreation plan for the BCWPA Project. This analysis will determine the net benefits for the proposed recreation sites at the C-9 Impoundment, C-11 Impoundment and Water Conservation Area 3A/3B Seepage Management Area (WCA 3A/3B SMA). The plan consists of 29 miles of designated trails including 9 miles looped around C-11 Impoundment, 7 miles looped around C-9 Impoundment, and 13 miles of north-south improved trail on levee L-37 which is on the west side of WCA 3A/3B SMA. C-11 Impoundment and C-9 Impoundment will provide the bottom side of the berm for horseback riding and the top-side of the berm for the other noon-motorized trail activities.

Recreation features are being included in the BCWPA Project as an incidental project benefit. These recreation benefits will not be used in the justification of the recommended plan. South Florida Water Management District (SFWMD) in coordination with the Corps of Engineers and other interested entities provided the conceptual design of the recreation facilities. A determination of final design will be performed during the detail design phase or plans and specifications phase. The Corps of Engineers' cost estimators provided MCACES cost estimates for the conceptual design of these recreation sites and facilities. Total costs for recreation facilities at the three sites including construction costs, non-construction costs and interest during construction is estimated at $6,499,000.

The BCWPA impoundments are expected to increase opportunities for biking, horseback riding, hiking, wildlife viewing, nature study, fishing and canoeing. The 2000 Florida Statewide Comprehensive Outdoor Recreation Plan (SCORP) identifies the proposed project area as part of Region 11 comprised of Broward, Dade and Monroe Counties. Recreation deficits through 2010 identified by the SCORP 2000 for this region as it relates to this project include; bicycle riding, nature study, freshwater fishing (non-boat), and hiking.

The Everglades Holiday Park which is adjacent to the WCA 3A/3B SMA proposed recreation facility and C-11 Impoundment currently experiences over 350,000 visitors per year from all over the state and the nation. The BCWPA proposed recreation facilities, especially WCA 3A/3B SMA proposed recreation facilities, are very likely to attract similar types and numbers of visitors because of their geographic proximity to the Everglades Holiday Park and large public interest in the Everglades.

The features of the BCWPA recreation plan will not require additional real estate to be purchased. All features will be compatible with the environmental purposes of the impoundment, and will not detract from the environmental or socioeconomic benefits being generated by the project. Public access will not be allowed for motorized vehicles such as airboats, power boats, ORVs, OHVs, and swamp buggies due to unresolved issues relating to project incompatibility and liability. Public access will be provided for bicycles, pedestrians, equestrians and non-motorized boats. The nature-based activities that will be permitted in and around the impoundment include bicycle riding, horseback riding, nature study, wildlife viewing, walking, canoeing and kayaking, and fishing. All are well-suited to the environmental purposes of this project. Due to the proximity of the project to developed areas, an evaluation of whether hunting activities should occur may need to be conducted by the Florida Fish and Wildlife Conservation Commission.

Construction of the inflow pump structure at the C-11 Impoundment could interrupt existing equestrian trail use of the northern levee of the C-11 Canal.

The design of the C-11 Impoundment should maintain the connectivity of this existing public use of the northern C-11 Canal right of way. Based on cost considerations, safety, and compatibility with the project goals and purposes, the current equestrian trail uses should not experience any major adverse impacts.

G.3 RECREATION FEATURES AND COSTS

G.3.1 Study Area

The study area for the recreation benefit analysis is within Broward County, Florida. The BCWPA study area is located along the eastern edge of the remaining Everglades ecosystem and on the western edge of Fort Lauderdale and its suburbs. The study area includes the proposed project area, WCA 3A and 3B, and the western portions of C-11 and C-9 drainage basins which includes the Village of Weston, Town of Davie, Town of Southwest Ranches, Cooper City, Pembroke Pines and Miramar (***Figure G-1***).

Drainage basins established by local drainage districts that reside, partially and wholly within the project area, include the following along C&SF Canal 11 (C-11): South Broward Drainage District, Central Broward Water Control District, and Indian Trace Development District. Together, these agencies make up what is known as the Western C-11 Basin. Local drainage districts located along the C&SF C-9 Canal include the following: South Broward Drainage District and various municipalities that provide some control over incorporated limits. Together, these agencies make up what is known as the C-9 Basin.

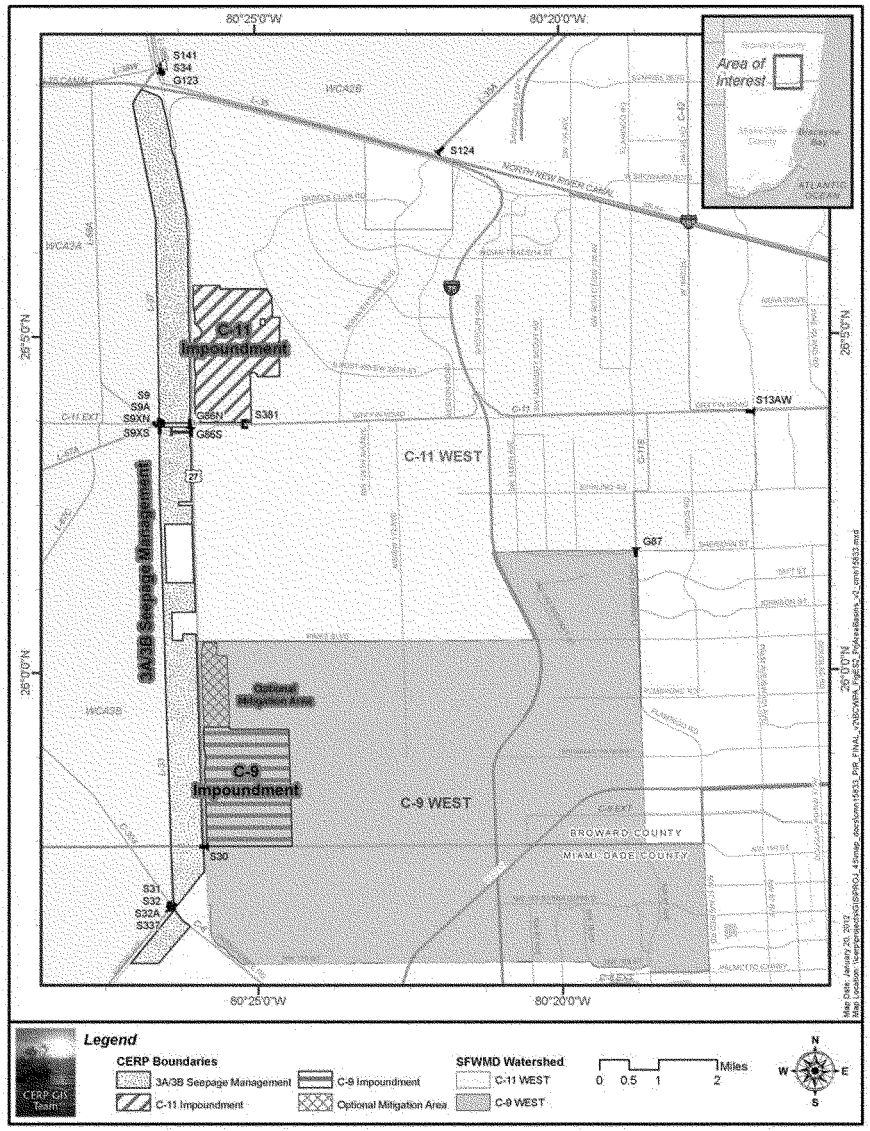

FIGURE G-1: BCWPA PROJECT STUDY AREA MAP

G.3.2 C-9 Impoundment Recreation Site

An existing transition lane off US Highway 27 in the southwest corner will provide access to this site. This entrance will also serve as the staff entrance to the expected location of water control structures along this southern levee (L-33). The final site location will be chosen by the designers during the detail design phase or plans and specifications phase. A staging area is proposed for the construction of the BCWPA C-9 Impoundment at this place. It would be used for the recreation parking. A parking area for visitors to the C-9 Impoundment recreation site is planned to be 90' by 200' allowing for 10 cars and 20 vehicles with trailers with a 90' turning radius for school buses. This conceptual design proposes an information kiosk, shaded benches, footbridges, a canoe launch with a platform walkway, trash barrels, protective fencing, signage and two vaulted toilets with solar fans. This site will provide access to the regional greenway trail system. The southern boundary of the C-9 Impoundment is the C-9 Canal's northern Right Of Way (ROW) which is an existing part of the Broward County Greenways and needs to be linked to the levees of the C-9 Impoundment. During design, placement of culverts in canals as land bridges or footbridges will be necessary to ensure continued east west connectivity and provide a connection from the greenway to the impoundment levee. Several water control structures may be located along the southern boundary of the C-9 Impoundment. It may be reasonable from a cost and operations perspective to maintain east west continuity of the Greenways trail by providing footbridges to cross and return across the C-9 Canal, thus providing access along the southern side of the C-9 Canal which is SFWMD ROW and also in Miami/Dade County (***Figure G-2***). This redirection of public access to bypass several control structures may allow the public less interruption due to operations and maintenance that would be expected to occur. No additional recreation costs will be needed for the trail system, since this will be on levees that are part of the project construction. The total initial cost estimate for this site is rounded to **$1,932,500** as shown in ***Table G-1***.

TABLE G-1: RECREATION FEATURES OF C-9 IMPOUNDMENT

Feature	Quantity
Footbridge	3
Benches	5
Trash Barrels	10
Canoe Launch with Platform Walkway	1
Kiosk 12' by 15' With 2 Benches'	1
Parking Area (2,000 sq. yds.) with Handicap Access and Service Road	2,000 sq. yd
Vault Toilet with Solar Fan	2
Site Grading & Landscaping	1
Protective Fencing	1
Signage	1
Planning, Engineering and Design	N/A
Construction Mgmt.	N/A
C-9 Site Total	**$1,932,500**

Figure G-2 depicts the locations of recreation features for the C-9 Impoundment.

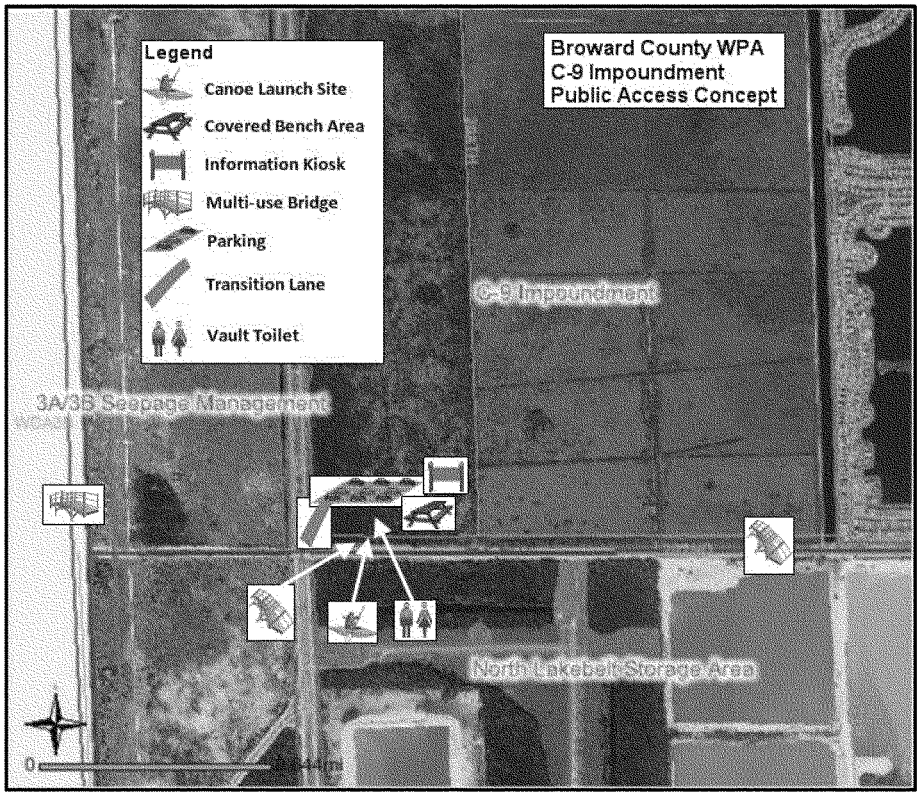

FIGURE G-2: C-9 IMPOUNDMENT RECREATION FEATURES

G.3.3 C-11 Impoundment Recreation Site

One of several existing transition lanes off US 27 can provide access to this site. It is proposed that one staging area for the construction of the C-11 Impoundment could occur at this place. A parking area for visitors to the impoundment is planned to be 90' by 200' allowing for 10 cars and 20 vehicles with trailers with a 90' turning radius for school buses. The final site will be chosen by the designers during the detail design phase or plans and specifications with the understanding that locating the public access site adjacent to the truck stop is not an acceptable alternative. The heavy traffic at the truck stop is a potential safety hazard as well as unfit for recreational aesthetics. There is also a proposed canoe launch with a platform walkway at this impoundment, an information kiosk, shaded benches, footbridges, trash barrels, protective fencing, and two vaulted toilets with solar fans. This site will

provide access to the trail system and the canals. The southern boundary of the C-11 Impoundment is the C-11 Canal's northern ROW which is an existing equestrian trail and needs to be linked to the levees of the C-11 Impoundment. During design, placement of culverts in canals as land bridges or footbridges will be necessary to ensure continued east west connectivity and provide a connection from the equestrian trail to the impoundment levee. Several water control structures may be located along the southern boundary of the C-11 Impoundment. It may be reasonable from a cost and operations perspective to maintain east west continuity of the equestrian trail by providing a footbridge in the SE portion of the impoundment to cross south and return north across the C-11 Canal at an existing SFWMD structure thus providing access along the southern side of the C-11 Canal, which is also SFWMD ROW (***Figure G-3***). This redirection of public access to bypass several control structures may allow the public less interruption due to operations and maintenance that would be expected to occur. No additional recreation costs will be needed for the trail system, since this will be on levees that are part of the project construction. The total initial cost estimate for this site is rounded to $2,229,000 as shown in ***Table G-2***.

TABLE G-2: RECREATION FEATURES OF C-11 IMPOUNDMENT

Feature	Quantity
Footbridge	3
Benches	5
Trash Barrels	10
Canoe Launch with Platform Walkway	1
Kiosk 12' by 15' With 2 Benches'	1
Parking Area (2,000 sq yd) with Handicap Access and Service Road	2,000 sq yds
Vault Toilet with Solar Fan	2
Site Grading & Landscaping	1
Protective Fencing	1
Signage	1
Planning, Engineering and Design	N/A
Construction Mgt	N/A
C-11 Site Total	**$2,229,000**

Figure G-3 depicts the recreation features for the C-11 Impoundment.

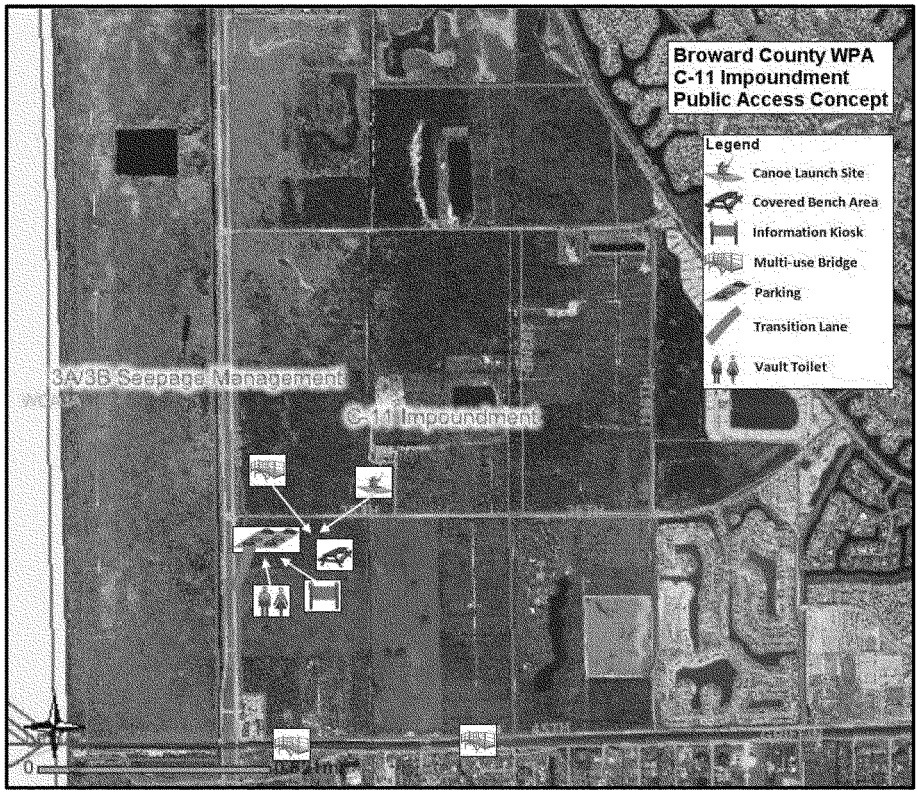

FIGURE G-3: C-11 IMPOUNDMENT RECREATION FEATURES

G.3.4 Water Conservation Area 3A/3B Seepage Management Area (WCA 3A/3B SMA) Recreation Site

Access to this recreation site is by Griffin Road. Parking is located on the south side of Griffin Road on the east side of the L-37 Borrow Canal and will provide connectivity to the existing recreation site in Everglades Holiday Park. The WCA 3A/3B SMA recreation area consists of a footbridge over the C-11 Canal that connects the north and south areas of the WCA 3A/3B SMA. The foot bridge allows people to get around the S-9 pump. Two canoe launches are proposed: one in WCA 3A SMA and one in WCA 3B SMA each accessing the borrow canal inside the project along the L37 levee (**Figure G-4**). The parking area for visitors to the seepage management recreation area is designed to be 90' by 200' allowing for 10 cars and 20 vehicle trailer with a 90' turning radius for school buses. The conceptual design proposes an information kiosk, shaded

benches, a footbridge, two canoe launches with platform walkways, two bike racks, protective fencing, signage and two vault toilets with solar fan and a 13 mile trail with an improved surface. The total initial cost estimate for this recreation site is $2,285,000 as shown in **Table G-3.**

TABLE G-3: RECREATION FEATURES OF WCA 3A/3B SMA

Feature	Quantity
Footbridge	1
Benches	5
Bike Racks (8 unit)	2
Trash Barrels	10
Canoe Launch with Platform Walkway	2
Kiosk 12' by 15' With 2 Benches'	1
Parking Area (2,000 sq yd) with Handicap Access and Service Road	2,000 sq yd
Vault Toilet with Solar Fan	2
Site Grading & Landscaping	1
Protective Fencing	1
Signage	1
Improved Surface Trails	13 miles
Planning, Engineering and Design	1
Construction Mgt	N/A
WCA 3A/3B SMA Site Total Cost	**$2,285,000**

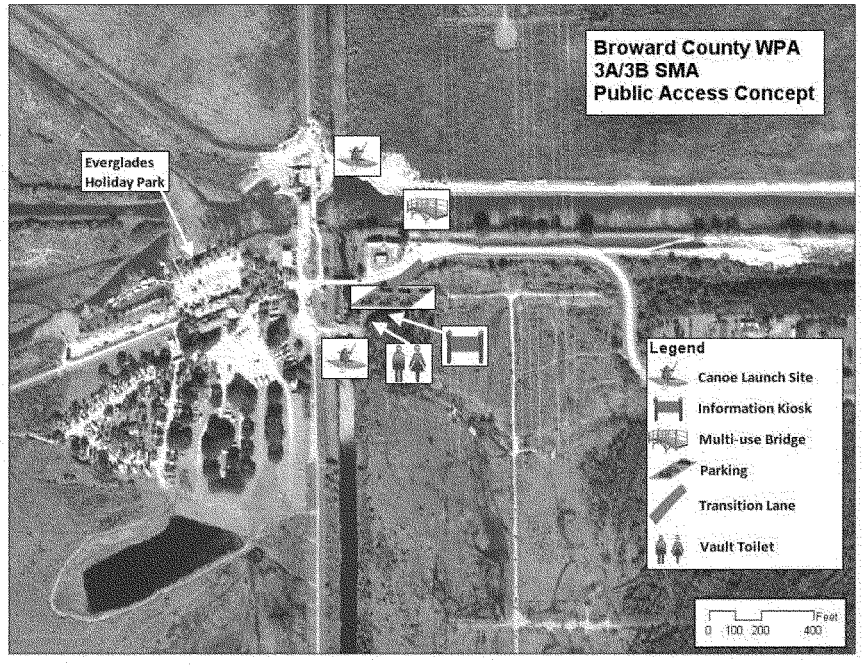

FIGURE G-4: WCA 3A/3B SMA RECREATION FEATURES

G.3.5 Total and Average Annual Costs of All Recreation Sites Combined

The total initial cost, which consists of construction and non-construction costs, for the recreational features at C-9 Impoundment, C-11 Impoundment and WCA 3A/3B SMA is $6,446,000. Interest during construction, which is estimated to last 6 months at an interest rate of 4.00 percent, is equal to $53,000. The total investment cost equals the total initial cost plus the interest during construction. Total investment cost is $6,499,000. The average annual cost of the total investment cost over a 38 year period of analysis at 4.00 percent is $336,000. Average annual Operation and Maintenance, Repair, Rehabilitation and Replacement (OMRR&R) is estimated for each site as 5 percent of construction cost plus $30,000 for toilet compost, trash collection and routine cleanup and maintenance. The total cost for OMRR&R is $412,000. The total average

annual cost, which consists of total investment cost and OMRR&R cost, is estimated at $748,000.

TABLE G-4: TOTAL AND AVERAGE ANNUAL COSTS (OCTOBER 2011 PRICE LEVELS)

	Costs*
Recreation Construction First Cost (FY 12)	**$6,446,000**
Interest During Construction	$53,000
TOTAL INVESTMENT COST	**$6,499,000**
Amortized Cost (4.00% & 38 yrs)	$336,000
Annual O&MRR&R Cost	$412,000
AVERAGE ANNUAL COST	**$748,000**

G.4 RECREATION BENEFITS

The national economic development (NED) benefit evaluation procedures contained in ER 1105-2-100 (22 Apr 00), Appendix E, Section VII, include three methods of evaluating the beneficial and adverse NED effects of project recreation: travel cost method (TCM), contingent valuation method (CVM), and unit day value (UDV) method.

The unit day value (UDV) method was selected for estimating recreation benefits associated with the recreation of the BCWPA Project. The UDV approach in recreation benefit analysis consists of two parts: determining value per visit and estimating visitation.

G.4.1 Determining Value per Visit

When the UDV method is used for economic evaluations, planners select a specific point value from the range of values for 5 different criteria. This point value is then converted into a dollar value. Application of the selected dollar value to the estimated annual use over the project life, in the context of the with- and without-project framework of analysis, provides the estimate of recreation benefits.

The without project condition in this analysis has no recreation value since the BCWPA impoundments would not exist and the land would not be open to the public. It is presumed that the impoundments must be opened to the public in order to realize the recreation benefits being claimed. The with-project condition will be the expected value of the recreational activities based on the UDV method. ***Table G-5*** illustrates the method of assigning a point value to general

recreation activities. The table also shows the point values assigned based on measurement standards described for the five criteria of number and quality of activities, the facilities ability to achieve the intent of the selected alternative, relative scarcity or the number of substitutes within a given travel time, ease of access, and aesthetic factors.

TABLE G-5: GUIDELINES FOR ASSIGNING POINTS FOR GENERAL RECREATION

Criteria	Judgment factors				
Recreation experience Total Points: 30	Two general activities	Several general activities	Several general activities: one high quality value activity	Several general activities; more than one high quality high activity	Numerous high quality value activities; some general activities
Point Value: 10	0-4	5-10	11-16	17-13	24-30
Availability of opportunity Total Points: 18	Several within 1 hr. travel time; a few within 30 min. travel time	Several within 1 hr. travel time; none within 30 min. travel time	One or two within 1 hr. travel time; none within 45 min. travel time	None within 1 hr. travel time	None within 2 hr. travel time
Point Value: 3	0-3	4-6	7-10	11-14	15-18
Carrying capacity Total Points: 14	Minimum facility for development for public health and safety	Basic facility to conduct activities	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative
Point Value: 8	0-2	3-5	6-8	9-11	12-14
Accessibility Total Points: 18	Limited access by any means to site or within site	Fair access, poor quality roads to site; limited access within site	Fair access, fair road to site; fair access, good roads within site	Good access, good roads to site; fair access, good roads within site	Good access, high standard road to site; good access within site
Point Value: 12	0-3	4-6	7-10	11-14	15-18
Environmental Total Points: 20	Low aesthetic factors that significantly lower quality	Average aesthetic quality; factors exist that lower quality to minor degree	Above average aesthetic quality; any limiting factors can be reasonably rectified	High aesthetic quality; no factors exist that lower quality	Outstanding aesthetic quality; no factors exist that lower quality
Point Value: 12	0-2	3-6	7-10	11-15	16-20

Point value assignments for ***Table G-5*** above are based on Economic Guidance Memorandum (EGM) 11-03. The Criteria and Judgment Factors for General Recreation were specifically used as the basis of the estimated point values for the proposed recreation area. Judgment factors were based on site visits and

coordination with state and local agencies. The following selection factors were used for the criteria outlined in ***Table G-5***.

* BCWPA impoundments and the WCA 3A/3B SMA proposed recreation resources would provide opportunities for several general recreation activities afforded by the project setting and the project levees adjacent to the Everglades. The sites offer solitude and a very panoramic setting in a growing metropolitan area, and would provide specific recreation amenities (as outlined in ***Table G-5***) for expanding local population and increasing demands for recreation. The environmental restoration component (water storage and release) could help to provide an increase of quality freshwater pier and bank fishing for the region on project lands. Canoe launching, benches and multipurpose trails experiences would be enhanced by the panoramic views and restored environment. These recreation sites will provide several general recreation activities. No high quality activities, activities uncommon to the region and/or nation, are expected to occur. Connections to regional greenway trails are proposed. Therefore, the point value given to this criterion is 10.

* The availability of opportunity rating is based upon current local recreation facilities near the project area in the proposed recreation resource location. A 25-mile radius around the proposed project area represents a fairly dense urban population to the east. A 50-mile radius would include more of the Everglades and a couple of other regional parks and greenways with similar resources. The proposed multi-use trail, freshwater bank fishing, canoe launch and benches would provide unique opportunities in the environmentally restored project area. The proposed recreation resources will help to provide facilities for current and projected statewide Region 11 deficits. Since there are several similar recreation opportunities available within one hour travel time and a few within a 30 minute travel time, the point value given to this criterion is 3.

* The general recreation values are based on the optimum use of the site potential, without overuse of the proposed recreation resources. Good water resources and access to them for non-boat fishing, multi-use trail and environmental observation comprise a large part of the projected recreation resources use. Adequate facilities will be constructed to conduct these activities without deteriorating the resource or activity experience. Peak use is expected to occur during 20 percent of the calendar year. Therefore, the point value given to this criterion was 8.

* The accessibility rating is based upon the availability of local highways, roads and streets in good condition that would provide access to the proposed recreation facilitates. Existing transition lane off US Highway 27 could provide access to these sites. This provides good access to the site along with good roads within the sites. Hence, the point value given to this criterion is 12.

* The environmental quality rating is based upon the existing aesthetic values. The proposed site possesses good aesthetic resources given that the area borders the Everglades with panoramic views. The best aesthetics of the proposed recreation sites could be views from the western WCA 3A/3B SMA levee looking out over the Everglades to the west. Hence, the point value given to this criterion is 12.

The value of a day of general recreation at the proposed recreation sites for the BCWPA Project was determined using the guidelines for Assigning Points for the General Recreation in ***Table G-5***. The points were then converted to dollar values using conversion factors included in the Economic Guidance Memorandum 11-03, Unit Day Values for Recreation, Fiscal Year 2011, which is based on ER 1105-2-100. ***Table G-6*** was used to convert points to a UDV FY2011 dollar amount. The total point value for the recreation sites was determined to be 45. The user day value conversion equivalent is $7.45.

TABLE G-6: CONVERSION OF POINTS TO DOLLAR VALUES FY11

Point Values	General Recreation Values
0	$3.72
10	$4.42
20	$4.89
30	$5.58
40	$6.98
50	$7.91
60	$8.61
70	$9.08
80	$10.01
90	$10.70
100	$11.17

G1.2. Estimating Visitation

The State of Florida's Department of Environmental Protection's Division of Recreation and Parks coordinated and developed the Florida Statewide Comprehensive Outdoor Recreation Plan (SCORP) for 2000. This information is used to derive and project the carrying capacity of the proposed recreation trails and determine unmet demands for different types of recreation.

The 2000 SCORP indicates demand not met for the year 2010 with a few activities associated with the BCWPA proposed recreation sites: bicycling, hiking, and non-boat freshwater fishing. These demands not met will likely be much greater by the year 2050 as population will nearly double. Since there is sufficient excess demand in Region 11 for biking and hiking according to the

SCORP, the resource capacity approach could be used to determine the number of visits per year for these activities. In Region 11, for 2010 estimates, current demands for biking and hiking trails is greater than what is currently supplied. Although there is a shortage of non-boat freshwater fishing resources in Region 11, it consists of only 2 miles. Since there are only significant shortages in biking and hiking trails, the number of average annual visits will be derived only for these activities. Even with the newly proposed recreation trails in the BCWPA Project, biking and hiking trail demands will still exceed the miles of trail supplied. Therefore, the resource capacity approach would be appropriate for evaluating visits for these recreation activities.

The use guidelines for designated biking and hiking trails were based on carrying capacity guidelines adopted by the 2000 SCORP and used by the state park system. They are based on maximum levels of carrying capacity developed by the Division of Recreation and Parks for use and protection of state park resources. The bicycle trail use guideline of 40 to 80 users per mile per day assumes 10 to 20 riders per mile per day with a daily turnover rate of 4. The use guideline for hiking trails, 4 to 20 hikers per mile per day, assumes 1 to 5 groups of 2 hikers per mile per day with a daily turnover rate of 2.

With the proposed BCWPA recreation sites consisting of 29 total miles of trails available for use, the estimated SCORP (2000) low end capacity for bicycling and hiking is 1,160 and 116 users per day, respectively. The estimated SCORP (2000) high end capacity for bicycling and hiking is 2,320 and 580 users per day, respectively (***Table G-7***). These estimates would be defined as the carrying capacity or the maximum number of bicyclers and hikers who can use 29 miles of trail per day while protecting the resource. The practical capacity of recreation trails, however, is much less than their carrying capacity.

TABLE G-7: ESTIMATED VISITATION FOR BIKING AND HIKING: SCORP RESOURCE CAPACITY APPROACH

Activity	Miles of Trail	Users/Mile/Day Low End	Users/Mile/Day High End	Users/Day Low End	Users/Day High End
Biking	29	40	80	1,160	2,320
Hiking	29	4	20	116	580
Total	29	44	100	1,276	2,900

Practical capacity is defined as the maximum annual output of recreation services possible given the existing pattern of consumer recreation behavior. Most people recreate on the weekends or holidays rather than weekdays because

their opportunity cost of work foregone is lower for the former than the latter. They also recreate during the season of the year when the weather is most favorable and during the most suitable hours of the day for a particular recreation activity. The outdoor recreation season in south Florida extends from September through May. This is nine months or approximately 38 weeks. Since peak visitation occurs on weekends and holidays, it was estimated that peak visitation occurs 76 days out of the year. Non-peak or weekday visitation is estimated to occur 190 days out of the year. The practical capacity provides the maximum visitation dictated by consumer behavior and, hence, limiting the carrying capacity of the trails. In addition, the parking facility capacity, in this case, provides yet another limiting factor in the number of users to these sites for those making trips by vehicle.

A new parking area is proposed for each recreation site. In total, the parking lots are limited to 90 spaces. Assuming an average of 3 riders per vehicle with a turnover rate of 4 vehicles per space per day for weekends and holidays, the number of recreation users by vehicle is limited to 1,080 per day. Weekdays may only produce a turnover rate of 2 vehicles per space per day. This would equate to 540 users per day. Therefore, the estimated annual number of users per year during the peak visitation periods is estimated at 82,080 (76 peak days * 1,080 users per day). For 190 days out of the year, there would be approximately 540 users per day or 102,600 (190 off-peak days * 540 user per day) users per year for off-peak days. The total number of users per year is estimated at 184,680 (***Table G-8***). The average annual daily users are estimated at 506. This represents approximately 53 percent of the users per year estimated at the Everglades Holiday Park. Since seasonal effects and parking constraints are real limitations on the number of daily users, the practical capacity method will be used in this analysis for calculating benefits. However, the number of users only represents those coming by vehicle. The number of users from nearby residents that bike to the trails, users that come from the Everglades Holiday Park boating tours and campgrounds and those that bike and hike from the months of June through August would increase the total number of users per year.

TABLE G-8: ESTIMATED VISITATION USING PHYSICAL CAPACITY APPROACH

Season Sept-June	Parking Spaces	Riders Per Vehicle	Turnover in Parking	Users Per Day	Days Available Sept - June	Users Per Year
Peak	90	3	4	1,082	76	82,080
Off-Peak	90	3	2	540	190	102,600
Total						184,680

Even though the SCORP projections for Region 11 show no projected shortage of horseback riding and nature study in the region by the year 2010, the BCWPA impoundments recreation sites proposal is planning to provide these activities for potential users to accommodate the expected demand that will increase as population nearly doubles by the year 2050. These recreation facilities may also function as an outdoor education opportunity for local school students within and around the study area.

With ensuing development within and around the study area and the increase in population projections for the State of Florida, the study team believes there would be ample use of the proposed recreation facilities and by 2050 fully expects a continued shortage in bicycling and hiking activities in Region 11.

G.5 ECONOMIC JUSTIFICATION

Economic justification is determined by examining the benefit to cost ratio and net benefits of the proposed recreation sites. The economic justification of the proposed recreation sites can be examined by comparing the equivalent average annual costs with the estimate of the equivalent average annual benefits that would be realized over the period of analysis. These average annual recreation benefits and costs are summarized in ***Table G-9***.

Engineering Regulation 1105-2-100 (The Planning Guidance Notebook) provides economic evaluation procedures to be used in all Federal water resources planning studies. The guidelines specified in the ER 1105-2-100 dated 22 April 2000 were observed in preparing this cost analysis. The Fiscal Year 2011 Federally mandated project evaluation interest rate of 4.00 percent, an economic period of analysis of 38 years and FY 2012 prices were used to evaluate the economic feasibility of the BCWPA recreation sites.

TABLE G-9: SUMMARY OF COSTS AND BENEFITS

Benefit	
Unit Day Value (FY2011)	$7.45
Average Annual Daily Users	506
Average Annual Users	184,690
Average Annual Benefit (rounded)	**$1,376,000**
Cost	
Total Recreation Initial Cost	$6,446,000
Interest during PED and Construction	$53,000
Total Investment Cost	$6,499,000
Average Annual Cost	$336,000
Annual O&MRR&R Cost	$412,000
Average Annual Cost	**$748,000**
Benefit to Cost Ratio	1.84
Average Annual Net Benefits	$628,000

This analysis concludes that there are nearly 1.84 times the benefits to costs. The average annual net benefit for the BCWPA recreation sites is estimated at $628,000. Therefore, the BCWPA recreation sites are economically justified.

APPENDIX H

REPORT POLICY UPDATES

TABLE OF CONTENTS

H.0 REPORT REVISIONS AND POLICY UPDATES. H-1

H.1 GENERAL. H-1
H.2 REAL ESTATE VALUATION POLICY CHANGE. H-3
H.2.1 Land Acquisition. H-3
H.2.1 Gross Appraisal. H-4
H.3 IN-PROGRESS REVIEW POLICY DIRECTIVES. H-4
H.3.1 Plan Formulation Review. H-5
H.3.1.1 Cost Updates. H-7
H.3.1.2 Real Estate Risk Register / Risk Analysis Update. H-8
H.3.1.3 Construction Risk Register / Risk Analysis Update. H-8
H.3.1.4 Cost Effectiveness and Incremental Cost Analysis Update. H-8
H.3.2 Agency Technical Review. H-9
H.3.3 Planning Model Updates. H-9
H.3.3.1 Planning Model Problems Noted. H-9
H.3.3.2 Planning Model Corrections. H-10
H.3.4.1 NATIONAL ACADEMY OF SCIENCE REVIEW. H-11
H.3.5 SEA LEVEL RISE POLICY. H-11
H.4 CERP POLICY GUIDANCE MEMORANDUM. H-11
H.4.1 ADAPTIVE MANAGEMENT PLAN. H-12
H.4.2 MIGRATORY BIRD SPECIES MONITORING. H-12
H.5 INTERIOR IMPOUNDMENT LEVEE ARMORING POLICY CHANGE. H-12
H.6 VALUE ENGINEERING REQUIREMENTS. H-13
H.7 RESIDUAL AGRICULTURAL CHEMICALS POLICY. H-14
H.8 OTHER CHANGES MENTIONED IN THE EXECUTIVE SUMMARY H-14

ATTACHMENTS

Attachment A – Smyth Report – Plan Formulation Analysis
Attachment B – SFWMD Agricultural Chemicals Request Letter
Attachment C – ATR Certification Letter
Attachment D – Environmental Benefits Model Approval Letter

H.0 REPORT REVISIONS AND POLICY UPDATES.

The recommended plan (Alternative 'A4') has not changed in the updated Broward County Water Preserve Area (BCWPA) Final Integrated Project Implementation Report (PIR) and Environmental Impact Statement (EIS). The purpose of Appendix H – Report Policy Updates, is to discuss new analyses and revisions to the 2007 BCWPA Revised Final PIR/EIS, and why such actions were actions were taken

H.1 GENERAL.

The BCWPA Final PIR/EIS dated, April 2007 was approved by the USACE Civil Works Review Board on 8 June 2007. The Final PIR/EIS notification was published in the Federal Register on May 4, 2007 and the proposed Report of the Chief of Engineers was at the same time sent out for State and Agency Review. Before the Chief of Engineers signed the report, though, the SFWMD submitted a request to change the real estate valuation policy. This required extensive coordination with HQUSACE and ASA(CW) offices.

Additional policy changes were raised in a January 2010 In Progres Review (IPR) meeting and in a 27 May 2010 Policy Guidance Memorandum which discussed requirements for all CERP PIRs and other implementation documents. (both are described below).

A change to local policy, agreed to by the USACE, SFWMD, USFWS and the FWC, resulted in removal of the soil cement 'wave run-up steps' on the inside of impoundment levees. The steps were initially designed and used to prevent wave run-up and levee degradation under storm conditions as required by USACE dam safety regulations.

The final array of alternatives was modified due to new information regarding seepage in the Project area; alternatives with 6-foot impoundments were screened from analysis. However, the recommended BCWPA plan has not changed or been updated. Alternative 'A4' is still the selected plan.

Real estate prices have been revised from the actual acquisition costs to fair market value costs on those lands not cost shared under the Department of Interior Grants.

Construction costs have increased due to inflation and new risk and uncertainty contingency policy.

Agricultural chemical threshold: testing results for the WCA 3A/3B SMA came back acceptable. Additional sampling and testing for selenium is needed for C-11 and C-9 Impoundments to address USFWS concerns of ecological risk interim

thresholds, as described in their 6 August 2010 letter (***Annex A***). Section 7 has been updated to address the HQ-USACE 14 Sept 2011 Agricultural Chemical Policy. In September 2011, the ASA(CW) provided new guidance for CERP Projects concerning Residual Agricultural Chemicals on project lands. (Per the requirements of this policy, the SFWMD sent a letter requesting that this PIR contain a section discussing Residual Agricultural Chemicals (Section 7.11). Appendix A includes a soil management plan.

The environmental benefits modeling has been updated and ATR completed and certified by the Ecosystem Planning Center of Expertise (22 Nov 2010) to comply with EC 1105-2-412 ("Assuring Quality of Planning Models " 31 March 2011). It has been approved for a one-time use by USACEHQ (1 Feb 2011).

An updated cost benefit / cost effectiveness / incremental cost analysis has been provided throughout the PIR/EIS (main report, recreation appendix, economic appendix, etc).

The Ecological Monitoring Plan has been updated based on the 2009 REstoration COordination and VERification (RECOVER) Monitoring Assessment Plan (Annex E, Part III).

A Vegetation Management Plan has been added to the PIR/EIS, per the 27 May 2010 *Memorandum through the Commander, South Atlantic Division, Subject: Comprehensive Everglades Restoration Plan (CERP) – Requirements for Project Implementation Reports (PIRs) and Other Implementation Documents* (Annex E, Part II).

A sea level rise analysis was added to the PIR/EIS to comply with EC 1165-2-211 ("Water Resource Policies & Authorities Incorporating Sea-level Change Considerations in Civil Works Programs"), dated July 2009 (see Section 5.10.5).

Remotely operated telemetry will be included to make the Broward County WPA functional and operational as needed. Telemetry is to be installed in the initial phase of construction.

A communication tower is proposed with no guy/support wires. The exact size and location is to be determined during detailed design of the Project after a path analysis has been completed so communication with West Palm Beach can be assured.

A 76 acre parcel of real estate within the southern portion of the WCA 3A/3B SMA was not cost effective to acquire. The parcel is within a triangle formed by the US Highway 27, Miami Canal (C-6) and Krome Avenue which will be excluded from the Project footprint. The USACE worked with the non-Federal sponsor to develop and screen concepts for a

solution based on USACE guidance, CERP goals and study objectives. The agreed upon solution would: 1) avoid the parcel and 'triangle' property that could not be hydraulically protected; 2) reroute the C-502B on the northwest side of Krome Avenue and connect it to the L-33 canal using an existing structure to convey the water into the C-6. There are no changes to the rest of the Project. Real Estate and engineering costs and risks were recalculated and recertified. Project benefits were checked. The PIR and figures were updated to reflect the solution.

Since 2007, state and Federal agencies including the USACE and SFWMD, have worked with the USFWS to develop Avian Protection Plan Guidelines, a cooperative partnership to protect migratory birds. Avian Protection Plan Guidelines for use with Stormwater Treatment Areas have been developed.

The above and other revisions are discussed in detail below.

H.2 REAL ESTATE VALUATION POLICY CHANGE.

The longstanding USACE national policy of using "fair market value" for real estate valuation and crediting purposes was changed to acquisitions costs per a SFWMD request in 2002. After the Civil Works Review Board for BCWPA in 2007, the SFWMD requested a change in the land valuation and crediting policy that had been used for the final PIR. The policy was changed back to the "fair market value" policy, on 30 July 2009, in accordance with a new ASA(CW) Memorandum In addition to the BCWPA project, other CERP projects listed for real estate updates included: C-43 Western Basin Reservoir; C-111 Spreader Canal; Biscayne Bay Coastal Wetlands.. More detailed information is provided below and within Attachment A.

H.2.1 Land Acquisition.

Within the C-11 Impoundment, comprised of approximately 1,830 acres, a total of 932.32 acres were acquired using State and Federal funds for a total of $53,497,940 expended. Within the C-9 Impoundment, comprised of approximately 1,807 acres, a total of 1,123 acres were acquired using State and Federal funds with a total of $21,266,690 expended. Within the WCA3A/3B SMA, comprised of approximately 4,353 acres, a total of 290.13 acres was acquired using State and Federal funds with a total of $4,790,246 expended. These costs include both the land acquisition cost as well as the cost of any improvements and SFWMD administrative costs for the acquisition of the lands. The non-Federal sponsor was unable to acquire all lands originally proposed for the WCA 3A/3B SMA. An approximate total of 189 acres will not be used. Some associated structures will not be needed. Level of service flood protection will not be affected. The C-502B conveyance canal has been rerouted and will function as planned. The WCA 3A/3B SMA will function as planned with no measureable effect to project benefits.

H.2.1 Gross Appraisal.

The BCWPA Project gross appraisal was updated by a team of real estate professionals from the SFWMD, Jacksonville District and South Atlantic District (SAD) USACE. The updated process was extended by the coordination an updated cost risk register that separated and detailed the assumptions and risks that were woven into the costs to determine the contingency value. After assumptions, risks, costs and contingency were explained and discussed with SAD and the Cost PCX and the Real Estate Risk Register provided, SAD approved the gross appraisal on 31 March 2011. Current real estate costs increased approximately 23% from those estimated in the 2007 Final PIR/EIS.

H.3 IN-PROGRESS REVIEW POLICY DIRECTIVES.

An In-Progress Review (IPR) meeting was held at HQUSACE on 27 January 2010. Members of the BCWPA PDT briefed the meeting about the ongoing work and findings to date on costs (real estate and construction), as well as the Plan Formulation Review Report (Attachment A) regarding the effect of the revised CERP real estate policy on plan formulation. The IPR was held to develop a process for finalizing the document taking into account the re-evaluation. The conclusion of sound plan formulation was agreed upon and accepted and the rough order of magnitude cost updates were acknowledged. The guidance received directed the BCWPA PDT to: 1.) update the BCWPA Project PIR and 2) complete independent external peer review (IEPR) of the environmental benefits model (EBM). A scope of work for IEPR on the EBM was begun immediately.
It was also determined at that time that more recent national policies were applicable to this study. A 6 July 2010 CECW-SAD Memorandum detailed the follow-up actions from the IPR, and included the following direction:
a. Optimization of the impoundment footprint should be conducted and added to the plan formulation. However, reformulation of the recommended plan was not required. The Final PIR will be updated accordingly, to include initial formulation tasks as specified in the January 2010 technical evaluation of the formulation methodology. This includes a revised Cost Effectiveness (CE) and Incremental Cost Analysis (ICA) on the final alternatives as well as updates to the costs associated with each project.
b. Agency Technical Review (ATR). ATR, model certification, and cost certification are required to update the PIR.

e. Independent External Peer Review (IEPR). IEPR Type I: The guidance at the time of the Civil Works Review Board in 2007 was EC 1105-2-408, and the BCWPA Project PIR was found to be fully compliant with that guidance. HQUSACE concurred that the real estate costs and current updates are not likely to change formulation. As a result, HQUSACE concluded that this project is not subject to additional IEPR requirements. The Chiefs Report will

document the review process that was undertaken, including the bi-annual programmatic reviews by the National Academy of Science.

IEPR Type II: The Jacksonville District determined the C-9 Impoundment is a potentially high hazard dam which will be finalized in design phase. In accordance with EC 1165-2-209, the hazard status is included in the PIR and a Type II IEPR will be conducted during the design phase.

d. Sea-Level Rise. Sea-Level Rise (SLR) will be evaluated in accordance with the current SLR guidance - EC 1165-2-211 (July 2009), as pertinent to the proposed BCWPA project.

H.3.1 Plan Formulation Review.

The Jacksonville District Planning Division let a contract to Smyth Water Planning Solutions on 30 September 2009 to review the Broward County Water Preserve Areas, April 2007 Project Implementation Report plan formulation. Necessary materials and points of contact were provided. A briefing with the SFWMD, meeting with resource agencies and a site visit was completed in November 2009. Weekly teleconferences were held to check review progress, answer questions and brainstorm the findings and follow-up actions. The 18 January 2010 report is included as Attachment A. Attachment A also includes: reference to 33 CFR 385,Part 385.5 with explanation; 30 July 2009 ASA(CW) response letter to SFWMD request for real estate valuation and crediting change; 30 July 2009 CECW-SAD memorandum on CERP land valuation and crediting.

The contractor report, findings and recommendations are below. The recommendations provided the study with elements of a path forward to outline actions needed to update the PIR to current real estate policy and associated details. The recommendations are:

- SAJ followed USACE Policy and procedures for plan formulation of BCWPA study. Office of Water Project Review (OWPR) was informed.

- SAJ followed CERP Programmatic Guidance in formulation of the BCWPA Project. OWPR was informed.

- CERP Real Estate Acquisition Cost Policy values were reflected in the BCWPA April 2007 PIR and are not applicable after 30 July 2009. OWPR was informed.

- Location of the C-11 Impoundment (C-11), C-9 Impoundment (C-9) and WCA 3A/3B Seepage Management Area (WCA 3A/3B SMA) were done

during the Restudy (Yellowbook) 1999 and valued/credited using the longstanding national policy of "fair market value." OWPR was informed.

- The revised Real Estate "fair market value" policy resulted in an increase of approximately: 21% for C-11 Impoundment, 10% for C-9 Impoundment and 96% for the WCA 3A/3B SMA. OWPR was informed.

- The WCA 3A/3B SMA real estate/location was initially valued with "actual acquisition costs". An update of those values to fair market value should not affect location determinations. No other lands within the study area could function to prevent seepage as successfully as the currently proposed WCA 3A/3B SMA. OWPR was informed.

- The WCA 3A/3B SMA land costs almost doubled using the "fair market value" pricings. Consider/compare the sheet pile wall alternative to the real estate costs (done: real estate was less expensive). OWPR was informed.

- The C-11 and C-9 Impoundments real estate/location was initially valued with "actual acquisition costs". An update of those values to fair market value should not affect location determinations. No other lands are available within the study area to provide their function at this time. OWPR was informed.

- The increase in real estate costs for C-11 and C-9 Impoundments may affect construction/real estate optimization. Greater impoundment depths would require less real estate for C-11 and C-9. Look into optimization of C-11 Impoundment to preclude the C-9 Impoundment. Policy and associated costs for higher impoundment levees preclude the real estate cost savings for one deeper impoundment. OWPR was informed. Additional optimization of the impoundment design and water depths was conducted, per the January 2010 IPR with OWPR, to see if the impoundment levees could be raised to reduce the footprint and save real estate costs. The optimization exercise revealed that the impoundment substrate is very porous. Seepage would dramatically increase if the impoundment were unlined and water storage depths exceeded 4.3 feet deep. Impoundment lining costs and dam safety design considerations for higher levees, overwash criteria and wave run-up armoring were estimated to be substantially more and not cost effective to hold the additional water. The optimization exercise affected the final array of alternatives that included impoundment depths proposed at 6-feet deep. These alternatives were screened out due to the optimization recommended by OWPR and a new array of final alternatives then underwent environmental benefits analysis and Cost Effectiveness and

Incremental Cost Analysis (CE/ICA) to determine the alternative that provided the best bang for the buck. The selected plan (Alternative A4) was reconfirmed. See Section 5 for more detailed information on the alternative screening process.

- The BCWPA April 2007 PIR /CE/ICA) was completed with dated real estate and construction costs. The PIR will update the CE/ICA, real estate and construction costs and other associated details. OWPR was informed.

- The SFWMD has been proactively acquiring land needed for the BCWPA Project since the early1990s. The project could not be constructed if the SFWMD had not proactively acquired project lands due to development and a key element of the Everglades restoration would be lost. OWPR was informed.

H.3.1.1 Cost Updates.

Cost updates are necessitated by the real estate land value update. All construction costs more than two years old are required to be updated to current price levels for economic justification. The BCWPA construction and real estate costs were updated to October 2011 costs once the risk register process was followed to determine level of risk for each construction and real estate variable. Once the level of risk and uncertainty was agreed upon, the construction and real estate cost contingencies were determined to place a risk-based cost on the each item. The costs were reviewed and certified by the Walla Walla District (NWW) U.S. Army Corps of Engineers, on 17 October 2011, after SAD reviewed and approved the risk registers.

The BCWPA cost estimate was developed in accordance with broadly defined risk analysis standards and recommended practices. It was performed to substantially meet the requirements and recommendations of the following documents: Cost and Schedule Risk Analysis (CRSA) Process guidance prepared by the USACE Cost Engineering DX; Memorandum from Major General Don T. Riley, 3 July 2007; Engineering and Construction Bulletin issued by James C. Dalton, P.E., 10 September 2007; ER 1110-2-1150, ER 1110-1-1150, 31 August 1999, ER 1110-2-1302, 15 September 2008; ETL 1110-2-573, 30 September 2008. The risk analysis process used for the BCWPA was intended to determine the probability of various cost outcomes and quantify the required contingency needed in the project costs to achieve the desired level of cost and schedule confidence. HQUSACE mandates the CSRA requirement to enforce improvements in establishing the cost and schedule risk and resulting contingencies that are used within the calculation of the Total Project Cost (TPC). The CSRA is part of the greater emphasis to produce quality TPCs. The

cost risk register, contingencies and costs were vetted through the ATR process and approved by NWW. The cost estimate is located in Appendix B of the PIR.

H.3.1.2 Real Estate Risk Register / Risk Analysis Update.

The real estate baseline cost estimate is developed from a gross appraisal performed by the Jacksonville District which is verified by SAD and HQUSACE. Teleconferences with the Cost Engineering DX discussed and lead to better understanding of risks inherent in real estate in the south Florida project area. Real estate cost uncertainties were identified, measured and agreed to for the Total Project Cost (TPC). A joint report was developed to describe the methodology, process, key assumptions and limitations of the risk analysis. It also explains the major findings, observations and recommendations of the risk analysis. Based on the CSRA a 22 percent contingency was recommended for those costs not already fully cost shared under the DOI grants. See Real Estate Appendix Table D for a more detailed real estate cost breakdown with contingencies.

H.3.1.3 Construction Risk Register / Risk Analysis Update.

The construction cost estimate and construction schedule risks and uncertainties were discussed with the SFWMD in a PIR Cost Scrub Workshop, held 4-5 April 2011. A follow-up PIR Cost Scrub Workshop In Progress Review was held 3 August 2011 to report the status of action items related to planning, engineering design, real estate, mitigation, monitoring, telemetry and other detailed design concerns. Engineering design risks were assessed, quantified and analyzed identifying key assumptions and limitations and determining significance for bearing on cost contingencies. Sensitivity analyses were conducted to provide an understanding of variability and key contributors. The risk register reflects the results of risk factors identification and assessment, quantification and contingency analysis. See Appendix B for more detailed information.

H.3.1.4 Cost Effectiveness and Incremental Cost Analysis Update.

The Cost Effectiveness and Incremental Cost Analysis (CEICA) have been updated with certified costs provided by the Walla Wall District. The Best Buy Plans are A4 and A1 with the alternative that displays the best bang for the buck being A4. The 2007 Final PIR CEICA determined Alternative A4 and F4 as cost effective and best buys. Alternative A4 developed 543,781 AAHUs at $66 each. Alternative A4 is the only alternative that fully met the P&G evaluation criteria. The current CEICA has similar findings except that the normalized AAHUs were dramatically reduced, cost per HU cost more but Alternative A4 was still the selected plan. See Section 5.4. for further details.

H.3.2 Agency Technical Review.

Agency Technical Review (ATR) of the BCWPA Project PIR was conducted beginning December 2010 and concluding March 2011. The Sacramento District performed the ATR and produced 54 comments that covered: civil engineering; cost engineering; economics; environmental; hydrology; plan formulation and real estate. The BCWPA PDT updated sections of the BCWPA Project PIR per the ATR comments before certification was completed.

ATR of the BCWPA Project Costs was conducted from late December 2010 and was certified on 17 October 2011. Cost updates necessitated an updated cost certification received 9 February 2012. The BCWPA Final PIR/EIS has been updated with 9 February 2012 certified costs.

H.3.3 Planning Model Updates.

A scope of work (SOW) was prepared for an IEPR of the planning level models used in the BCWPA PIR and PIR review. It was coordinated with the USACE Ecosystem Planning Center of Expertise (ECO PCX) in Rock Island District. The SOW planning models submitted for review and certification were based on hydrodynamic modeling of discharges into the Water Conservation Area 3 and their environmental effects. The SAWCAT expansion model, EVERKITE model and UMAM model, as described and detailed in the April 2007 PIR, were submitted for IEPR. The ECO PCX reviewed the SOW and found the planning model work submitted did not meet approval requirements as discussed below. Multi-discipline, multi-agency subject matter expert environmental benefits subteam workshops were set up by the USACE and held to resolve concerns about: planning model base assumptions; suitability indices; the lack of model equations; and environmental benefit outputs. The subteam was directed to identify and analyze model problems, propose solutions to address concerns and write them up in a substantive paper for resubmission for IEPR. The subteam met in 27 April 2010 and again in 24 May 2010 to complete the task.

H.3.3.1 Planning Model Problems Noted.

The basis for the IEPR submittal was the planning models (performance measures - PMs) as described in the BCWPA April 2007 PIR used for the IEPR SOW. Hydrologic and environmental PMs were developed and used to evaluate each alternative against each other. Problems noted during initial model review included:

a. Planning model base assumptions were not well documented and their source of development was not well explained.

b. Suitability indices (SIs) were not well documented and their source of development was not well explained. The SIs were not correctly used in the benefits equation and could not be scientifically verified.

c. Model equation development was not well explained nor was its development documented. The SIs used in the equation offset each other and the denominator could not be scientifically substantiated.

d. Environmental benefit outputs were not replicable because no spreadsheets were found to rerun calculations used to determine the specific or system benefits. The subteam could not determine if the calculations were correct or erroneous.

H.3.3.2 Planning Model Corrections.

The BCWPA Subteam developed a model that could be better supported and in compliance with more recent USACE guidance (EC 1105-2-412, 31 March 2011) to clearly identify and quantify ecosystem restoration outputs. Performance measures were used to calculate benefits and compare alternatives for the BCWPA Project based on ecological attributes likely to show the effects of the project on the regional ecosystem, these measures directly relate to RECOVER performance measures and Interim Goals. While management measures and alternatives were evaluated in a number of ways, for multiple purposes, plan selection was based upon outputs from three planning models and related Performance Measures (PMs). Plan selection is primarily based on upon benefits to sawgrass, snail kites and ridge and slough habitat (including periphyton, prey fish and wading birds), by employing the following Performance Measures.

- PM 1: Reduction in Cattail Vegetation Expansion Rate,
- PM 2: Snail Kite Habitat Quality,
- PM 3: Ridge and Slough Habitat Quality.

See Appendix C for more details on the development of the environmental benefits model.

The BCWPA Project environmental benefits model was certified by the USACE, Engineering Research and Development Center on 7 October 2010. The Ecosystem PCX proposed one-time use approval of the environmental benefits model. The approval was agreed to by the Deputy Chief, Planning and Policy Division, Directorate of Civil Works on 1 February 2011.

H.3.4 Independent External Peer Review (IEPR).

USACE determined the C-9 Impoundment is a potentially high hazard dam which will be finalized in design phase. In accordance with EC 1165-2-209, the hazard status is included in the PIR and a Type II IEPR will be conducted during the design phase.

H.3.4.1 National Academy of Science Review.

External scientific peer review through the National Research Council (NRC) of the National Academy of Sciences report: **Progress Toward Restoring the Everglades: The Third Biennial Review - 2010** has been conducted at the programmatic level and will continue throughout the planning and implementation of the CERP program. The recommendations of the NRC were to initiate partial construction on CERP projects to ascertain early benefits. The SFWMD under the former Acceler-8 program has begun construction on some of the features in the Recommended Plan and monitoring of those features. The BCWPA PIR includes an Adaptive Management Plan (Annex E -Part IV- of the PIR) which describes potential operational adjustments to ensure meeting restoration goals.

The recommendations of the NRC through external programmatic level reviews emphasize an Incremental Adaptive Restoration approach of CERP. The BCWPA addressed NAS's recommendations are summarized in the Executive Summary, Section 7.5 and detailed in Annex E-Part IV and Annex F of the PIR.

H.3.5 Sea Level Rise Policy.

A sea level rise analysis was added to the PIR/EIS to comply with EC 1165-2-211 ("Water Resource Policies & Authorities Incorporating Sea-level Change Considerations in Civil Works Programs"), dated July 2009. The three scenarios were evaluated and it was found that projected sea level rise would not adversely affect the project during the period of analysis. Additional information is available in Section 2.2 and Section 5.10.5 of the PIR.

H.4 CERP POLICY GUIDANCE MEMORANDUM.

On 27 May 2010, CECW-SAD issued a Policy Guidance Memorandum re:, Requirements for CERP PIRs and Other Implementation Documents The memorandum referenced six related memos, letters and MOUs and it directs South Atlantic Division to provide within PIRs: 1) Vegetation Management Plans to assess the need for future management activities to control exotic/invasive or native nuisance vegetation, including the scope, duration, costs and funding source for such activities (see Annex E, Part II), 2) Operational Testing and Monitoring Period that describes the rationale, actions needed, expected duration and required monitoring (see Annex D), 3) Monitoring Plan to address the success of the ecosystem restoration project (see Annex E, Part III),

and 4) Land Formulation Valuation and Crediting Plan to determine and describe the land requirements, costs, and crediting for CERP projects (see Real Estate Appendix D).

H.4.1 Adaptive Management Plan.

The CERP Guidance Memorandum Number 56; Guidance for Integration of Adaptive Management (AM) into Comprehensive Everglades Restoration Plan (CERP) Program and Project Management was approved on 8 February 2011. This new policy requires an adaptive management plan be completed for all projects, including the BCWPA Project PIR. The BCWPA Project PIR Draft Adaptive Management Plan is currently under review with USACE, SFWMD, USFWS and FDEP and will be incorporated into the PIR (Annex E) when finished. The Adaptive Management Plan will also include options for the potential selenium ecological risks discussed previously. The PIR/EIS will be available online at www.evergladesplan.org on the project website.

H.4.2 Migratory Bird Species Monitoring.

Since 2007, state and Federal agencies including the USACE and SFWMD, have worked with the USFWS to develop Avian Protection Plan Guidelines, a cooperative partnership to protect migratory birds. Avian Protection Plan Guidelines for use with Stormwater Treatment Areas have been developed. Programmatic Avian Protection Plan Guidelines are currently being developed by an interagency team led by the USFWS. These guidelines will be used by the USACE and SFWMD to produce an Avian Protection Plan (APP) for migratory birds and their nests during normal operations of reservoirs and impoundments. The BCWPA APP would address emergency operations of the impoundment in addition to normal operations. Upon finalization of the USACE and SFWMD's APP and formal agreement to its terms by the USFWS, guidelines for operation of impoundments found within the APP would be incorporated into the C-9 and C-11 Impoundment Operating Manuals for the protection of migratory birds and their nests.

H.5 INTERIOR IMPOUNDMENT LEVEE ARMORING POLICY CHANGE.

Due to observations of wildlife impacts during the drawdown from April to August 2008 at the completed Ten Mile Creek Water Preserve Area Critical Restoration Project (TMCP), the USFWS wrote a 26 January 2009 supplement to the final Fish and Wildlife Coordination Act (FWCA) Report (USFWS 1999) for the TMCP, St. Lucie County, Florida. The supplement documented wildlife entrapment at the wave run-up steps observed during reservoir drawdown. Subsequent meetings, discussions and USFWS evaluations of the wave run-up steps were also documented in the supplement. Adaptive management designs responded with ramps that were constructed to provide access for wildlife to

traverse the wave run-up steps, without success. The USFWS recommended that options be investigated to replace the wave run-up steps to include: armored soil cement surface, geo-textile webbing or other soil-stabilizing methods that will allow wildlife movement over the levee embankment. Other project design features were also discussed. The Florida Fish and Wildlife Conservation Commission (FWC) agreed with the USFWS supplement in a letter of concurrence dated 12 August 2009. FWC recommended levee embankments be stabilized without the use of soil cement, wave run-up steps, parapets or other vertical features to reduce wildlife entrapment potential.

The USACE and the SFWMD agreed to develop other means to protect CERP impoundment levees from wave run-up that would not include wildlife entrapments. This agreement led to the removal of wave run-up steps from the BCWPA impoundment levee design and use of a value-engineered armored surface protect the impoundment levees from overwash erosion is to be finalized in the detailed design phase.

H.6 VALUE ENGINEERING REQUIREMENTS.

Reference ER 11-1-321, dated 28 February 2005, which contains general and procedural requirements for executing USACE Value Engineering (VE). The VE studies are required for Civil Works (CW) projects with construction costs of $2 million and greater. At least one VE study will be performed as part of plan formulation for Feasibilities Studies, General Reevaluation Reports (GRR), Limited Reevaluation Reports (LRR) and Post Authorization Changes (PACs). The CW Projects with construction costs greater than 10 million dollars are required to have two VE studies, one during plan formulation and one during Plans and Specifications (P&S).

Effective in FY2010, the Civil Works Milestones for Value Engineering were issued for use on all CW projects. This means any projects missing VE coverage are much more exposed for HQ/MSC coordination. The BCWPA VE Milestones should be included in the project activities schedule and the Milestones are:

CW192 VE/VM Study/Workshop Start
CW195 VE/VM Study/Workshop Finish (As noted in REF 8010G for Feasibility, LRR, GRR, PAC).

In summary, the VE reports (August 2005 and September 2010) for the BCWPA Project found potential savings of approximately 6 million dollars. See the Engineering Appendix of the Broward County Water Preserve Areas Project Implementation Report for the BCWPA Value Engineering Report. The September 2010 VE study was not required by the 27 January 2010 IPR, but the PDT felt it was important to complete.

H.7 RESIDUAL AGRICULTURAL CHEMICALS POLICY.

In September 2011, the ASA(CW) provided new guidance for CERP Projects concerning Residual Agricultural Chemicals on project lands. Per the requirements of this policy, the SFWMD sent a letter requesting that this PIR contain a section discussing Residual Agricultural Chemicals (Section 7.11).

Residual agricultural chemicals are an issue on the BCWPA project because the USFWS expressed concerns that Se residues may affect fledglings through foraging and consumption of the soil based food web within the project areas that impound water. Additional SFWMD testing and analysis was completed in May 2011 and confirmed previous Se soil test results in a draft report by Environmental Consulting & Technology, Inc, SFWMD A/E contractor. The report recommended an ecological risk assessment to include a bioaccumulation study, toxicity study and food web modeling. The SFWMD has scheduled a bioaccumulation study for FY 2012. The results of the bioaccumulation study are scheduled to be available by June of 2012. These results will determine if the screening level (2 mg/kg) is appropriately protective or if it should be adjusted.

This revised PIR includes a section for Residual Agricultural Chemicals (Section 7.11) as the submittal for conditional approval to utilize the ASA(CW) CERP policy. Given the uncertainty regarding the extent of corrective action that may be required, cost estimates developed for Section 7.11 assume that up to 2,000 acres of project land is impacted by elevated selenium concentrations. It is likely that this estimate of affected acreage is conservative. A final determination of the applicability of this policy to the project will be made once all of the environmental risk studies are complete and an approved soil management plan is available. A supplement to this PIR, entitled BCWPA Residual Agricultural Chemical Plan will be provided prior to construction to HQUSACE for review and concurrence prior to construction.

H.8 OTHER CHANGES MENTIONED IN THE EXECUTIVE SUMMARY.

Proposed Communication Tower

Remote Operation Telemetry

76-Acre Land Tract in the WCA 3A/3B Seepage Management Area

ATTACHMENT A: PLAN FORMULATION REVIEW REPORT

Plan Formulation Review
Broward County Water Preserve Areas

The Effect of Revised CERP Real Estate Policy on Plan Formulation

Prepared for:
Jacksonville District – Corps of Engineers

Prepared by:
Smyth Water Planning Solutions
January 18, 2010

Contract No: W912EP-09-D-0005
Water Resources Planning

SUMMARY

This report was prepared for the Jacksonville District of the US Army Corps of Engineers under Water Resources Planning Contract W912EP-09-D-0005 with Gulf Engineers and Consultants, Inc., of Baton Rouge, Louisiana. Specifically, this report is submitted in response to Task Order 0012, dated September 30, 2009, which requires a plan formulation review of two different Comprehensive Everglades Restoration Project studies. This report concerns the first of the two studies, the Broward County Water Preserve Areas.

The Scope of Work calls for the Contractor to review the plan formulation process as described in the April 2007 Broward County Water Preserve Areas Project Implementation Report. This review is to include an assessment of the key decision points in the plan formulation process, the degree to which the then-assumed real estate policy (land values based on acquisition cost) used in the formulation and evaluation of alternative plans affected key decisions, and the degree to which current real estate policy (land values based on fair market value) might affect the selection of the recommended plan. Should this revision in real estate policy affect plan formulation, the Contractor is to recommend a strategy (or options, if appropriate) for reformulating the project to be in compliance with current real estate policy. If no reformulation is needed, the Contractor is to support that conclusion.

In conducting the review, the Contractor inspected the project area and critically reviewed the Corps project study and its policy review documents, the documents provided by the South Florida Water Management District, and other pertinent documents. Representatives of the Corps and South Florida Water Management District who had been involved in the early and the current planning of the project were also interviewed.

The Broward County Water Preserve Areas project is a critical feature in efforts to restore the Everglades. This review confirms that starting in the early 1990s those involved in the planning of the project concluded that the primary features of the project (impoundments and seepage management areas) needed to be at the same general locations as those shown in the April 2007 PIR. By the time the Restudy report[1] was submitted to Congress for authorization in July of 1999, lands were already being acquired for the project. The pressures of urban development in Broward County, ever moving westward, resulted in the South Florida Water Management District acquiring almost 70 percent of the land needed for construction by the time the Restudy report was submitted to Congress.

As of November 2009, almost 86 percent of the lands needed for the project either have been purchased, formal agreements reached for their use, or are already South Florida Water Management District lands. The South Florida Water Management District has purchased almost all of the private lands needed for the project. Except for about 75 acres of private lands that still need to be purchased, all other lands are either already in public ownership or are South Florida Water Management District lands. Therefore, in a practical sense, about 99.1 percent of the lands needed for the project are currently available.

[1] Often called the "Yellow Book."

This review did not find any evidence to indicate that the real estate policy to value lands based on acquisition costs influenced decisions on selecting the location for the major components of the Broward County Water Preserve Areas project. At the time the basic decisions were being made on the location of the C-9 and C-11 Impoundments and the Seepage Management Area, the real estate policy to value lands based on fair market value was in effect. The use of the real estate policy to value lands based on acquisition costs for the Comprehensive Everglades Restoration Project only applied during the period 2002[2] through July 30, 2009. Moreover, once the decision was made to manage water levels in areas adjacent to Water Conservation Area 3 as the way to reduce seepage losses, the only possible location was the site already selected. Likewise, due to the intense development that has taken place in the C-9 and C-11 west drainage areas, the only possible locations for the impoundments are at the sites selected in the 1990s.

In implementing Corps projects, non-Federal sponsors are neither required nor encouraged to purchase lands for projects until they have been fully authorized and detailed designs have been completed. In view of the significant development that has taken place in Broward County, had the South Florida Water Management District waited until the Federal processes were complete, implementation of the project either would not have occurred due to the unavailability of undeveloped land, or the purchase of developed lands would have been prohibitive. The South Florida Water Management District's foresight in acquiring the needed land preserved the ability to implement the project and to do so much more cost effectively.

Updated real estate estimates developed by the Jacksonville District show that the cost of lands for the C-9 Impoundment have increased by about 21 percent, for the C-11 Impoundment by about 10 percent, and for the WCA 3A/3B Seepage Management Areas by about 96 percent.

The almost doubling of the real estate cost for the Seepage Management Area does not affect its location, as it is located in the only feasible place. However, such a substantial increase in land cost may make the alternative to use a sheet pile cut-off wall to reduce seepage from Water Conservation Area 3A look more favorable. This plan was considered early in the plan formulation process. In the April 2007 Project Implementation Report, this alternative was eliminated because it was more costly than the land cost of the Seepage Management Area.[3] It is recommended that a sheet pile cut-off wall be re-evaluated. A full-scale design and cost estimate may not be required. Discussions conducted with representatives of the South Florida Water Management District during the review indicated that, in addition to the adverse impacts noted in the April 2007 Project Implementation Report, construction of a sheet pile cut-off wall will likely also have adverse impacts on municipal well fields. The evaluation may need to consider plans to mitigate for these adverse effects which would increase that alternative's cost. Only if a preliminary cost estimate indicates that the sheet pile cut-off wall is a technically sound, cost-effective and an environmentally acceptable substitute for the Seepage Management Area feature should detailed work be undertaken.

[2] The exact date is uncertain, but a July 30, 2009, letter from the Acting Assistant Secretary of the Army (Civil Works) to the Executive Director of the SFWMD indicates that it was in 2002.
[3] Item 6, page 5-6, Section 5, Formulation and Evaluation of Alternative Plans, PIR April 2007.

The increase in real estate costs for the C-9 and C-11 Impoundments might affect the optimization of storage volumes for these impoundments. Greater impoundment depths would likely result in less land requirements. To address this matter, it is recommended that the design depths of the two impoundments be re-evaluated to determine if the storage can be at a deeper depth, thereby reducing the amount of land required, and likely reducing real estate costs. A full-scale redesign and cost estimate may not be required. Discussions conducted with representatives of the South Florida Water Management District and the Jacksonville District during this review suggested that increasing depths by a significant amount might change the design requirements so that dam safety concerns become an issue. In addition, greater depths would likely increase seepage, which might have to be addressed by the installation of a liner. Both these impacts would result in increased construction costs which might be greater than any real estate cost savings. Only if a preliminary review of this issue indicates that project construction costs would not significantly increase and/or that there would be a substantial real estate cost saving should more detailed work be undertaken.

The increased real estate costs for the C-9 and C-11 Impoundments might also affect the results of evaluation of both the initial and the final array of alternatives. These analyses would be the cost effectiveness and incremental analyses, which resulted in the selection of the recommended plan. It is recommended that the real estate cost of the eight alternative plans which underwent the cost-effectiveness and incremental analyses be included and those analyses updated. Due to the passage of time since the prior cost estimates were completed,[4] it is recommended that current construction costs also be included in those analyses. If the re-evaluation of the sheet pile cut-off wall or the optimization of impoundment footprint produce additional alternative plans that should be considered in the initial array, those plans should be included.

[4] Cost estimates for the alternatives for which the cost-effectiveness and incremental analyses were conducted were at a 2005 price level.

Table of Contents

MAIN REPORT

Summary i
1.0 Introduction and Background 1
2.0 Description of Work 3
3.0 Materials Reviewed 4
4.0 Project Site Visit and Interviews 4
5.0 Water Preserve Areas 4
6.0 Broward County Water Preserve Areas Project 5
7.0 Acceler8 Program 7
8.0 Former CERP Land Valuation and Crediting Policy 8
9.0 Current CERP Land Valuation and Crediting Policy 9
10.0 Timing of the Changes in CERP Real Estate Valuation Policy 10
11.0 Key Plan Formulation Decision Points 10
12.0 Lands Already Acquired 12
13.0 Revised Real Estate Estimates 13
14.0 Plan Formulation Review and Evaluation 15
15.0 Decisions Regarding Where to Locate Project Features 16
15.1.1 Location of WCA 3A/3B Seepage Management Area 16
15.1.2 Location of C-9 and C-11 Impoundments 18
16.0 Decisions Regarding Selection of the Recommended Plan 20
17.0 Conclusions and Recommendations 22

TABLES

Table 1 Estimated Real Estate Requirements for Recommended Plan 7
Table 2 Timing of CERP Real Estate Valuation and Crediting Policy 10
Table 3 Real Estate Plan Formulation Decision Points 11
Table 4 Status of Real Estate Acquisitions 13
Table 5 Increase in Real Estate Costs – Recommended Plan 14
Table 6 Increase in Real Estate Costs – Final Array of Alternatives 15
Table 7 PIR Plan Formulation Decisions 20

FIGURES

Figure 1 Broward County Water Preserve Areas Project (Project Area Map) 5
Figure 2 Broward County Water Preserve Areas Project (Aerial Photograph) 6
Figure 3 Broward County Water Preserve Areas – Undeveloped Sites 19

APPENDICES

Appendix A List of Participants in Site Visit and Interviews
Appendix B Documentation of November 12, 2009 Site Visit
Appendix C Description of Former Land Valuation and Crediting Policy
Appendix D Army Civil Works Land Valuation and Crediting Guidance
Appendix E Headquarters Corps of Engineers Land Valuation and Crediting Guidance
Appendix F C-9 Impoundment – Real Estate Acquisitions and Dates (Private Lands)
Appendix G C-11 Impoundment – Real Estate Acquisitions and Dates (Private Lands)
Appendix H WCA 3A/3B Seepage Management Area – Real Estate Acquisitions and Dates (Private Lands)

Plan Formulation Review
Broward County Water Preserve Areas

The Effect of Revised CERP Real Estate Policy on Plan Formulation

1.0 INTRODUCTION AND BACKGROUND

The lands and hydrologic systems of South Florida have been greatly altered, thereby causing significant adverse effects on the natural ecosystem. Shortly after disastrous hurricanes in 1926 and 1928, the US Congress directed the US Army Corps of Engineers (USACE) to construct flood control projects. In 1948, the much broader Central and Southern Florida (C&SF) project was initiated. The C&SF project established protective works, controls, and procedures for flood control, water-level control, water conservation, salt water intrusion prevention, and fish and wildlife preservation. The various levees, canals, ditches, and pumping systems, combined with sprawling urban development and highways, have altered drainage patterns and diverted waters away from the Everglades. This has resulted in significant adverse changes to the natural systems which are needed for healthy and sustained natural habitats.

In light of the environmental consequences of this earlier work, in 1992 Congress authorized the USACE to conduct a review of the C&SF project.[5] The purpose of this review was to determine the feasibility of modifying the C&SF project, or its operation, to improve the quality of the environment, to protect the underground aquifer, and to improve the integrity, capability, and conservation of urban water supplies affected by the project or its operation. The overall intent was to improve the sustainability of South Florida in the interest of environmental quality, water supply, and other purposes.

In 1996, the USACE was more formally directed by Congress to develop a comprehensive plan for restoring, preserving, and protecting the South Florida ecosystem while also providing other water-related needs to the region, such as water supply and flood protection.[6] Congress gave much more specific direction and guidance on what the comprehensive plan should include and how to go about developing it. The legislation required that the USACE provide the report to Congress on this "Restudy"[7] by July 1, 1999. The Jacksonville District of the USACE and the South Florida Water Management District (SFWMD) jointly, and with the involvement of other Federal agencies, State and Tribal governments, stakeholder representatives and the public, formulated projects that would ultimately be proposed to protect and restore the South Florida ecosystem.

[5] Section 309(1) of the Water Resources Development Act of 1992.
[6] Section 528 of the Water Resources Development Act of 1996.
[7] Restudy means the review study of the C&SF Project, for which federal participation in the study was authorized by the Water Resources Development Acts of 1992 and 1996.

The report resulting from that planning effort was submitted to Congress on July 1, 1999, and is called the "Comprehensive Everglades Restoration Plan" (CERP),[8] which proposed implementation of both structural and operational modifications to the C&SF project. In 2000, the Congress approved the CERP as a framework for the restoration of the South Florida natural ecosystem as part of the Water Resources Development Act (WRDA) of 2000.[9] The CERP project consists of 68 major components, all designed to restore, preserve, and protect the South Florida ecosystem while providing for other water-related needs of the region. This restoration of the ecosystem was envisioned to occur through improving and/or restoring the proper quantity, quality, timing and distribution of water made available for the ecosystem while also addressing urban and agricultural water supply concerns and maintaining existing levels of flood protection.

Section 601(b)(2)(C) of WRDA 2000 included three initial projects which together form the Broward County Water Preserve Areas (BCWPA) project. These were the C-9 and C-11 Impoundments[10] and the Water Conservation Area (WCA) 3A/3B Seepage Management Area.[11] Following the passage of WRDA 2000, the USACE and SFWMD set out to undertake the additional studies required by WRDA 2000 for the BCWPA project. This was done through the preparation of a Project Implementation Report (PIR).

The "Final Integrated Project Implementation Report and Environmental Impact Statement on the Broward County Water Preserve Areas Project" was completed and submitted for Headquarters' USACE (HQUSACE) review and approval in late 2006 or early 2007. The PIR had undergone the usual USACE technical and policy reviews, including an Alternative Formulation Briefing in 2005. Once at HQUSACE, the project underwent the final policy review by the Office of Water Project Review. On April 12, 2007, a Civil Works Review Board meeting was held during which all aspects of the planning of the project, and its prior technical and policy reviews, were discussed. At that time, except for one remaining issue relating to land valuation and crediting, the project appeared ready for favorable approval.

In August 2007, the SFWMD requested a change in the land valuation and crediting policy that was being used in the preparation of the BCWPA PIR. The method used in the PIR for valuing lands needed for the project was based on the acquisition cost of those lands. In August of 2007, the SFWMD requested that the USACE return to the longstanding national policy of using fair market value for valuation and crediting purposes.

[8] The report is sometimes called the "Yellow Book," in reference to the color of its cover.
[9] Section 601 of the Water Resources Development Act of 2000.
[10] As originally formulated and recommended as part of CERP, the C-9 and C-11 Impoundments also included storm water treatment capabilities.
[11] The three components of the BCWPA project were authorized for implementation after the review and approval of the Secretary of the Army. The Assistant Secretary of the Army (Civil Works) would act for the Secretary in this regard.

This revision in land valuation and crediting policy raised questions about whether the former policy, in its use of acquisition costs, had inappropriately biased plan formulation in favor of locating the three critical facilities needed for the implementation of the BCWPA project on lands already purchased by the SFWMD.[12]

It is the express purpose of this plan formulation review to address this issue. The land valuation and crediting policy would affect the identification, evaluation and screening of alternative sites for project features, the optimization of the size of features, the cost-effectiveness analysis which compares the costs and environmental benefits of various plans, and the incremental cost/benefit analysis that results in the selection of a recommended plan. In a USACE study, it is typical that once a project has been selected from the array of all considered plans, it must undergo a much more detailed design and cost estimate. This detailed and final feasibility work also involves more detailed real estate cost estimates.

2.0 DESCRIPTION OF WORK

This report was prepared for the Jacksonville District USACE under Water Resources Planning Contract W912EP-09-D-0005 with GEC, Inc., of Baton Rouge, Louisiana. Specifically, this report is submitted in response to Task Order 0012, dated September 30, 2009, which called for a plan formulation review of two different CERP projects. This report concerns the first of the two projects, the BCWPA project.

The Scope of Work calls for the Contractor to evaluate the plan formulation process as described in the April 2007 BCWPA PIR. This evaluation is to include: (1) an assessment of the key decision points in the plan formulation process; (2) the degree to which the then-assumed CERP policy on real estate values (acquisition costs) used in the evaluation of alternative plans affected key decisions; and (3) the degree to which current CERP policy on real estate values (fair market value) might affect the selection of the recommended plan. Should this change in land valuation and crediting policy affect plan formulation, the Contractor is to recommend a strategy (or options, if appropriate) for reformulating the project in compliance with current CERP policy. If no reformulation is needed, the Contractor is to provide support for that conclusion.

The plan formulation review is to take place through a field trip to inspect the project area, a review of government supplied documents, the interview of key USACE and SFWMD study participants, and independent research. A report is to be prepared on the evaluation. Except for the field trip, all work was done at the Contractor's office in Raleigh, North Carolina. This document is the report required under the contract.

[12] These critical facilities would be the C-9 and C-11 Impoundments and the WCA 3A/3B Seepage Management Area.

3.0 MATERIALS REVIEWED

The Scope of Work listed a number of documents to be reviewed. Those documents, as well as others that were reviewed, are listed below:

- April 2007 Project Implementation Report (PIR), April 2007
- April 12, 2007, Civil Works Review Board (CWRB) Materials
- February 15, 2006, Alternative Formulation Briefing (AFB) Materials
- Report on "Water Preserve Areas: Defining Biological Functions and Spatial Extent"
- Report on "Water Preserve Areas – 1999" by the National Audubon Society.
- October 2001 Water Preserve Areas Draft Integrated Feasibility Report
- 1996 Draft Report "Water Preserve Areas – Land Suitability Analysis"

4.0 PROJECT SITE VISIT AND INTERVIEWS

The Scope of Work called for the Contractor to visit the project area and interview key members of the BCWPA's Project Delivery Team. The Jacksonville District made the arrangements for the site visit, which was conducted on November 12, 2009, and attempted to have the Project Delivery Team present. Unfortunately, not all personnel were available at the time of the site visit. Several were called later to discuss the plan formulation aspects of the project. Those people present on the site visit and those later interviewed are listed in Appendix A. A record of the site visit and discussions of the real estate issues are presented in Appendix B.

The representatives of the USACE, SFWMD, and the two resource agencies who attended the site visit were most helpful in explaining the real estate aspects of the project and the influence that the availability and suitability of land sites had on the plan formulation process.

5.0 WATER PRESERVE AREAS

Water preserve areas have long been recognized as critical features of any plan to restore the South Florida ecosystem, and were integral parts of the CERP project that was approved by Congress in WRDA 2000. Water preserve areas provide a variety of functions critical to ecosystem restoration and are envisioned as a system of marshlands, reservoirs, and aquifer recharge basins that could be managed to store excess runoff, restore natural flow patterns, recreate wetlands, provide water-quality treatment, and provide a buffer between developed areas and the Everglades. One of these critically important water preserve areas is the BCWPA project. The major features of the BCWPA project (C-9 Impoundment, C-11 Impoundment, and WCA 3A/3B Seepage Management Area) were included as three of the initial 10 CERP projects authorized for implementation by Section 601(b)(2)(C) of WRDA 2000.

6.0 BROWARD COUNTY WATER PRESERVE AREAS PROJECT

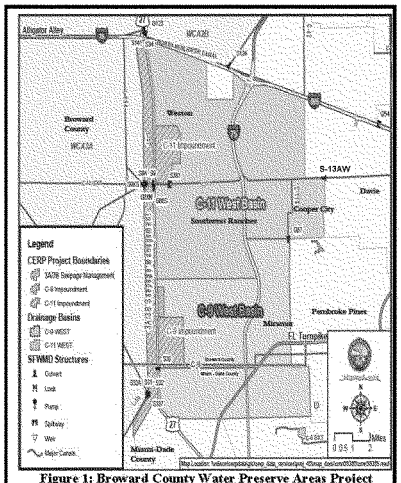

Figure 1: Broward County Water Preserve Areas Project (Source: USACE Briefing Slides)

The Broward County Water Preserve Areas project is located along the eastern edge of the remaining Everglades ecosystem, just east of Water Conservation Areas (WCA) 3A and 3B, and along the western edge of heavily developed portions of Broward County in the C-9 and C-11 west drainage basins. A small portion of the seepage management area also extends into Miami-Dade County.

The project was formulated to reduce seepage loss from WCA 3 into the C-9 and C-11 west drainage basins and to capture and store excess storm water runoff from the west C-11 drainage basin which currently discharges untreated runoff directly into WCA 3, thus reducing nutrient loading to the natural system. The C-11 and C-9 Impoundments also aid in seepage management by reducing seepage from WCA 3A/3B into the developed areas immediately to the east of WCA 3A/3B through hydraulic resistance with the water that is stored in the impoundments.[13] The impoundments will also assist in maintaining existing levels of flood protection that result from discharges at the S-9 pump station located at the western end of the C-11 Canal.

The BCWPA's major components were three of the initial 10 CERP projects authorized by Section 601(b)(2)(C) of WRDA 2000. The C-9 and C-11 Impoundments were authorized at total project costs of $89,146,000 and $124,837,000, respectively.[14] The Water Conservation Area 3A/3B Seepage Management Area was authorized at a total project cost of $100,335,000. The April 2007 PIR indicates that the project costs of these three features exceed the Section 902 cost limit for the WRDA 2000 authorization, and as such, new authorizations will be needed.[15]

[13] Source: Paragraph 7.0, page 7-1, Section 7, The Selected Plan, April 2007 PIR.

[14] The C-9 and C-11 Impoundments were also authorized as storm water treatment areas.

[15] Section 902 of WRDA 1986, specified that the total costs set forth in a project authorization shall be the maximum cost for that project, except that the Secretary of the Army may increase those costs to make modifications which do not materially alter of the scope or function of the project, if such costs do not exceed 20 percent of the total costs stated in the authorization. Section 902 also allowed for cost increases from the date of the authorization based on engineering and other appropriate indexes and for additional modifications required by changes in Federal law.

The key components of the Broward County Water Preserve Areas project are also shown on the following aerial photograph.

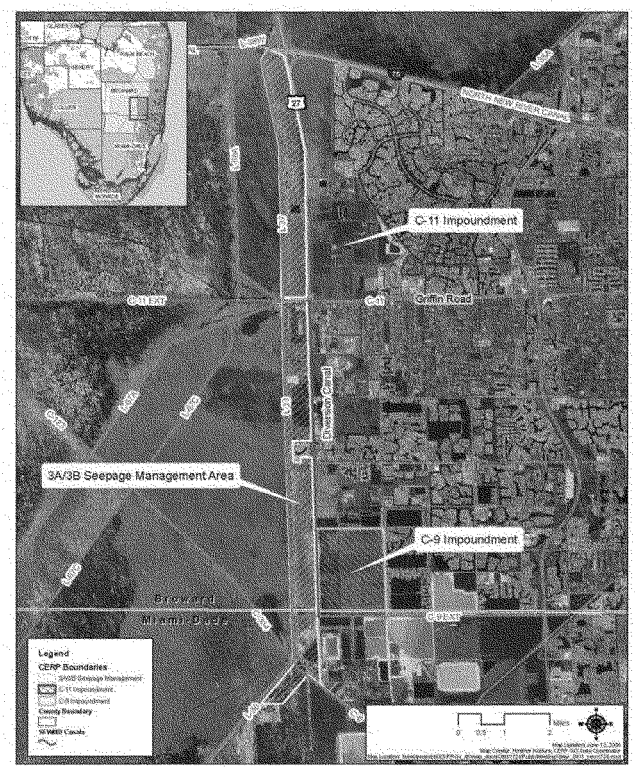

Figure 2: Broward County Water Preserve Areas Project
(Source: South Florida Water Management District)

Land needed for the three major components of the BCWPA project can be found in Table 1.

Table 1
Broward County Water Preserve Areas
Estimated Real Estate Requirements for Recommended Plan

BCWPA Project Component	Acreage Required
C-9 Impoundment	2,187.22[16]
C-11 Impoundment	1,831.07[17]
WCA 3A/3B Seepage Management Area	4,632.90[18]
Total Real Estate Requirements	8,651.19

7.0 ACCELER8 PROGRAM

In October 2004, the State of Florida and the SFWMD initiated an Acceler8 Program to expedite the restoration of the Everglades. This Acceler8 Program consisted of eight projects (some with multiple components) that, when completed, would provide environmental, flood control, and water supply benefits. These projects were selected because they could provide immediate benefits to the Everglades and the South Florida ecosystems. Specific benefits of the selected Acceler8 projects included increasing water storage capability, improving water deliveries to the estuaries, improving hydropatterns in the Everglades, improving ecosystem water quality, improving habitat in Lake Okeechobee, and increasing water supplies. The SFWMD is no longer planning to implement the BCWPA project under the Acceler8 Program. The SFWMD and Jacksonville District agreed through an exchange of letters in May and June of 2007 to shift responsibility for construction of the BCWPA features to the USACE.[19]

[16] Source: Table D-4: Baseline Cost Estimate for C-9 Impoundment, Appendix D, Real Estate Plan, Broward County Water Preserve Areas PIR, April 2007.
[17] Source: Table D-2: Baseline Cost Estimate for C-11 Impoundment, Appendix D, Real Estate Plan, Broward County Water Preserve Areas PIR, April 2007.
[18] Source: Table D-3: Baseline Cost Estimate for WCA 3A/3B Seepage Management Area, Appendix D, Real Estate Plan, Broward County Water Preserve Areas PIR, April 2007.
[19] June 18, 2007, letter from the SFWMD to the Jacksonville District stated that the USACE should complete the remaining design and construction of the BCWPA project.

8.0 FORMER CERP LAND VALUATION AND CREDITING POLICY

It is USACE national policy that the fair market value of lands, regardless of when those lands are acquired, be used in plan formulation and in determining project costs and for crediting local sponsors for lands provided for implementation of a project.

However, in about 2002,[20] the SFWMD requested that CERP project lands be valued and credited based on actual acquisition costs. The USACE agree to this deviation in policy, as did the Office of the Assistant Secretary of the Army (Civil Works), and the then-current Administration. Under this CERP real estate policy, lands would be valued at the actual cost of the lands, costs incurred at the time of purchase, rather than the fair market value of the land at some future date which would be specified in a Project Partnership Agreement (PPA).[21]

Those involved in the planning and evaluation of CERP PIRs had very clear and detailed guidance on how to include many of the critical factors that influenced the plan formulation, alternative evaluation, and plan selection processes. Section 601 of WRDA 2000 required the Secretary of the Army to promulgate programmatic regulations on how to proceed on further studies to ensure that the goals and purposes of the CERP were achieved. Those regulations became effective on December 12, 2003.[22]

The Programmatic Regulations require that further detailed guidance be developed for the formulation and evaluation of CERP projects and the preparation of PIRs. In response, the Jacksonville District and the SFWMD jointly prepared six guidance memoranda.[23] The former land valuation and crediting policy is documented in Guidance Memorandum #2, which was followed by those involved in the formulation and evaluation of the BCWPA project and in the developing of the cost estimates used in the preparation of the April 2007 PIR.

That guidance states "As described in Guidance Memorandum #1, the Project Delivery Team should use actual acquisition costs in plan formulation, cost estimating, and crediting subject to those costs being reasonable, allocable, and allowable. For those projects where the non-Federal sponsor has already acquired lands, formulation of alternative plans using other sites will be

[20] The enclosure to a July 30, 2009, letter from the Acting Assistant Secretary of the Army (Civil Works) to the Executive Director of SFWMD notes that the CERP real estate policy of valuing and crediting land based on acquisition costs was agreed to by the SFWMD and the Administration in about 2002.

[21] PPA – A legal contract signed by the USACE and a non-Federal sponsor for the implementation of a project. A PPA is typically executed after a project is fully authorized, after the project has been designed, after the USACE receives initial funding from Congress for construction, and before lands are acquired by the non-Federal sponsor. The typical date for the evaluation of the "fair market value" is the date that the lands are provided to the USACE for implementation of the project in accordance with the earlier signed PPA.

[22] Department of the Army, Corps of Engineers, Title 33, Part 385 of the Code of Federal Regulations, as published in the Federal Register, Vol. 68, No. 218, November 12, 2003.

[23] CERP Programmatic Regulations, Six Program-Wide Guidance Memoranda, Final Draft, April 2005.

minimized if the intended project purposes can be achieved and no more cost-effective sites are identified during formulation."[24]

A very concise description of the policy and how it affects the real estate acquisition is found in the April 2007 PIR's Real Estate Plan. A copy of this description is presented as Appendix C in this report.

9.0 CURRENT CERP LAND VALUATION AND CREDITING POLICY

Based on documents reviewed for this review, on August 10, 2007,[25] the SFWMD wrote to the Assistant Secretary of the Army (Civil Works) requesting a change in the land valuation and crediting policy that was being used for the BCWPA project. The SFWMD wished to discontinue the CERP policy and return to the USACE national policy of valuing and crediting based on fair market value.

In a letter dated July 30, 2009, the Acting Assistant Secretary of the Army (Civil Works) informed the SFWMD that the USACE would return to the longstanding national policy of using "fair market value" for crediting purposes for future CERP projects. The Acting Assistant Secretary provided additional details regarding implementation of the land valuation and crediting policy and related matters in an enclosure to his letter.

For the BCWPA project, the final April 2007 PIR was to be returned to the Jacksonville District and revised, as appropriate, to apply the national valuation and crediting policy of using fair market value, except to lands acquired utilizing Federal funds under the 1996 Farm Bill or to which Section 601 (e)(3)(A) of WRDA 2000 applied. The USACE was then instructed to evaluate any impacts to plan formulation, plan selection, or justification and, if necessary, reformulate the project and revise the PIR to reflect use of the longstanding national policy on land valuation and crediting. A copy of that letter and enclosure can be found in Appendix D to this report.

In a memorandum also dated July 30, 2009, the HQUSACE provided additional guidance to the Jacksonville District regarding the return to the longstanding national policy of using "fair market value" for valuation and crediting purposes for future CERP projects. This guidance applies to the Broward County Water Preserve areas project. A copy of that memorandum can be found in Appendix E to this report.

[24] Paragraph 2.3.2 "Use Actual Acquisition Costs in Plan Formulation, Cost Estimating, and Crediting," Guidance Memorandum #2, "Formulation and Evaluation of Alternative Plans For Project Implementation Reports," Final Draft, April 2005.

[25] The enclosure to a July 30, 2009, letter from the Acting Assistant Secretary of the Army (Civil Works) to the Executive Director of SFWMD notes that on August 10, 2009, the SFWMD requested this change in CERP real estate policy.

10.0 Timing of the Changes in CERP Real Estate Valuation Policy

In evaluating the effect of the former CERP land valuation and crediting policy (acquisition costs) on plan formulation and study and project decision, and the change back to the national USACE policy (fair market value), it is important to consider when the CERP real estate policies were changed and how they were used in the plan formulation process.

Table 2 presents information on the dates when the CERP policy to use land acquisition costs in plan formulation and cost estimates were put into effect, when the CERP policy returned to the USACE national policy, and which USACE studies and reports were based on what policy. There is every indication that for CERP studies, up until about 2002, the land values used in plan formulation and evaluation were based on "fair market value."

Table 2
Broward County Water Preserve Areas
Timing of CERP Real Estate Valuation and Crediting Policy

CERP Land Valuation Policy	Date	USACE Studies Conducted Under Policy
Fair Market Value	Prior to about 2002	CERP Restudy (Yellow Book) Water Preserves Areas Feasibility Study
Acquisition Costs	About 2002 to July 30, 2009	April 2007 BCWPA PIR
Fair Market Value	July 30, 2009, to present	Revisions to BCWPA PIR

11.0 Key Plan Formulation Decision Points

As described in the April 2007 PIR, the plan formulation process utilized for the BCWPA project is a complete and well-organized process. The PIR provides data on a number of measures and preliminary plans considered to meet the planning objectives and to help restore the Everglades. However, the development of a plan to resolve the seepage and discharge issues with WCA 3A and 3B, and with the Broward County drainage basins, started long before the initiation of the PIR. Based on the reviews conducted in this plan formulation review, it is very clear that decisions on project sites and alternatives took place during the Restudy, the planning effort that resulted in the WRDA 2000 conditional authorization of the three components of the BCWPA. Even then, there is ample documentation that the sites for the impoundments and seepage management area were identified prior to the Restudy being completed. Table 3 identifies key plan formulation decision points associated with the BCWPA project.

Table 3
Broward County Water Preserve Areas
Real Estate Plan Formulation Decision Points

Planning Decision Point	When Conducted	Real Estate Influence on Plan Formulation
Draft Land Suitability Analysis	1996	Suitability and availability of lands were considered. No indication that land cost was a factor.
Restudy	1996 – 1999	Alternative plans were evaluated. The costs of alternatives and CERP recommended plans based on fair market value.
Draft Water Preserve Areas Feasibility Report	Prior to Oct 2001	Plan formulation focused on refinements to plans identified in the Restudy. Different storage volumes evaluated and constraints identified. Land costs of alternatives based on fair market value.
PIR - Evaluation of Measures	Early stages of PIR*	Ten types of management measures considered, not just the "Restudy" Impoundments and Seepage Management Area. No evidence that real estate value or ownership was a factor in screening. Conclusion was that above-ground reservoirs and seepage management would best meet the CERP-wide and project-specific goals and objectives.
PIR - Project Siting Analysis	Early stages of PIR*	An evaluation of the availability and suitability of lands to determine the most feasible locations for the project was conducted. It used results of previous studies. Possible site south of project area was being used for mining, and possible site north of the project area was already proposed as an impoundment for another CERP project. It was determined that the identified undeveloped sites were the most practicable location for the project without incurring exorbitant costs of purchasing lands containing existing urban developments.
PIR - Preliminary Alternatives	Early stages of PIR	All 28 alternatives evaluated (plus no action plan) with different configurations of features that would ultimately become the recommended plan. Screening criteria not based on costs or land availability since land were previously identified
PIR - Initial Alternatives (Cost Effectiveness Analysis)	Spring of 2005	All 8 alternatives evaluated (plus the no action plan) were different configurations of what would become the recommended plan. Real estate costs were a factor in the cost effectiveness analysis.
PIR - Final Alternatives (Incremental Analysis)	Spring of 2005	All 4 alternatives evaluated (plus no action plan) were different configurations of what would become the recommended plan. Real estate costs were a factor in the cost effectiveness analysis.
PIR - Recommended Plan	Spring of 2005	Alternative sites not considered. Increase in real estate costs of recommended plan.

* It is likely that this work was a re-evaluation of work done in CERP Restudy or "Yellow Book" and Draft Water Preserve Areas Feasibility Report.

12.0 LANDS ALREADY ACQUIRED

The SFWMD has been acquiring lands needed for many CERP projects for some time. From this review, it would appear that the SFWMD has based such purchases on site selection information contained in the April 1999 Final Integrated Feasibility Report and Programmatic Environmental Impact Statement. This is the CERP report that was submitted to Congress in July 1999.

Lands needed for implementation of the BCWPA project include both private and public lands, and lands already owned by the SFWMD as part of their existing projects in the area. The SFWMD will not need to acquire actual title to the public lands, but instead will be entering into agreements for the use of those properties.

Based on SFWMD data, approximately 8,721 acres of land will be needed for implementation of the BCWPA project. Of this amount, approximately 6,751 acres have been or will need to be purchased from private interests, approximately 1,397 acres are already in public ownership and agreements have been or will be needed to use those lands, and approximately 573 acres are already owned by the SFWMD and used for its projects.

Information on the acquisition of the lands needed for the project is presented in Table 4.[26] More detailed information on the acquisition of the private lands for each of the three major components of the BCWPA projects can be found in Appendices F, G, and H. These appendices contain information on the date that SFWMD purchased each tract and the acreage acquired.

Based on SFWMD data, as of the end of November 2009, about 7,459 acres of the approximately 8,721 acres needed for the BCWPA project (about 85.5 percent) have already been purchased by the SFWMD, have been committed to the project via an executed agreement to use public lands, or are already lands owned by SFWMD for its projects and will also be used for the BCWPA project. Of the private lands, about 6,676 acres of the total amount of 6,751 acres needed for implementation (about 98.9 percent) have already been purchased by the SFWMD. Of the approximately 1,397 acres of publicly owned lands needed for implementation, agreements have already been made to use about 210 acres for the BCWPA project. The approximately 573 areas of SFWMD lands needed for implementation are assured for the project. However, even though agreements have not yet been negotiated, the use of public lands for the project is almost assured. Therefore, for all practical purposes, all but 75 acres of lands are already available for the project. Under this condition, about 99.1 percent of the lands needed for the BCWPA project are available.

[26] Table 4 is based on information provided by the SFWMD on November 24, 2009 and on December 22, 2009. The acreages shown in Table 4 as being needed for the implementation of the BCWPA project do not match what is presented in the April 2007 PIR, as shown in Table 1. However, any differences are small and will be resolved as the project design becomes more detailed and land requirements more exact.

Table 4
Broward County Water Preserve Areas
Status of Real Estate Acquisitions

Component	Acres Required[27]	Acres Acquired[20] (Nov 09)	Percent of Acreage Acquired[28]			
			CERP Report (Jul 99)	Draft PIR (Nov 05)	Final PIR (Apr 07)	Nov 09
C-9 Impoundment						
Private Lands	2,191	2,191	98.9%	100.0%	100.0%	100.0%
Public Lands	69	0	0.0%	0.0%	0.0%	0.0%
C-11 Impoundment						
Private Lands	1,530	1,530	33.5%	100.0%	100.0%	100.0%
Public Lands	298	210	70.5%	70.5%	70.5%	70.5%
WCA 3A/3B Seepage Management Area						
Private Lands	3,030	2,955	86.6%	96.8%	97.5%	97.5%
SFWMD Lands [29]	573	573	100.0%	100.0%	100.0%	100.0%
Public Lands	1,030	0	0%	0%	0%	0%

13.0 REVISED REAL ESTATE ESTIMATES

On November 30, 2009, the Jacksonville District provided updated real estate costs based on the revised CERP real estate policy. Information was provided on the cost of lands for the recommended plan and for the four alternative plans considered in the April 2007 PIR's final array of alternatives.

[27] Source: South Florida Water Management District, December 22, 2009. Acquisition is through either purchase of land (private lands) or through agreements to use land (public lands) for the BCWPA project.
[28] Source: South Florida Water Management District, November 24, 2009. Percentages based on acres and dates that those lands were acquired.
[29] These lands are already owned by the South Florida Water Management District.

Regarding the plan recommended in the April 2007 PIR, costs for lands and damages were provided based on the real estate policy which was in effect when the PIR studies were undertaken (estimates based on acquisition costs), and under the revised CERP policy (estimates based on fair market value). This information is presented in Table 5.

The total estimated real estate costs for all three components of the recommended plan increased from about $308.9 million to about $434.6 million, an increase of approximately $125.7 million or 40.7 percent. The largest increase in estimated land cost was for the WCA 3A/3B Seepage Management Area, which had a cost increase of about 96 percent. It should be noted that in addition to the increase resulting from the method of estimating land values, the increase is in part due to an increase in prices levels between the April 2007 PIR (October 2006 price level[30]) and October 2009 estimates (October 2009 price level).

Table 5
Broward County Water Preserve Areas
Increase in Real Estate Costs
Recommended Plan

Component	Real Estate Cost Estimates (Lands and Damages)			
	April 2007 PIR[31] Acquisition Costs (October 2006 $)	Revised Costs[32] Fair Market Value (October 2009 $)	Cost Increase (Dollars)	Cost Increase (Percent)
C-11 Impoundment	$190,700,000	$230,279,136	$39,579,136	20.8%
C-9 Impoundment	$31,780,000	$34,883,155	$3,103,155	9.8%
3A/3B Seepage Management Area	$86,440,000	$169,394,319	$82,954,319	95.9%
Total	$308,920,000	$434,556,610	$125,636,610	40.7%

Regarding the four plans presented as the final array of alternatives in the April 2007 PIR, updated real estate costs were also provided based on the revised CERP policy (estimates based on fair market value). These plans are Alternative Plans F2, F4, A3 and A4. This information is presented in Table 6.

[30] Paragraph 7.6.1, Implementation Costs, page 7-36, Section 7, The Selected Plan, April 2007 PIR.
[31] Table 7-5, Section 7, The Selected Plan, April 2007 PIR.
[32] E-Mail received from Paul Stevenson, dated November 30, 2009.

Table 6
Broward County Water Preserve Areas
Increase in Real Estate Costs
Final Array of Alternatives

Component	Real Estate Cost Estimates (Lands and Damages)			
	April 2007 PIR[33] Acquisition Costs (2005 $)	Revised Costs[34] Fair Market Value (October 2009 $)	Cost Increase (Dollars)	Cost Increase (Percent)
Alternative F2	$256,105,000	$373,364,627	$117,259,627	45.8%
Alternative F4	$256,105,000	$365,541,827	$109,436,827	42.7%
Alternative A3	$289,105,000	$403,289,350	$114,184,350	39.5%
Alternative A4	$277,530,500	$387,872,898	$110,342,398	39.8%

14.0 PLAN FORMULATION REVIEW AND EVALUATION

The review of the impacts that the change in CERP real estate valuation policy had on the formulation, evaluation, selection, and justification of the BCWPA project needs to consider all significant decisions that were made in the planning of the project. The evaluation also needs to consider when those decisions were made, for, as noted in Table 2, the real estate policy changed during the time when plan formulation decisions were being made.

For the BCWPA project, there were two separate planning efforts during which the most fundamental plan formulation decisions were made. These were (1) the C&SF Restudy or the planning effort that resulted in the C-9 Impoundment, C-11 Impoundment, and WCA 3A/3B Seepage Management Area conditional authorizations in WRDA 2000, and (2) the April 2007 PIR.

All the documents considered in this plan formulation review and the discussion with those involved in the studies indicated that the basic decisions on where to locate the project features were made prior to the initiation of the April 2007 PIR. Likewise, all the data reviewed indicated that all of the decisions on the actual size (volume of water stored, footprint of the

[33] Table F-33, Appendix F (Economic and Social Considerations), April 2007 PIR.
[34] E-mail received from Paul Stevenson, dated November 30, 2009.

structures, etc.), design, benefits/outputs, costs, and justification of the project were made during the preparation of the April 2007 PIR.

Each of these fundamental stages in project development will be evaluated separately and conclusions and recommendations for any revisions on work done will be given for each.

15.0 DECISIONS REGARDING WHERE TO LOCATE PROJECT FEATURES

Pages 5-1 and 5-2 of the PIR document the plan formulation and evaluation efforts that took place in the "Restudy." This was the planning effort that resulted in the most critical decision to locate the features of the BCWPA project at the sites where they are now located.

It is important to understand that a PIR is not a new feasibility study. Planning in a PIR "is based on a component or components that have previously been formulated to a certain level in developing the Plan and are expected to accomplish specific Plan[35] goals. As such, formulation in the PIR always begins with the formulation already documented in the Plan."[36]

That same paragraph in the guidance memorandum continues "the project described in the Plan should be reviewed and cost information updated based on available information. The Project Delivery Team should conduct an initial screening effort to determine if the project as described in the Plan will still achieve the benefits of the project as described in the Plan in a cost-effective manner."

Later on, the USACE guidance states that "If the project as described in the Plan is reaffirmed, then the Project Delivery Team's efforts will focus on development of design alternatives and optimization of the project features, cost-effectiveness, satisfaction of programmatic regulations requirements for PIRs, Micro-computer Aided Cost Engineering System (M-CASES) cost estimates, and the integrated NEPA documentation to supplement the information contained in the Programmatic Environmental Impact Statement for the Plan."

This is exactly the type of plan formulation that was done by the Jacksonville District for the BCWPA project. Therefore, one conclusion from the evaluation of the planning for the BCWPA project is that the Jacksonville District followed CERP policy.

15.1.1 LOCATION OF WCA 3A/3B SEEPAGE MANAGEMENT AREA

The purpose of the seepage management area is to reduce seepage losses from Water Conservation Areas 3A and 3B (WCA 3A/3B) and also to preserve the spatial extent of the wetlands. The seepage flows from west to east as the water flows underground from WCA 3A/3B into developed areas. Some of this water drains into the local canals and finds its way

[35] This would be the CERP project approved by Congress in WRDA 2000.
[36] Paragraph 2.4 – PLAN FORMULATION AND EVALUATION, CERP Guidance Memorandum #2, "Formulation and Evaluation of Alternative Plans For Project Implementation Reports," Final Draft, April 2005.

into the C-11 Canal. This water is pumped back into WCA 3A. However, some of the seepage water is lost to the WCA.

Regarding the affect of the revision in CERP real estate policy, there are two basic questions that need to be answered. The first question is whether the CERP real estate policy that valued land based on acquisition cost biased the decision to locate this project feature on lands that were being acquired by the SFWMD? It must be pointed out clearly that the decision on where to locate this feature was made in the Restudy (pre-1999). At that time, the CERP real estate policy was that land values were based on "fair market value." Therefore, the CERP policy to use acquisition costs to value real estate was not a factor in the decision process because during the time those decisions were being made on where to locate the WCA 3A/3B Seepage Management Area, the policy was to value and credit lands based on fair market value.

The second basic question is where else can the WCA 3A/3B Seepage Management Area be located? The Seepage Management Area must be located adjacent to and just east of WCA 3A/3B, and west of the developed area. There simply is no other sensible location for this facility.

The conclusion stemming from this plan formulation review is that the revision of CERP real estate policy had no effect on the selection of the site for the WCA 3A/3B Seepage Management Area. If the type of facility included in the project is to be the mechanism to manage seepage, then the facility must be at the location proposed.

It should be clearly noted that the approximate $125.7 million increase in the real estate cost of the recommended project is mostly due to the revision in CERP policy (some unknown portion of this increase in real estate costs is due to price level increases), and that about $82.9 million of that total increase (or approximately 66 percent) is due to the increase in the real estate cost of the WCA 3A/3B Seepage Management Area.

The April 2007 PIR noted that a sheet pile wall could be constructed to eliminate seepage out of WCA 3A/3B. While the PIR noted that construction of a wall would alter the desired hydroperiods within the buffer strip (assumed to be adverse impacts), it also noted that approximately 73,130 feet of wall would cost more than the approximate cost of the proposed land for the WCA 3A/3B Seepage Management Area.[37] In light of the substantial increase in the real estate cost of the Seepage Management Area, it is recommended that the Jacksonville District re-evaluate the cost of the sheet pile wall to see if it is still more costly than purchasing the land for the proposed project. In conducting this preliminary re-evaluation, the District should be aware that in addition to the impacts already noted in the April 2007 PIR, the sheet pile wall may have adverse impacts on municipal well fields.[38]

[37] Page 5-6, Section 5 (Formulation and Evaluation of Alternative Plans), April 2007 PIR.
[38] Based on discussions and information collected during the November 12, 2009, site visit.

15.1.2 LOCATION OF C-9 AND C-11 IMPOUNDMENTS

The purpose of the C-11 Impoundment is to collect storm water runoff from the C-11 west drainage basin and store it in the impoundment instead of pumping that untreated runoff into WCA 3A through the S-9 Pump Station, as is the current practice. As noted in the April 2007 PIR, the impoundment pool will also assist in reducing seepage from WCA 3A and the Seepage Management Area, thereby increasing groundwater recharge, providing an additional source of water supply, and reducing saltwater intrusion into drinking water aquifers.

The purpose of the C-9 Impoundment is to receive and store excess storm water runoff from the C-11 west drainage basin. If storage capacity exists in the C-11 impoundment, and there is no need to send runoff from the C-11 Impoundment, runoff for the west C-9 drainage basin may be pumped into the C-9 Impoundment. Like the C-11 Impoundment, the C-9 pool will assist in reducing seepage from WCA 3B and the Seepage Management Area, thereby increasing groundwater recharge, providing an additional source of water supply, and reducing saltwater intrusion into drinking water aquifers.

Regarding the effect of the revision in CERP real estate policy on the location of these two features, like for the WCA 3A/3B Seepage Management Area, there are two major questions to answer. The first question is whether the CERP real estate policy, whereby land is valued based on acquisition costs, biased the decision to locate the project on lands that were being acquired by the SFWMD? In this regard, it is important to understand that the decisions on where to locate these project features were made during the Restudy (pre-1999). The former CERP policy to use acquisition costs to value real estate was not a factor in that decision process because, during the time when those decisions were being made, the policy was to value and credit lands based on fair market value.

The second question is where else can the impoundments be located? At the time the Restudy was being conducted, it might have been that other sites were available. So for the purpose of this review, assume that at that time (pre-1999) other sites might have been available. The April 2007 PIR documents an effort to look for alternative sites for the impoundments. The nearest undeveloped site to the south had just been permitted for mining, and was therefore not available. The nearest possible undeveloped site to the north was already identified as an impoundment for another CERP project, and was also not available. The April 2007 PIR documents that no undeveloped sites, other than the already identified C-9 and C-11 sites, were available in either the C-9 or C-11 drainage basins.

The site visit conducted on November 12, 2009, verified that no large undeveloped sites are available in the area east of WCA 3A/3B. For all practicable purposes, the project area is completely developed. Figure 3 is an aerial photo of the project area showing what would appear to be large undeveloped tracts. Inspection shows that those areas are not available for construction of the impoundments. Other than using the undeveloped sites identified in the PIR, the only other option is to acquire developed sites, which certainly would be much more expensive and likely cost prohibitive.

It is the conclusion of this plan formulation review that the revision of CERP real estate policy had no affect on the selection of the sites for the C-9 and C-11 Impoundments. It is recommended that the Jacksonville District prepare supplemental information that explains when the CERP real estate policies were in effect and the site selection process. That supplemental information might also present an aerial photograph like that shown in Figure 3, along with additional supporting information on what might appear to be potential sites, but showing that they are not available.

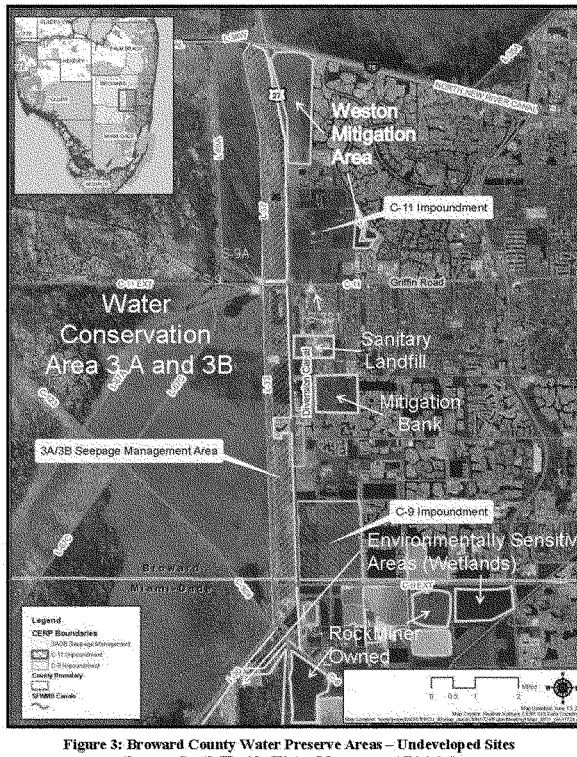

Figure 3: Broward County Water Preserve Areas – Undeveloped Sites (Source: South Florida Water Management District)

16.0 DECISIONS REGARDING SELECTION OF THE RECOMMENDED PLAN

Table 6 displays the plan formulation steps that the April 2007 PIR documents as being conducted during the PIR stage of the study. The results of each step are also presented.

Table 7
Broward County Water Preserve Areas
PIR Plan Formulation Decisions

Planning Evaluation	PIR Reference	Real Estate Influence on Plan Formulation
Management Measures	Para 5.3.1 Page 5-4	Ten types of management measures were evaluated. Screening criteria were cost, environmental degradation, effectiveness, and uncertainty. Two plans were screened out because of cost. **Conclusion was that above-ground reservoirs and seepage management would best meet CERP-wide and project-specific objectives.**
Project Siting Analysis	Para 5.3.2 Page 5-7	The availability of lands for above-ground reservoirs was evaluated. Two undeveloped sites were considered, one north and one south of the project. One site is being used for mining and the other for another CERP project. Significant additional costs would be incurred to use those sites. **Conclusions were that previously identified sites for C-9 and C-11 Impoundments were the most practicable for the project, and that the seepage management feature must be next to WCA 3.**
Initial Array of Alternatives/Options	Para 5.3.2 Page 5-7	Twenty-eight alternatives, plus the no action plan were evaluated. They were configurations of C-9 and C-11 Impoundments. The seepage management area was the same for all plans. Screening criteria were the reduction in S-9 discharge, beneficial wet and dry season effects, and maintenance of the existing flood protection. **Conclusion was that eight plans should be carried forward.**
Cost Effectiveness Analysis of Initial Array of Alternatives	Para 5.3.5.3 Page 5-7 Table 5-4	Eight alternatives, plus the no action plan, were evaluated. Cost and benefits/outputs were calculated for each and a cost-effectiveness analysis was conducted. **Conclusion was that four plans should be carried forward.**
Incremental Analysis of Final Array of Alternatives	Para 5.4.2.1 Page 5-30	Four alternatives, plus no action plan, were evaluated. Cost and benefits/outputs were evaluated. **A single plan was selected for recommendation.**
Recommended Plan	Section 7 Pages 7-1 to 7-52	More detailed design and costs. Increase in real estate costs for the recommended plan.

The decisions on the sites for the C-9 and C-11 Impoundments and the WCA 3A/3B Seepage Management Area were made during the Restudy phase of project development. Data provided

by the SFWMD indicates that by July 1999 almost 70 percent of all the land needed for the project had already been acquired. By July 1999, almost all of the land (98.9 percent) was already acquired for the C-9 Impoundment, and slightly over 86 percent of the land needed for the WCA 3A/3B Seepage Management Area was acquired. At the time when the basic decisions were made on where project features were to be located, the real estate policy was that land costs would be estimated at fair market value. Therefore, the difference between acquisition costs and estimated future fair market values was not a factor in those decisions.

However, it is very clear from the reviews conducted that the estimates of land cost undertaken for the April 2007 PIR were based on acquisition costs. It would be expected that when lands are acquired for a project the actual acquisition cost would be less than the future estimated fair market value. This conclusion has been verified by the recent Jacksonville District real estate updates which show that overall the real estate estimates for the recommended plan have increased by slightly over 40 percent.

The impact of using the higher real estate estimates is that the cost of a unit of ecosystem restoration benefits would be more than that shown in the April 2007 PIR. Therefore, the recommended project, and all of the alternatives evaluated, would likely be found to have higher unit costs and perhaps show less justification than that presented in the April 2007 PIR.[39]

Regarding the planning decisions made in the PIR phase, review of Table 6 shows that alternative plan costs were not included in the plan formulation process until after the initial 28 alternatives were screened and the eight alternatives were carried forward for the cost-effectiveness and incremental analyses.[40] These eight alternatives made up the "Initial Array of Alternatives."[41]

It is recommended that the Jacksonville District revise the cost estimates for these eight alternatives to account for updated estimated real estate costs based on fair market values, and then update the cost effectiveness and incremental cost analyses found in the April 2007 PIR.[42] Since considerable time has passed since the cost estimates in the April 2007 PIR were developed,[43] it is strongly suggested that the Jacksonville District update all costs, not just real estate costs, and revise the PIR accordingly, or as an alternative, prepare an addendum that includes the fully updated costs and a cost effectiveness and incremental analysis based on those updated costs.

[39] Since the benefits of an ecosystem restoration project are non-monetary, justification is not as absolute as if the benefits were expressed in monetary terms. Under USACE policy, ecosystem restoration projects are to address significant regional or national aquatic problems in a cost effective manner. Justification in itself is subjective but can be supported by a complete, concise and scientifically-supported presentation of the nature, quantity, quality, and significance of the ecosystem outputs.

[40] Table 5-3, page 5-13, Section 5 (Formulation and Evaluation of Alternative Plans), April 2007 PIR.

[41] Table 5-4, page 5-14, Section 5 (Formulation and Evaluation of Alternative Plans), April 2007 PIR.

[42] Specifically, this work would start with Section 5.3.5 of the April 2007 PIR and continue through Section 5.4.2.1. If the plans change, additional updates to the PIR would be necessary.

[43] The costs of the alternative plans evaluated in the cost-effectiveness and incremental analysis were at a 2005 price level and the cost of the final recommended plan was at an October 2006 price level.

17.0 CONCLUSIONS AND RECOMMENDATIONS

The following is a list of conclusions and recommendations drawn from this plan formulation review which focused on the revision in CERP real estate policy and its affect on the BCWPA.

- The Jacksonville District followed USACE policy and procedures in the formulation of the Broward County Water Preserves Areas Project.
- The Jacksonville District followed CERP Programmatic Guidance in the formulation of the Broward County Water Preserve Areas Project.
- The CERP real estate policy of using acquisition costs to value and credit lands obtained by the non-Federal sponsor were in effect from about 2002 to July 30, 2009, and therefore should only have affected decisions made in the April 2007 PIR.
- Decisions on where to locate the C-9 and C-11 Impoundments and the WCA 3A/3B Seepage Management Area were made during the Restudy (Yellow Book), and those decisions were made when the longstanding national policy of using "fair market value" for valuing and crediting real estate was in use.
- The recently revised CERP real estate policy, which changed the procedure of valuing lands based on acquisition costs to that of valuing lands based on fair market value, has resulted in about a 10 percent increase in the real estate costs for the C-9 Impoundment, about a 21 percent increase in the real estate cost for the C-11 Impoundment, and about a 96 percent increase in the real estate cost of the WCA 3A/3B Seepage Management Area.
- Regarding the location of the WCA 3A/3B Seepage Management Area, the return to the CERP policy of valuing lands based on fair market value should not have affected the location of this project component since at the time the decision on location was made the policy of valuing lands based on fair market value was in effect. In addition, there are currently no other sites where this feature can be located and be effective.
- In light of the almost doubling of the real estate cost of the WCA 3A/3B Seepage Management Area, the previously considered sheet pile cut-off wall, which was dropped from further consideration as it was previously found to be more costly that the land cost for the seepage management area, may now look more favorable. It is recommended that a sheet pile cut-off wall be re-evaluated. Note that in the re-evaluation, a full-scale design and cost estimate may not be required. The April 2007 PIR notes that this alternative has adverse impacts which might exclude it from further consideration.
- Regarding the location of the C-9 and C-11 Impoundments, the return to the CERP policy of valuing lands based on fair market value should not have affected the location of these project component, since at the time the decisions on location were made the policy of valuing lands based on fair market value was in effect. In addition, there are currently no undeveloped lands of sufficient size for these facilities. Any site that would currently be available would be fully developed and the real estate costs and community impacts of pursuing such an option would be prohibitive.

- The increase in the real estate costs for the C-9 and C-11 Impoundments might affect the optimization of those facilities. Greater impoundment depths would likely result in less land needed for the impoundments. It is recommended that the design depths of the two impoundments be re-evaluated to determine if the storage can be at deeper depth thereby reducing the amount of land required. Care should be taken in this re-evaluation, as a full-scale redesign and cost estimate may not be required. Increasing the depths by a significant amount might change the design conditions so that dam safety concerns and increased seepage might become issues. Both of these impacts might result in an increase in construction cost which might be greater than any real estate cost savings.
- The April 2007 PIR provides strong support for the selection of the National Ecosystem Restoration Plan through the use of cost-effectiveness and incremental analyses. However, the cost estimates used in these analyses are based on the earlier CERP real estate policy of valuing lands based on acquisition costs. As such, the PIR should be updated, or an addendum prepared, to account for both the use of the now current CERP real estate policy and the current construction cost estimates.
- Regarding the Broward County Water Preserve Areas Project, the South Florida Water Management District has been acquiring land needed for the project since the early 1990s. In light of the significant development that has taken place in the project areas over the past 25 years, if it was not for this proactive measure on the part of the South Florida Water Management District, the project would not be able to be constructed and a key element in the restoration of the Everglades would be lost.

APPENDIX A
List of Participants in Site Visit and Interviews

Name	Agency	Site Visit	Inter-view	Date of Discussion or Interview
Tom Teets, CERP Yellow Book Planner	SFWMD	Yes	Yes	November 12, 2009
Jeff Needle, Plan Formulator, Engineering, Project Manager	SFWMD	Yes	Yes	November 12, 2009
Jenni Hiscock, Lead Engineer	SFWMD	Yes	Yes	November 12, 2009
Liberta Scotto, Biologist	US Fish & Wildlife Service	Yes	Yes	November 12, 2009
Barron Moody, Biologist	Florida Fish & Wildlife Conservation Commission	Yes	Yes	November 12, 2009
Grady Caulk, Archeologist	USACE	Yes	Yes	November 12, 2009
Alan Bruns, Current Project Manager	USACE	Yes	Yes	November 12, 2009, and many other discussions
Paul Stevenson, Current Planning Technical Lead	USACE	Yes	Yes	November 12, 2009
Angie Dunn, New Environmental POC	USACE	Yes	Yes	November 12, 2009
Cynthia Irvin, Past Planning Technical Lead	USACE	No	Yes	December 11, 2009
Joe Redican, Past Planning Technical Lead	USACE	No	No	Not able to interview
Mike Rogalski, Past Project Manager	USACE	No	No	Not able to interview
Don Nelson, Real Estate	USACE	No	Yes	Several discussions

APPENDIX B
Documentation of November 12, 2009 Site Visit

Smyth Water Planning Solutions Memorandum

Date: November 20, 2009

To: Paul Stevenson, Jacksonville District – Planning Technical Lead

From: James J. Smyth, P.E.

Subject: Broward County WPA Project Trip Report – Site Visit and Interviews

1. Broward County Water Preserve Areas (BCWPA) project site visit and interviews (a portion of the planned interviews) took place on Thursday, November 12, 2009. The purpose of the trip was to become more familiar with the BCWPA project and to interview people who either participated in the plan formulation process or who might be informed of that process, all for the purpose of addressing the effects real estate policy and values used in the April 2007 PIR had on plan formulation. A specific interest is in identifying alternative sites that were, at the time of the formulation of the plan in the April 2007 PIR, or are currently available. Interviews of the participants took pace during a project briefing and during the tour itself.

2. The project site visit was of the proposed BCWPA project lands and included the South Florida Water Management District's pumping facility along the C-11 canal, the proposed sites for the C-9 and C-11 Impoundments, the proposed connecting canals, ditches, and pumps, and the proposed site of the Seepage Management Area.

3. In addition to myself, the following representatives from the South Florida Water Management District (SFWMD), Jacksonville District of the Corps of Engineers (USACE), US Fish and Wildlife Service, and the Florida Fish and Wildlife Conservation Commission also participated:

a. South Florida Water Management District (SFWMD):
   (1) Jeff Needle, Lead Project Manager (and Plan Formulator)
   (2) Tom Teets, Director, Policy & Coordination (and CERP Yellowbook Planner)
   (3) Jenni Hiscock, Lead Engineer

b. Jacksonville District (USACE):
   (1) Alan Bruns, Project Manager
   (2) Paul Stevenson, Planning Technical Lead
   (3) Angie Dunn, Environmentalist
   (4) Grady Caulk, Archeologist

c. US Fish and Wildlife Service
   (1) Liberta Scotto, Biologist

d. Florida Fish and Wildlife Conservation Commission
   (1) Barron Moody, Biologist

SUBJECT: Broward County WPA Trip Report – Site Visit and Interviews

4. The group met at SFWMD Pump Station S-9/S-9A. Jeff Needle provided an aerial photo of the proposed project, and briefed the group on the functioning of the C-9 and C-11 drainage area and the pumps, canals, and ditches that are used by the SFWMD to maintain drainage and flood protection to developed areas and to reduce water infiltration into the area from the WPAs. He explained how the system was designed, how the SFWMD maintains and operates the system, and what improvements that have been implemented by SFWMD over the years. Jeff Needle, Tom Teets, and Jenni Hiscock answered questions about the original planning for the proposed project, the sites available for its facilities, the intended purpose, and the benefits and costs.

5. SFWMD provided a table which provided information on the planning for the BCWPA project. The table contains data from: (1) Greater Everglades Ecosystem Restoration Plan (1993); (2) Water Supply Preserves (Jan 1994); (3) C&SF Restudy Reconnaissance Report (1994); (4) East Coast Buffer Project Feasibility Report (1996); (5) Land Suitability Analysis (1996); (6) Governor's Commission Conceptual Plan (1996); (7) C&SF Restudy Final Report (1999); (8) WPA Feasibility Study – PSP (draft 2001); (9) Broward County WPA PIR (April 2007); and (10) Broward County WPA PIR – Future Without Project. Information was provided for each BCWPA facility (C-9, C-11, and SMA). This included the intended function of each facility at the time of each study and its acreage and depth, and where appropriate, information on alternatives was also presented. Five maps which supported the table were provided via e-mail on 11-13-09, and six additional maps were provided via e-mail on 11-18-09.

6. SFWMD representatives were questioned on Acelerß activities on the BCWPA project. SFWMD indicated that the BCWPA project was to be studied and implemented by the Corps. It was understood that the SFWMD has already purchased almost all of the lands that would be needed for the BCWPA project (as currently formulated).

7. The BCWPA project's WRDA 2000 authorization was discussed. All agreed that since the current estimate of the project cost exceeded the Section 902 cost limit, and assuming that this cost increase stands, the project will need new Congressional authorization.

8. A draft report entitled "Water Preserve Areas – Land Suitability Analysis," which related to BCWPA land suitability/availability, was shown to the group. A copy was requested.

9. SFWMD was requested to provide available information on the undeveloped land shown on the aerial photo. Information on such things as ownership and use, and possible availability as alternative sites for the BCWPA facilities. The representatives of the SFWMD indicated that they would make such information available.

10. Information was requested on the management measures considered in the early planning for the BCWPA. SWPS was referred to the October 2001 Water Preserves Areas draft feasibility report for such data. Paul Stevenson has provided an electronic file of this report.

11. This was an excellent site visit. The SFWMD provided a very informative and helpful briefing and tour, as well as, excellent background on the BCWPA project. The data provided and information shared will be very helpful in preparing my report on plan formulation.

APPENDIX C
Description of Former Land Valuation and Crediting Policy
(Appendix D, Real Estate Plan, April 2007 PIR)

The Programmatic Regulations for the CERP, 33 CFR 385, Part 385.5, require the development of Six Program-Wide Guidance Memorandum. The February 2006 draft of the Six Program-Wide Guidance Memorandum in Section 1.10 states: "The South Florida Water Management District (SFWMD) and others have been acquiring lands needed for CERP implementation in advance of completion of a PIR, based on the April 1999 'Final Integrated Feasibility Report and Programmatic Environmental Impact Statement.' Under current USACE policy, the fair market value of lands, regardless of when the lands are acquired, is used in plan formulation, in determining project costs, and for crediting local sponsors. Due to the extremely high rate of appreciation of real estate values in south Florida, application of this policy for lands already acquired by the SFWMD and others will result in higher project costs. The non-Federal sponsor for a project will receive credit for the actual cost of the land needed for a project instead of what the land is worth at the time of a Project Cooperation Agreement (PCA) signing. Consequently, the Project Delivery Team should use actual acquisition costs in plan formulation, cost estimating, and crediting, subject to those costs being reasonable, allocable, and allowable." Section 2.3.2 entitled "Use Actual Acquisition Costs in Plan Formulation, Cost Estimating, and Crediting" states "As described in Guidance Memorandum #1, the Project Delivery Team should use actual acquisition costs in plan formulation, cost estimating, and crediting subject to those costs being reasonable, allocable, and allowable. For those projects where the non-Federal sponsor has already acquired lands, formulation of alternative plans using other sites will be minimized if the intended project purposes can be achieved and no more cost-effective sites are identified during formulation." SFWMD's actual acquisition costs for lands already acquired were used for plan formulation, cost estimating and will be used for crediting.

Broward County Water Preserve Areas: The Effect of Revised CERP Real Estate Policy on Plan Formulation

APPENDIX D

Army Civil Works
Land Valuation and Crediting Guidance

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

JUL 30 2009

Mrs. Carol Wehle
Executive Director
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

Dear Ms. Wehle:

Thank you for your strong support of the Comprehensive Everglades Restoration Plan (CERP). We worked successfully together for a number of years while I was at The Department of the Interior, and I am looking forward to continuing that successful relationship now that I work for Army Civil Works. I share the overarching objective of restoring the Everglades to make sure that this National treasure is alive and well for future generations.

In that regard, I am responding to a series of requests made in 2008 and 2009 by you regarding the land valuation and crediting policy and the Master Agreement for CERP. In these requests you have asked the Corps to return to the longstanding national policy of using "fair market value" for crediting purposes in Project Implementation Reports (PIRs) for future CERP projects. The fair market value method and policy is set forth in the Corps Real Estate Handbook (ER 405-1-12). I am pleased to inform you that I have approved your request. The "fair market value" method has already been embraced and reflected in the Master Agreement (MA), and will be utilized in subsequent Project Implementation Reports and their implementing Project Partnership Agreements. Additional details regarding implementation of the land valuation and crediting policy and related matters are provided in the enclosed Memorandum for Record.

I appreciate your leadership and the efforts of your staff regarding the Master Agreement and in particular at the July 21 and 22, 2009 meeting where Corps and SFWMD representatives were able to resolve remaining Master Agreement issues, subject to Governing Board approval. I further understand that the parties have agreed to address certain technical matters, where there has been full agreement on their substance, in separate guidance documents. I believe that we are now ready to move forward with the implementation of CERP projects. Please let me know if you would like me to join you at the next SFWMD Governing Board meeting to sign the Master Agreement.

I look forward to your confirmation of this agreement and our continued partnership on Everglades restoration.

Very truly yours,

Terrence C. Salt
Acting Assistant Secretary of the Army
(Civil Works)

Enclosure

Printed on Recycled Paper

Memorandum for Record
Land Valuation And Crediting Policy
CERP Projects

1. Background. In the SFWMD letter dated August 10, 2007, regarding Land Crediting for the Broward County Water Preserve Areas Project, subsequent related correspondence, and in discussions with the Army Corps of Engineers (Corps) and the office of the Assistant Secretary of the Army for Civil Works, SFWMD asked the Assistant Secretary to approve a change to the land valuation and crediting policy that had been agreed to by the SFWMD and the Administration ca. 2002. The SFWMD wished to discontinue that policy and return to use of the Corps' national policy used for all water resources projects implemented by the Corps, using fair market value when evaluating land values and appropriate credit amounts. This policy change will be applied to CERP projects that have yet to be authorized and is contingent upon the SFWMD agreeing to execute the *CERP Master Agreement* and associated *Project Partnership Agreements (PPAs)* and Pre-Partnership Credit Agreements (PPCAs) that which specifically did not include provisions to provide credit and cost sharing associated with the items 1 through 3 listed in paragraph 3 below.

2. Relationships to Water Quality Matters and SFWMD Funding for CERP. The SFWMD request was based in part on a clarification by the Corps (see May 25, 2007 Memo, "Comprehensive Everglades Restoration Plan, Water Quality Improvements") that water quality improvement features will only be included in a CERP project as a cost shared feature where the water involved already complies with water quality standards for the current use of the affected water, and that the work being proposed as part of a CERP project must be deemed essential to the Everglades restoration effort. This approach is fully consistent with the authorizing statute and subsequent law for CERP.

a. The Corps water quality policy memorandum was of concern to SFWMD staff because they believed that additional funds would be required to comply with the water quality policy. SFWMD staff believed that by returning to the Corps national policy, wherein they would receive credit for lands in accordance with Paragraph 12-36 of Engineering Regulation ER-405-1-12, their funding concerns could be ameliorated to some degree.

b. The Assistant Secretary subsequently issued a policy statement addressing the cost sharing of Water Quality improvements specifically for CERP projects on November 30, 2007, entitled "Comprehensive Everglades Restoration Plan, Water Quality Improvements, Policy Determination." This memorandum affirmed the policy initially set in place by the Corps' memorandum of May 25, 2007.

3. Additional Policy Change Requests from SFWMD. In SFWMD's August 27, 2008 letter and prior and subsequent communications, the SFWMD also asked for additional changes in policy on several other items of cost sharing related to construction of CERP projects, experienced significant cost growth. Those four additional issues are: 1) credit for debt service payments on construction financing; 2) credit for land management costs

before land certification to the U. S. Army Corps of Engineers; 3) credit for operations and maintenance costs during the period of a pre-partnership credit agreement; and, 4) cost sharing site preparation and remediation costs for commercially available products (such as pesticides) used for their intended purpose which only become a CERCLA regulated substance due to the Federal project changing the land use to an aquatic environment having a more stringent cleanup level on lands needed for a CERP project. Concurrent with the policy change on land valuation and crediting, the ASA(CW) affirms that the Corps will not provide credit for the first three items identified here. Guidance has been prepared separately on the fourth issue, which provides for consideration of certain site preparation and remediation costs if they would not have occurred except for the federal ecosystem restoration project and if the Congress subsequently authorizes the Corps to cost share these activities.

4. Land Valuation and Crediting Policy. The Corps Real Estate Handbook (ER 405-1-12) requires, in part, that a gross appraisal be prepared to provide an estimate of value for disclosure and use in PIRs. The policy also provides that for crediting purposes: "(1) The fair market value of Lands, Easements, and Rights-of-Way (LER) owned by the non-Federal sponsor on the effective date of the Project Cooperation Agreement (PCA) [now PPA] for the project is the fair market value of the real property interests as of the date the non-Federal Sponsor provides the Government with authorization for entry thereto for construction purposes" and, "(2) The fair market value of LER acquired by the non-Federal sponsor after the effective date of the PCA [now PPA] for the project is the fair market value of the real property interests at the time the interests are acquired." This policy would be applied to CERP as follows:

a. For the three CERP projects authorized in the Water Resources Development Act of 2007 (Indian River Lagoon South, Picayune Strand, and Site 1 Impoundment projects), real estate costs will remain as recommended in the final PIR and Chief of Engineers' Reports. Due to the fact that these projects have already been authorized by Congress, SFWMD has not proposed and the Army has no authority to alter the previously agreed to terms for cost sharing.

b. For CERP projects without an approved final PIR, the national valuation and crediting policy contained in ER 405-1-12 will be used for plan formulation, cost estimation, and crediting, except as to lands acquired utilizing Federal funds under the 1996 Farm Bill or to which Section 601 (e)(3)(A) are applicable.

c. For the two CERP projects with final PIRs, but without final Chief of Engineers Reports (Caloosahatchee River C-43 West Basin Storage Reservoir and Broward County Water Preserve Areas projects), the final PIRs will be returned to the Jacksonville District and revised, as appropriate, to apply the national valuation and crediting policy contained in ER 405-1-12, except as to lands acquired for any project utilizing Federal funds under the 1996 Farm Bill or to which Section 601 (e)(3)(A) are applicable. The Corps will then evaluate any impacts to plan formulation, plan selection, or justification and, if necessary, PIRs will be adjusted or reformulated and revised before resubmitting them for approval. As part of this adjustment or reformulation, land requirements may differ from those identified in the final PIRs that were submitted for Washington level review in 2007.

APPENDIX E

Headquarters Corps of Engineers Land Valuation and Crediting Guidance

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO ATTENTION OF:

JUL 30 2009

CECW-SAD

MEMORANDUM FOR COMMANDER, SOUTH ATLANTIC DIVISION (CESAD-PDS-P)

SUBJECT: Comprehensive Everglades Restoration Plan (CERP); Land Valuation and Crediting Issues

1. Background. The Comprehensive Everglades Restoration Plan (CERP) land valuation and crediting policy previously approved by the Assistant Secretary of the Army (Civil Works) (ASA(CW)) is based on actual costs. The South Florida Water Management District (SFWMD) requested application of the national U.S. Army Corps of Engineers (USACE) land crediting principles to future CERP projects and the ASA(CW) has agreed to SFWMD's request. The purpose of this memorandum is to provide general guidance on several additional issues as outlined in paragraph 2 below as well as to provide guidance on an issue related to credit for incidental acquisition costs as outlined in paragraph 3 below.

2. Land Valuation Issues for Lands Acquired Pre-PPA.

a. Will tracts of land required for a CERP project that are acquired by SFWMD prior to the execution of a Project Partnership Agreement (PPA) be valued for crediting purposes as one assembled aggregated tract or as individually acquired? Consistent with long-standing USACE practice, and as supported by the unique land credit provision for CERP contained in Section 601(e)(5)(A) of WRDA 2000, tracts acquired by the SFWMD that are acquired and provided in furtherance of a CERP project should be valued and credited as individual tracts regardless of whether the acquisition was prior to or after execution of the PPA for that project. This general principle would not apply where the SFWMD acquired contiguous tracts that are required for a CERP project but it acquired such tracts prior to the PPA for a reason and use other than for implementation of the CERP project. A determination that a tract was acquired "in furtherance of a CERP project" should be supported by documentation existing at the time of acquisition.

b. What is the effect, if any, on valuation of a tract for crediting purposes where the tract was acquired by the SFWMD prior to execution of a PPA and, thereafter, restrictions on use of that tract consistent with use for the project were imposed by deed, zoning controls, or otherwise? The unique statutory land credit provision for CERP projects is clear that the non-Federal sponsor will be afforded credit for the value of lands, or interests in lands, that it provides in accordance with a PIR "regardless of the date of acquisition." *See* Section 601(e)(5)(A) of WRDA 2000. To effectuate the clear intent of Congress reflected in this credit provision, land use restrictions imposed in furtherance of a CERP project after acquisition of a tract by the SFWMD should not be considered in valuing that tract for crediting purposes.

Broward County Water Preserve Areas: The Effect of Revised CERP Real Estate Policy on Plan Formulation

CECW-SAD
SUBJECT: Comprehensive Everglades Restoration Plan (CERP); Land Valuation and Crediting Issues

c. What is the effect, if any, on valuation for crediting purposes where an improved tract (that is, a tract improved with either structural or agricultural features) was acquired by the SFWMD prior to execution of a PPA and, thereafter, the improvements were demolished, or otherwise removed, prior to the date the SFWMD provides the tract to the Government for construction under a PPA? For the same reasons as expressed in subparagraph b.above, demolition of improvements after a tract was acquired in furtherance of a CERP project should not change the approach to value from that applicable at the time of acquisition. Accordingly, the tract should be valued for crediting purposes as it was improved when acquired by the SFWMD. To accomplish this result, the contributory value of the improvements, as of the date of the SFWMD's acquisition, should be added to the market value of the land on the date it is provided for the project as appraised in accordance with its highest and best use on the date of acquisition.

3. Incidental Costs. The SFWMD has requested that it be afforded credit for the costs incurred by other non-Federal governmental entities incidental to acquisition of project lands by such entities. The wording of Section 601(e)(5)(A) is clear that credit may be afforded only for "incidental costs for land acquired by a non-Federal sponsor." Credit may be afforded for traditional incidental acquisition costs that are incurred by SFWMD (such as appraisal costs, mapping costs, or relocation assistance benefits) as well as costs actually incurred by SFWMD in obtaining the required real property rights from other non-Federal governmental entities. However, to be eligible for credit to be afforded to the SFWMD for incidental acquisition costs, SFWMD must have, in fact, incurred those costs.

STEVEN L. STOCKTON, P.E.
Director of Civil Works

2

APPENDIX F

Broward County Water Preserve Areas Project
Real Estate Acquisitions and Dates (Private Lands)
C-9 Impoundment
Total Private Lands Required = 2,191 Acres

Tract	Acquired Acreage	Acquired Date	Percent Acquired
Information on Individual Tracts Not Reproduced	584.07	21-May-96	26.66%
	32.48	21-May-96	28.14%
	3.86	21-May-96	28.32%
	178.04	8-Jul-96	36.44%
	37.81	8-Jul-96	38.17%
	8.26	8-Jul-96	38.55%
	5.00	8-Jul-96	38.77%
	5.00	8-Jul-96	39.00%
	12.25	28-Mar-97	39.56%
	13.45	28-Mar-97	40.17%
	81.31	28-Mar-97	43.89%
	15.84	16-Apr-97	44.61%
	15.61	16-Apr-97	45.32%
	11.10	16-Apr-97	45.83%
	0.59	16-Apr-97	45.85%
	31.30	20-May-97	47.28%
	1.12	20-May-97	47.33%
	10.00	20-May-97	47.79%
	9.99	20-May-97	48.25%
	7.89	20-May-97	48.61%
	136.44	26-May-97	54.83%
	276.83	22-Aug-97	67.47%
	7.85	29-Aug-97	67.83%
	9.62	12-Dec-97	68.27%
	5.00	17-Apr-98	68.49%
	623.45	9-Dec-98	96.95%
	43.62	9-Dec-98	98.94%
	10.01	10-Oct-02	99.40%
	3.56	17-Jan-03	99.56%
	9.88	23-Jun-03	100.01%
Total Acreage	2,191.23		

South Florida Water Management District
November 24, 2009

APPENDIX G

Broward County Water Preserve Areas Project
Real Estate Acquisitions and Dates (Private Lands)
C-11 Impoundment
Total Private Lands Required = 1,530 Acres

Tract	Acquired Acreage	Acquired Date	Percent Acquired
Information on Individual Tracts Not Reproduced	26.15	5-Jun-96	1.71%
	17.71	13-Feb-97	2.87%
	17.57	13-Feb-97	4.02%
	9.17	13-Feb-97	4.61%
	17.58	13-Feb-97	5.76%
	8.45	13-Feb-97	6.32%
	9.58	25-Feb-97	6.94%
	19.17	1-May-97	8.19%
	17.84	20-May-97	9.36%
	17.71	20-May-97	10.52%
	17.69	20-May-97	11.67%
	17.67	20-May-97	12.83%
	18.11	20-May-97	14.01%
	18.33	20-May-97	15.21%
	9.41	20-May-97	15.83%
	74.91	26-Jun-97	20.72%
	19.17	30-Jul-97	21.98%
	34.31	30-Jul-97	24.22%
	116.22	14-Aug-97	31.81%
	9.58	16-Sep-97	32.44%
	10.00	8-Jan-99	33.09%
	3.17	14-Jun-99	33.30%
	2.33	30-Jun-99	33.45%
	10.00	6-Aug-99	34.11%
	28.71	18-Aug-99	35.98%
	9.58	20-Aug-99	36.61%
	77.04	28-Dec-99	41.64%
	39.17	10-Aug-00	44.20%
	10.00	12-Jul-01	44.86%
	13.69	15-Nov-01	45.75%
	9.58	15-Nov-01	46.38%
	53.78	8-Feb-02	49.89%
	9.47	8-Feb-02	50.51%
	10.00	8-Feb-02	51.17%
	10.00	8-Feb-02	51.82%

South Florida Water Management District
November 24, 2009

Broward County Water Preserve Areas: The Effect of Revised CERP Real Estate Policy on Plan Formulation

Broward County Water Preserve Areas Project
Real Estate Acquisitions and Dates
C-11 Impoundment
Total Private Lands Required = 1,530 Acres

Tract	Acquired Acreage	Acquired Date	Percent Acquired
Information on Individual Tracts Not Reproduced	10.00	8-Feb-02	52.47%
	12.57	8-Feb-02	53.30%
	10.00	8-Feb-02	53.95%
	4.16	8-Feb-02	54.22%
	39.17	19-Feb-02	56.78%
	18.72	19-Feb-02	58.00%
	9.58	19-Feb-02	58.63%
	10.00	19-Feb-02	59.28%
	4.58	22-Feb-02	59.58%
	10.00	22-Feb-02	60.24%
	16.67	22-Feb-02	61.33%
	16.67	22-Feb-02	62.42%
	8.40	6-Mar-02	62.97%
	10.00	6-Mar-02	63.62%
	40.00	6-Mar-02	66.23%
	9.58	6-Mar-02	66.86%
	10.00	6-Mar-02	67.51%
	10.00	6-Mar-02	68.17%
	10.00	6-Mar-02	68.82%
	46.52	6-Mar-02	71.86%
	9.59	6-Mar-02	72.49%
	9.59	6-Mar-02	73.11%
	28.04	6-Mar-02	74.95%
	9.58	6-Mar-02	75.57%
	112.55	6-Mar-02	82.93%
	9.58	6-Mar-02	83.56%
	40.75	18-Mar-02	86.22%
	10.00	30-Apr-02	86.87%
	10.00	1-May-02	87.53%
	58.95	14-Nov-02	91.38%
	30.00	13-Dec-02	93.34%
	45.14	23-Apr-04	96.29%
	50.93	14-Jun-04	99.62%
	9.76	17-Nov-04	100.26%
	0.83	15-Sep-08	100.31%
Total Acreage	1,534.76		

South Florida Water Management District
November 24, 2009

Broward County Water Preserve Areas: The Effect of Revised CERP Real Estate Policy on Plan Formulation

Broward County Water Preserve Areas Project
Real Estate Acquisitions and Dates
WCA 3A/3B Seepage Management Area
Total Private Lands Required = 3,030 Acres

Tract	Acquired Acreage	Acquired Date	Percent Acquired
Information on Individual Tracts Not Reproduced	5.00	15-Aug-91	12.47%
	1.20	15-Aug-91	12.51%
	9.90	15-Aug-91	12.84%
	46.00	15-Aug-91	14.36%
	7.10	15-Aug-91	14.59%
	67.80	15-Aug-91	16.83%
	31.00	15-Aug-91	17.85%
	31.00	15-Aug-91	18.88%
	6.90	15-Aug-91	19.10%
	34.10	15-Aug-91	20.23%
	8.50	15-Aug-91	20.51%
	25.50	15-Aug-91	21.35%
	6.90	15-Aug-91	21.58%
	33.10	15-Aug-91	22.67%
	60.80	15-Aug-91	24.68%
	16.00	15-Aug-91	25.21%
	5.00	15-Aug-91	25.37%
	13.40	15-Aug-91	25.81%
	9.80	15-Aug-91	26.14%
	15.40	15-Aug-91	26.64%
	7.10	15-Aug-91	26.88%
	24.50	15-Aug-91	27.69%
	4.30	1-May-92	27.83%
	4.00	1-May-92	27.96%
	7.30	1-May-92	28.20%
	2.40	1-May-92	28.28%
	55.10	1-May-92	30.10%
	62.00	1-Dec-92	32.15%
	9.80	8-Dec-92	32.47%
	35.80	8-Dec-92	33.65%
	13.50	8-Dec-92	34.10%
	8.50	8-Dec-92	34.38%
	11.70	15-Dec-92	34.76%
	1.90	15-Dec-92	34.83%
	8.20	15-Dec-92	35.10%

South Florida Water Management District
November 24, 2009

Broward County Water Preserve Areas: The Effect of Revised CERP Real Estate Policy on Plan Formulation

Broward County Water Preserve Areas Project
Real Estate Acquisitions and Dates
WCA 3A/3B Seepage Management Area
Total Private Lands Required = 3,030 Acres

Tract	Acquired Acreage	Acquired Date	Percent Acquired
Information on Individual Tracts Not Reproduced	8.50	15-Dec-92	35.38%
	8.50	22-Dec-92	35.66%
	39.40	22-Dec-92	36.96%
	40.90	22-Dec-92	38.31%
	40.70	29-Dec-92	39.65%
	13.00	6-Jan-93	40.08%
	14.00	6-Jan-93	40.54%
	4.60	6-Jan-93	40.69%
	4.90	6-Jan-93	40.86%
	9.80	6-Jan-93	41.18%
	9.80	6-Jan-93	41.50%
	6.90	6-Jan-93	41.73%
	6.60	13-Jan-93	41.95%
	6.60	13-Jan-93	42.17%
	6.80	13-Jan-93	42.39%
	16.60	27-Jan-93	42.94%
	4.60	27-Jan-93	43.09%
	39.50	27-Jan-93	44.39%
	140.00	27-Jan-93	49.01%
	15.60	27-Jan-93	49.53%
	4.80	4-Feb-93	49.69%
	9.60	10-Feb-93	50.00%
	13.20	10-Feb-93	50.44%
	31.00	10-Feb-93	51.46%
	17.00	10-Feb-93	52.02%
	6.00	17-Mar-93	52.22%
	8.50	24-Mar-93	52.50%
	8.30	24-Mar-93	52.78%
	57.70	25-Mar-93	54.68%
	45.80	25-Mar-93	56.19%
	4.90	25-Mar-93	56.35%
	6.80	25-Mar-93	56.58%
	24.70	25-Mar-93	57.39%
	8.30	25-Mar-93	57.67%
	52.90	1-Apr-93	59.41%

South Florida Water Management District
November 24, 2009

Broward County Water Preserve Areas: The Effect of Revised CERP Real Estate Policy on Plan Formulation

Broward County Water Preserve Areas Project
Real Estate Acquisitions and Dates
WCA 3A/3B Seepage Management Area
Total Private Lands Required = 3,030 Acres

Tract	Acquired Acreage	Acquired Date	Percent Acquired
Information on Individual Tracts Not Reproduced	38.60	1-Apr-93	60.69%
	13.00	1-Apr-93	61.12%
	26.50	1-Apr-93	61.99%
	2.20	1-Apr-93	62.06%
	8.50	7-Apr-93	62.34%
	8.50	20-Apr-93	62.62%
	65.60	25-Jun-93	64.79%
	43.40	8-Jul-93	66.22%
	13.90	8-Jul-93	66.68%
	8.10	8-Jul-93	66.95%
	4.90	25-Aug-93	67.11%
	6.10	25-Aug-93	67.31%
	7.80	1-Oct-93	67.57%
	9.80	10-Nov-93	67.89%
	3.40	10-Nov-93	68.00%
	12.80	14-Dec-93	68.43%
	11.70	14-Dec-93	68.81%
	11.88	28-Dec-93	69.20%
	5.68	28-Dec-93	69.39%
	14.21	27-Jan-94	69.86%
	17.00	27-Jan-94	70.42%
	13.20	15-Feb-94	70.86%
	3.40	17-Feb-94	70.97%
	9.80	6-Apr-94	71.29%
	5.12	13-Apr-94	71.46%
	4.90	13-Apr-94	71.62%
	15.60	13-Apr-94	72.14%
	17.80	13-Apr-94	72.73%
	9.80	19-Apr-94	73.05%
	6.80	29-Apr-94	73.27%
	19.80	19-May-94	73.93%
	9.00	19-May-94	74.23%
	30.50	19-May-94	75.23%
	8.50	26-May-94	75.51%
	8.10	26-May-94	75.78%

South Florida Water Management District
November 24, 2009

Broward County Water Preserve Areas: The Effect of Revised CERP Real Estate Policy on Plan Formulation

Broward County Water Preserve Areas Project
Real Estate Acquisitions and Dates
WCA 3A/3B Seepage Management Area
Total Private Lands Required = 3,030 Acres

Tract	Acquired Acreage	Acquired Date	Percent Acquired
Information on Individual Tracts Not Reproduced	13.50	10-Jun-94	76.23%
	4.88	10-Jun-94	76.39%
	7.20	22-Sep-94	76.62%
	1.10	22-Sep-94	76.66%
	7.12	22-Sep-94	76.90%
	15.59	22-Sep-94	77.41%
	7.80	22-Sep-94	77.67%
	1.10	3-Nov-94	77.70%
	1.10	3-Nov-94	77.74%
	1.10	3-Nov-94	77.78%
	4.90	3-Nov-94	77.94%
	4.90	15-Nov-94	78.10%
	4.90	27-Feb-95	78.26%
	0.40	28-Mar-95	78.27%
	1.10	18-Apr-95	78.31%
	9.90	18-Apr-95	78.64%
	13.93	12-Apr-96	79.10%
	1.10	3-Jul-96	79.13%
	1.10	3-Jul-96	79.17%
	1.10	3-Jul-96	79.21%
	1.10	11-Sep-96	79.24%
	1.10	7-Apr-97	79.28%
	0.91	19-Nov-97	79.31%
	39.35	19-Nov-97	80.61%
	19.24	19-Nov-97	81.24%
	18.99	19-Nov-97	81.87%
	18.07	19-Nov-97	82.47%
	16.52	19-Nov-97	83.01%
	0.34	19-Nov-97	83.02%
	10.07	19-Nov-97	83.35%
	0.44	19-Nov-97	83.37%
	9.98	19-Nov-97	83.70%
	0.83	19-Nov-97	83.73%
	16.93	19-Nov-97	84.28%
	8.30	3-Sep-98	84.56%

South Florida Water Management District
November 24, 2009

Broward County Water Preserve Areas: The Effect of Revised CERP Real Estate Policy on Plan Formulation

Broward County Water Preserve Areas Project
Real Estate Acquisitions and Dates
WCA 3A/3B Seepage Management Area
Total Private Lands Required = 3,030 Acres

Tract	Acquired Acreage	Acquired Date	Percent Acquired
Information on Individual Tracts Not Reproduced	9.60	3-Sep-98	84.87%
	6.21	16-Oct-98	85.03%
	2.10	3-Dec-98	85.15%
	19.54	7-Jan-99	85.79%
	0.58	8-Jan-99	85.81%
	9.77	4-Mar-99	86.14%
	3.00	11-Mar-99	86.23%
	1.09	21-May-99	86.27%
	9.22	30-Jun-99	86.58%
	5.76	11-Aug-99	86.77%
	1.00	11-Aug-99	86.80%
	3.00	6-Oct-99	86.90%
	5.25	18-Jan-00	87.07%
	2.00	30-Mar-00	87.14%
	1.00	31-Mar-00	87.17%
	3.00	5-Jun-00	87.27%
	8.56	21-Jun-00	87.55%
	5.75	21-Jun-00	87.74%
	0.10	14-Jul-00	87.74%
	9.55	14-Jul-00	88.06%
	7.60	14-Jul-00	88.31%
	23.76	14-Jul-00	89.09%
	9.89	1-Sep-00	89.42%
	7.80	4-Oct-01	89.68%
	4.35	15-Nov-01	89.82%
	5.00	11-Dec-01	89.99%
	8.21	10-May-02	90.26%
	10.00	6-Jun-02	90.59%
	3.38	17-Jul-02	90.70%
	5.91	4-Oct-02	90.89%
	1.09	7-Jan-03	90.93%
	10.00	28-Feb-03	91.26%
	12.90	7-Mar-03	91.69%
	24.90	13-Mar-03	92.51%
	7.50	13-Mar-03	92.76%

South Florida Water Management District
November 24, 2009

Broward County Water Preserve Areas: The Effect of Revised CERP Real Estate Policy on Plan Formulation

Broward County Water Preserve Areas Project
Real Estate Acquisitions and Dates
WCA 3A/3B Seepage Management Area
Total Private Lands Required = 3,030 Acres

Tract	Acquired Acreage	Acquired Date	Percent Acquired
Information on Individual Tracts Not Reproduced	2.40	13-Mar-03	92.83%
	5.00	13-Mar-03	93.00%
	4.65	14-Mar-03	93.15%
	0.65	14-Mar-03	93.17%
	7.29	14-Mar-03	93.41%
	5.00	14-Mar-03	93.58%
	1.08	17-Apr-03	93.62%
	0.76	18-Apr-03	93.64%
	1.09	9-May-03	93.68%
	2.00	16-Jul-03	93.74%
	4.66	25-Aug-03	93.90%
	10.38	26-Aug-03	94.24%
	3.80	1-Oct-03	94.36%
	9.77	23-Nov-03	94.69%
	1.09	24-Nov-03	94.72%
	1.09	24-Nov-03	94.76%
	4.15	15-Dec-03	94.90%
	4.22	15-Dec-03	95.03%
	1.78	15-Dec-03	95.09%
	6.06	15-Jan-04	95.29%
	4.55	30-Jan-04	95.44%
	9.75	29-Mar-04	95.77%
	9.98	18-Apr-04	96.09%
	4.35	5-May-04	96.24%
	2.00	10-May-04	96.30%
	1.00	10-May-04	96.34%
	1.61	28-Jun-04	96.39%
	0.55	2-Aug-04	96.41%
	2.30	25-Apr-05	96.48%
	9.33	25-Aug-05	96.79%
	22.19	25-Apr-07	97.52%
Total Acreage	2,955.00		

South Florida Water Management District
November 24, 2009

ATTACHMENT B – SFWMD AGCHEM REQUEST LETTER 29 SEPTEMBER 2011

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

VIA EMAIL

September 29, 2011

Mr. David S. Hobbie
Deputy District Engineer
Programs and Project Management Division
U.S. Army Corps of Engineers
701 San Marco Blvd.
Jacksonville, FL 32207-8175

Dear Mr. Hobbie:

Subject: Request for Inclusion of a Section Entitled "Residual Agricultural Chemicals" within the Broward County Water Preserve Areas Final Integrated Project Implementation Report and Environmental Impact Statement

I am writing on behalf of the South Florida Water Management District (SFWMD) to request inclusion of a section entitled "Residual Agricultural Chemicals" to the Broward County Water Preserve Area Final Integrated Project Implementation Report and Environmental Impact Statement (BCWPAs). This request is in accordance with Paragraph 4 of the Comprehensive Everglades Restoration Plan (CERP) - Residual Agricultural Chemicals Memorandum issued September 14, 2011 from the Assistant Secretary of the Army for Civil Works. In accordance with the policy guidance, SFWMD requests that soils containing residual agricultural chemicals remain on Project lands, and that the Jacksonville District handle these soils during construction efforts for the Project.

SFWMD has provided information to the Jacksonville District to fulfill the applicable requirements set forth in Paragraph 4 of the policy guidance for the BCWPAs Project and will work with the Jacksonville District to complete this new section.

Please contact Tom Teets, Federal Policy Chief, at 561-682-6993 should you have any questions concerning this request.

Sincerely,

Ernie Barnett
Director
Office of Everglades Policy and Coordination

EB/am

c: Stuart Appelbaum, USACE
Alan Bruns, USACE
Howie Gonzales, USACE
Mark Shafer, USACE
Kim Taplin, USACE
Tom Teets, SFWMD

3301 Gun Club Road, West Palm Beach, Florida 33406 • (561) 686-8800 • FL WATS 1-800-432-2045
Mailing Address: P.O. Box 24680, West Palm Beach, FL 33416-4680 • www.sfwmd.gov

ATTACHMENT C – AGENCY TECHNICAL REVIEW (ATR) CERTIFICATION LETTER 17 MARCH 2011

CESPK-PD-W 17 March 2011

MEMORANDUM FOR THE RECORD

SUBJECT: Review Report for Agency Technical Review, Broward County Water Preserve Areas, Central and Southern Florida Project, Final Integrated Project Implementation Report and Environmental Impact Statement

1. Agency Technical Review of the Final Project Implementation Report (PIR) prepared by the Jacksonville District was managed by the Ecosystem Restoration Planning Center of Expertise in MVD. The ATR was performed by a team composed of staff of the Sacramento and San Francisco Districts (SPD) and the Savannah District (SAD). The Eco-PCX manager and ATR team members are listed in Attachment 1. The Review Plan for the Final PIR served as the charge to the reviewers. An earlier version of the Final PIR was peer reviewed in accordance with the quality management requirements in effect at the time and was approved by the Civil Works Review Board in April 2007. The current Final PIR is an update of the 2007 version. ATR of the updated Final PIR was required by HQUSACE because the 2007 Final PIR was not subject to the current quality management guidance provided by EC 1165-2-209. Review of the Final PIR by the Cost Engineering Directory of Expertise is being conducted separately from rest of the ATR and is not addressed in this review report.

2. Review of the Final PIR resulted in a total of 54 comments. The PDT concurred with and resolved 51 comments, and 3 comments were resolved by clarifying information provided by the PDT. Resolution of comments was based on the PDT responses provided in DrChecks and review of revised report sections incorporating the PDT responses. The attached DrChecks reports provide detailed documentation and summaries of the ATR comments and PDT responses (Attachments 2-4). There are no unresolved comments.

Scott Miner
Agency Technical Review Team Leader
Planning Division
Sacramento District

Attachments (4)

COMPLETION OF AGENCY TECHNICAL REVIEW

The Agency Technical Review (ATR) has been completed for the Final Integrated Project Implementation Report and Environmental Impact Statement for the Central and Southern Florida Project, Broward County Water Preserve Areas. The ATR was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-209. During the ATR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy. Review of the Final PIR by the Cost Engineering Directory of Expertise is being conducted separately from rest of the ATR and is not addressed by this certification. All comments resulting from the ATR have been resolved and the comments have been closed in DrChecks[sm].

Scott Miner
ATR Team Leader
Planning Division
Sacramento District

3/17/11
Date

2

ATTACHMENT D – ENVIRONMENTAL BENEFITS MODEL CECW-P CERTIFICATION LETTER 5 APRIL 2011

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

REPLY TO
ATTENTION OF

CECW-P 1 February 2011

MEMORANDUM FOR Director, National Ecosystem Restoration Planning Center of Expertise (ECO-PCX)

SUBJECT: Broward County Water Preserve Areas (WPA), Broward County, Florida. Ecosystem Planning Models – Approval for Use

Three ecosystem planning models used to quantify project benefits are approved for use for the subject project. Adequate technical reviews have been accomplished and the model meets the certification criteria contained in EC 1105-2-412. This approval is based on the decision of the HQUSACE Model Certification Panel which considered the National Ecosystem Planning Center of Expertise (ECO-PCX) assessments of the models. Below are specific assessments.

a. Ridge and Slough Model. This model has been published in peer reviewed journals and used in many projects for plan formulation and plan outputs and justification. The Ridge and Slough Model relies on a variety of performance indicators to measure and project outputs. This model is well documented, published, and tested, and is approved for use.

b. Snail Kite Habitat Quality Model. This model is part of the suite of habitat models used in South Florida restoration efforts. It focuses on vegetative changes which can either expand or reduce optimum forage habitat for an endangered raptor which only eats snails found in that vegetation. Like the Ridge and Slough Model, this model has been well documented and tested by planning and operations efforts in the ecosystem and is approved for use.

c. Cattail Spread Rate Reduction Model. Of the three models used for the Broward County WPA project, the Cattail model triggered the most review comments due to the sensitivity of Phosphorus loading issues in the aquatic ecosystem in Florida and the potential wide error bands around projections of Phosphorus reduction from project and system operations. The modeling team added backup information to address the model review comments. As a result, the Cattail Spread Rate Reduction Model is approved for use.

APPLICABILITY: Approval of these three models is limited to the subject project.

EXPIRES: 28 February 2018

HARRY E. KITCH, P.E.
Deputy Chief, Planning and Policy Division
Directorate of Civil Work

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