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COMPREHENSIVE EVERGLADES RESTORATION PLAN, CENTRAL EVERGLADES PLANNING PROJECT, INTEGRATED PROJECT IMPLEMENTATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT: FINAL JULY 2014, REVISED DECEMBER 2014

COMMUNICATION

FROM

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

TRANSMITTING

THE FINAL COMPREHENSIVE EVERGLADES RESTORATION PLAN INTEGRATED PROJECT IMPLEMENTATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT, PURSUANT TO THE WATER RESOURCES DEVELOPMENT ACT OF 2000, SEC. 601

PART 6 OF 6

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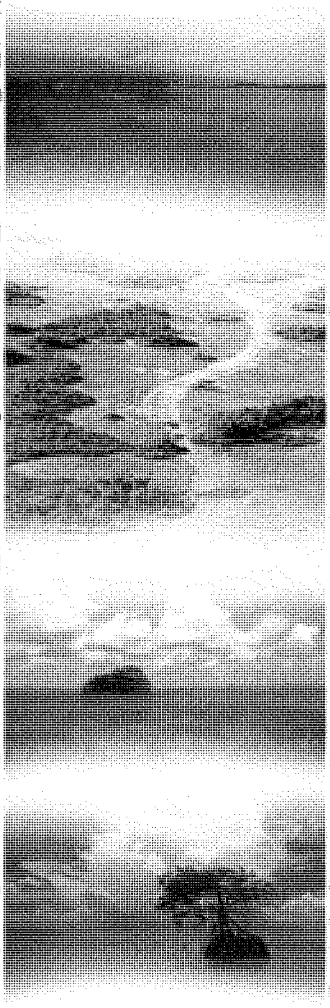
RESTORING THE HEART OF THE EVERGLADES

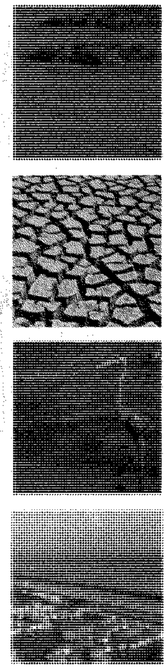


CENTRAL EVERGLADES PLANNING PROJECT

COMPREHENSIVE EVERGLADES RESTORATION PLAN

CENTRAL EVERGLADES PLANNING PROJECT

FINAL INTEGRATED PROJECT IMPLEMENTATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT



July 2014
Revised December 2014

Annex B-I

Cover insets (left to right):

Landscapes: Lake Okeechobee, Water Conservation Area 3, Everglades National Park, Florida Bay; **Map:** Depicts Average Annual Overland Flow across the period of record (1965-2005) for existing conditions, as modeled by the CEPP regional hydrologic model (the coloration of the arrows represents the relative volume of flow, while the direction of the arrows represents the movement of flow across the landscape); **Small Landscapes:** Ponding, soil oxidation (peat reduction), dry area of Everglades National Park, juxtaposition of urban development.

ANNEX B

ANALYSES REQUIRED BY WRDA 2000 AND FLORIDA STATE LAW

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ANALYSES REQUIRED BY WRDA

B.1 LEGAL BASIS - Background

Federal law and regulation implementing the Comprehensive Everglades Restoration Plan (CERP) require Project Implementation Reports (PIRs) to address certain assurances as part of the project being recommended for approval and implementation. This section addresses provisions of Section 601(h) of the Water Resources Development Act of 2000 (WRDA 2000), the Programmatic Regulations for the CERP (33 CFR Part 385) for Savings Clause requirements and Project-Specific Assurances.

The following sections describe the specific requirements from WRDA 2000 and the CERP Programmatic Regulations and present the methods, results, and conclusions of the analyses necessary to meet those requirements.

B.1.1 Water Resources Development Act (WRDA 2000)

Congress enacted the WRDA 2000, Section 601, Comprehensive Everglades Restoration Plan, which approved CERP "as a framework for modifications and operational changes to the Central and Southern Florida (C&SF) 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." Section 601(h) of WRDA 2000, entitled, "Assurance of Project Benefits" establishes project-specific assurances to be addressed as part of CERP implementation.

Section 601 (h) (1) of WRDA 2000 provides the following:

> *IN GENERAL - The overarching objective of the Plan is the restoration, preservation, and protection of 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, 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.*

In this document, Sections B.1 and B.1.1 discuss the Savings Clause and project assurances required by WRDA 2000 to be addressed in each PIR. Section B.1.2 lists the Savings Clause and project assurances provisions of the CERP programmatic regulations, which provide supplemental information for implementing the WRDA 2000. Section B.1.2.5 discusses the role of the Draft Guidance Memoranda in the analyses.

The Savings Clause analysis is listed in WRDA 2000 as a means to protect users of legal sources of water supply and to protect the levels of service for flood protection that were in place at the time of enactment. Specifically, Section 601(h)(5) of WRDA 2000, entitled "Savings Clause", requires an analysis of each project's effects on legal sources of water that were in existence on the date of enactment of WRDA 2000 (i.e., December 2000), effects on levels of service of flood protection in existence on the date of enactment of WRDA 2000, and effects on the Seminole Tribe of Florida Water Supply Compact with the State of Florida and South Florida Water Management District (SFWMD). Section 601(h) (5) of WRDA 2000 states the following:

(A) NO ELIMINATION OR TRANSFER. – Until a new source of water supply of comparable quantity and quality as that available on the date of enactment of this Act is available to replace the water to be lost as a result of implementation of the Plan, the Secretary and the non-Federal sponsor shall not eliminate or transfer existing legal sources of water, including those for –

(i) an agricultural or urban water supply;
(ii) allocation or entitlement to the Seminole Indian Tribe of Florida under section 7 of the Seminole Indian Land Claims Settlement Act of 1987 (25 U.S.C. 1772e);
(iii) the Miccosukee Tribe of Indians of Florida;
(iv) water supply for Everglades National Park; or
(v) water supply for fish and wildlife.

(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.

(C) NO EFFECT ON TRIBAL COMPACT. – Nothing in this section amends, alters, prevents, or otherwise abrogates rights of the Seminole Indian Tribe of Florida under the compact among the Seminole Tribe of Florida, the State, and the South Florida Water Management District, defining the scope and use of water rights of the Seminole Tribe of Florida, as codified in section 7 of the Seminole Indian Land Claims Act of 1987 (25 U.S.C. 1772e).

The analysis of project-specific assurances is listed in WRDA 2000 as a means to assure that CERP project benefits are realized by establishing the appropriate quantity, timing, and distribution of water to be dedicated and managed for the natural system. Section 601(h) (4) of WRDA 2000, entitled "Project-Specific Assurances", contains the following requirements for PIRs:

(A) PROJECT IMPLEMENTATION REPORTS. –

(i) IN GENERAL. – The Secretary (of the Army) 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 –

...(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;

WRDA 2000 excerpts cited above are intended to provide a concise summary of the Savings Clause and Project-specific Assurances analyses required under WRDA 2000. Refer to WRDA 2000 for complete text.

B.1.2 Programmatic Regulations (33 CFR PART 385)

Section 601(h)(3) of WRDA 2000 required the Secretary of the Army, with the concurrence of the Governor and the Secretary of the Interior, to promulgate Programmatic Regulations to ensure that the goals and objectives of the CERP are achieved. The Final Programmatic Regulations for the CERP, which were published in 33 CFR Part 385 in 2003, establish the processes and procedures to guide the U.S. Army Corps of Engineers (Corps or USACE) in the implementation of the CERP. In this document, Section B.1.2 summarizes the requirements of the Programmatic Regulations that provide supplemental information to WRDA 2000.

B.1.2.1 Pre-CERP Baseline

Section 385.35(a) of the Programmatic Regulations requires the development of a pre-CERP baseline to aid the Corps and the South Florida Water Management District (SFWMD) when implementing the Savings Clause to determine if existing legal sources of water will be eliminated or transferred and to demonstrate that the levels of service of flood protection in existence on the date of enactment of WRDA 2000, and in accordance with applicable law, will not be reduced by implementation of a project.

B.1.2.2 Savings Clause - Elimination or Transfer of Existing Legal Sources of Water

Section 385.36 of the Programmatic Regulations requires that PIRs include a determination of existing legal sources of water that are to be eliminated or transferred as a result of project implementation. If a project is expected to result in an elimination or transfer of an existing legal source of water, the PIR shall include an implementation plan that ensures a new source of water of comparable quantity and quality is available to replace the source that is being transferred or eliminated.

B.1.2.3 Savings Clause - Flood Protection

Section 385.37 of the Programmatic Regulations requires that PIRs include an analysis of the project's impacts on levels of service for flood protection that existed on the date of enactment of WRDA 2000 (December 2000) and are in accordance with applicable law. Where appropriate and consistent with restoration of the natural system, opportunities to provide additional flood protection shall be considered. The conditions that existed on the date of enactment of WRDA 2000 are included in the Pre-CERP Baseline.

B.1.2.4 Project Assurances - Identification of Water for the Natural System

Section 385.35(b) of the Programmatic Regulations requires that each PIR identify the quantity, timing, and distribution of water to be dedicated and managed for the natural system necessary to meet CERP restoration goals.

B.1.2.5 Project Assurances - Identification of Water for Other Water-Related Needs

Section 385.35(b) of the Programmatic Regulations also requires that procedures be developed for identifying water generated by CERP for use in the human environment. Identification of the quantity, timing, and distribution of this water for other water-related should be included in PIRs.

B.1.2.6 Draft Guidance Memoranda

The Programmatic Regulations require the development of six guidance memoranda jointly by the Corps and SFWMD in consultation with others. The Draft Guidance Memoranda dated July 2007 provided additional information to complete the analyses initially described in WRDA 2000; however, since the guidance memoranda exist in draft form only, the PIRs completed prior to their approval can use appropriate methods deemed reasonable at the time. The July 2007 Draft Guidance Memoranda are available for review at the following link:

http://www.evergladesplan.org/pm/progr_regs_guidance_memoranda.aspx

Section 385.35(b)(3)(iii) of the Programmatic Regulations specifically states that "PIRs approved before... the development of the guidance memorandum may use whatever method the Corps of Engineers and the non-Federal sponsor deem is reasonable and consistent with the provisions of Section 601 of WRDA 2000." During the preliminary planning phases of the CEPP project, based on consideration of the expedited schedule, the Corps and SFWMD advocated using efficiencies learned from the processes of developing prior PIRs, including prior CERP project methodologies for the technical analyses described in Draft Guidance Memoranda 3 (Savings Clause Requirements) and Draft Guidance Memoranda 4 (Identifying Water Made Available for the Natural System and for Other Water-Related Needs). The two draft memoranda provide additional background information and describe the analyses and tools to address the Savings Clause and project assurances requirements of the Programmatic Regulations. Selected tools appropriate to the CEPP project scale and available were applied to conduct the necessary analyses. The analyses completed for the CEPP PIR, which are documented in Section B.2, Section B.3, and section B.4 within this Annex, meet the intent of the draft memoranda while fulfilling the requirements of Section 601 of WRDA 2000 and the Programmatic Regulations.

Section B.2.1 of this report contains the key assumptions common to Savings Clause and project assurance analyses including an overview of the modeling tools available, the scenario assumptions, and the regional project effects resulting from achieving the CEPP project objectives.

Section B.2.2 of this report contains a description of the assumptions, concept, and methodologies applied for the CEPP evaluation of Savings Clause requirements.

Section B.2.3 contains a description of the assumptions, concepts, and methodologies applied for the CEPP evaluations to identify water made available by the project for the natural system and for other water-related needs of the region.

Section B.3 describes the results of these analyses, while Section B.4 provides conclusions and identifies the amount of water made available by the project for the natural system to be reserved or allocated by the State of Florida and the amount of water made available for other water-related needs.

B.2 Methods

The same hydrologic models used for plan formulation are typically applied to the Savings Clause and project assurance analyses. This ensures consistency when representing the project effects in the analyses subsequent to plan selection. The Regional Simulation Model (RSM) for Basins (RSM-BN) and the RSM Glades-LECSA (RSM-GL) hydrologic models were used to simulate and evaluate the environmental effects of the CEPP final array of alternatives through comparison with pre-project base conditions simulated with the same models. The RSM-BN is applied north of the L-4/L-5/L-6 (the CEPP formulation redline) for Lake Okeechobee, the Everglades Agricultural Area (EAA), and the Northern Estuaries; the RSM-GL is applied within the Water Conservation Areas (WCAs), Everglades National Park (ENP), and the Lower East Coast Service Areas (LECSAs). The RSM models uses a 41-year period of hydrologic record (1965 through 2005) which includes sufficient climatological variability (including natural fluctuations of water) to represent the full range of hydrologic conditions experienced within the South Florida region over a long-term period. No one modeling tool or representation of model results can definitively predict with project hydrologic conditions across the entire CEPP project area given the large regional scope of the project, model tools limitations and assumptions, and future uncertainties regarding the effects of other projects. However, each snapshot of model results can form the basis for applying best professional judgment to determine whether the potential effects of CEPP would reduce the availability of an existing source of water or reduce the level of service for flood protection, and to quantify the water necessary to achieve the benefits of the plan.

The plan formulation process applied during CEPP analyzed the environmental effects and benefits of the project alternatives through qualitative and quantitative comparisons between the future without (FWO) project condition and the future with project condition. The FWO project condition describes what is assumed to be in place if none of the study's alternative plans are implemented. The FWO project condition for CEPP assumes the construction and implementation of authorized CERP and non-CERP projects, and other Federal, state or local projects constructed or approved under existing governmental authorities that occur in the CEPP study area, as described in **Section 2.5** of the PIR main report. The future with project condition describes what is expected to occur as a result of implementing each alternative plan that is being considered in the study. Based on this formulation and evaluation approach, the CEPP alternatives were analyzed as the next-added increment of CERP projects to be added to a system of projects identified as likely to have been implemented prior to implementation of the CEPP project. The CEPP recommended plan (Alt 4R2) was formulated, evaluated, and justified based on the ability of the CEPP recommended plan: (1) to contribute to the goals and purposes of the CERP Plan, and (2) to provide benefits that justify costs on a next-added basis.

B.2.1 Project Objectives and Associated Baseline Model Assumptions

Viewed from a programmatic perspective, the identification of water for the natural system associated with the CERP involves an analysis of four different aspects of ecological responses to hydrologic changes: 1) responses to the change in the quantity of water received by the natural system; 2) responses to the timing of those deliveries; 3) responses to the distribution of water delivered to the natural system; and 4) responses to the quality of the water received by the natural system. In a project specific sense, however, the relative importance of each of these aspects (quantity, timing, distribution, and quality) will vary from project to project depending upon the specific objectives established for the project.

For example, some CERP projects may focus formulation efforts on simply changing the timing (i.e., seasonality) or distribution (i.e., inflow and outflow points or internal movement) of water delivered to the natural system. Other projects may focus primarily on increasing or decreasing the amount of water delivered to the natural system depending on its needs, while still other projects may focus on improving the quality of the water delivered to the natural system to maintain desirable ecological community structure. All of these aspects, depending upon their applicability to specific CERP projects, are addressed during plan formulation through performance measures and evaluation criteria used to evaluate alternative plans and ultimately select a plan. Hydrologic targets for the natural system applied during plan formulation help to identify the quantity of water required to meet restoration objectives, in contrast to water that exceeds the targets and may be harmful or otherwise not contribute to meeting the restoration targets.

CEPP achieves the project objectives by changing the timing, distribution, and volume of water conveyed, to the natural system. The large regional scale of the CEPP causes large volumes of water to move between ecosystems and basins consistent with the project's objectives (**Table B-1**). The water made available for the natural system is the water required for the protection of fish and wildlife within natural systems, including water that contributes to meeting hydrologic, water quality, and ecologic targets for natural system restoration. The Savings Clause and project assurances analyses will focus on whether these regional-scale changes meet the requirements of WRDA 2000 and the Programmatic Regulations.

Concurrent with development of the operational refinements to the National Ecosystem Restoration (NER) Plan, which is described in **Section 4.6.2** of the PIR main report, preparation for Savings Clause and Project Assurances analyses was initiated. The analyses of the Saving Clause and Project Assurance requirements includes considerations of three different sets of assumptions at three different points in time or conditions as depicted in **Table B-2**. Following identification of the recommended plan in June 2013, the CEPP base condition assumptions established for plan formulation were subsequently revisited and updated to represent the most current information for the analysis of Savings Clause requirements and Project-Specific Assurances. Specifically, the Existing Condition Baseline (ECB) was updated to 2012EC and the Future Without Project baseline (FWO) was updated utilizing new information for the Initial Operating Regime Baseline (IORBL1). Comparison of the CEPP Recommended Plan (Alt 4R2) to these new baselines resulted in different trends as seen during plan formulation for selected areas as discussed in the results section below. The model assumption tables for all base conditions (ECB, 2012EC, FWO, and IORBL) and Alternative 4R2 (Alt 4R2) are provided in Reference 2 of the Hydrologic Modeling Annex (A-2) to the Engineering Appendix (Appendix A).

The revised 2012 Existing Condition Baseline (2012EC) updated the ECB to include implementation of Everglades Restoration Transition Plan (ERTP) operations for WCA-3A and the South Dade Conveyance system, in addition to minor localized corrections to improve RSM-GL representation of the S-9/S-9A operations and the L-28 weir (all other ECB assumptions remain unchanged). The revised Initial Operating Regime Baseline (IORBL1) updated the FWO to include the 2.6 mile western Tamiami Trail bridge proposed with the initial increment of the DOI Tamiami Trail Next Steps Project (based on best available phased implementation information from DOI), operational updates to the CERP Indian River Lagoon South (IRLS) project (based on best available information from the IRLS project team), and operational refinements to the CERP Broward County Water Preserve Area project (to reduce excess discharges to tide via S-29, including accounting for the effects of the Lake Belt expansion assumed in the CEPP FWO condition), in addition to the same minor localized corrections included with the 2012EC to improve RSM-GL representation of the S-9/S-9A operations and the L-28 weir (all other FWO assumptions remain unchanged). The 2012EC and the IORBL1 represent the existing condition baseline and future without project baseline assumptions for purposes of completing the CEPP assessments for the Savings Clause and Project Assurances. Compared to the FWO baseline, the updated IORBL1 baseline indicates significant hydrologic differences with respect to the Saint Lucie Estuary and Biscayne Bay, with other portions of the CEPP project area performing similar to the FWO; a summary of these performance differences between the FWO and IORBL1 is provided in Appendix C.2.2 for the St. Lucie Estuary and Biscayne Bay.

The CEPP PIR report documentation and two complete sets of RSM-BN and RSM-GL hydrologic model performance measure output are posted on the Everglades Plan public web site for the CERP: http://www.evergladesplan.org/pm/projects/proj_51_cepp.aspx

The following complete performance measure data sets are provided to facilitate additional review of the hydrologic modeling output for the baselines and the Recommended Plan Alt 4R2:

- ECB, FWO, Alternative 4R, Alternative 4R2 (comparison used for NEPA evaluation in Section 5 of the main PIR report)
- ECB, 2012EC, IORBL1, Alternative 4R2 (comparison used for the Savings Clause and Project Assurances evaluation in Annex B of the PIR report)

Final CEPP hydrologic modeling products have been uploaded to the CERP Model Management System (MMS), a geographic information system (GIS) based application that includes model input data, select model output data, source code/executable files and documentation. CEPP modeling products in MMS can be accessed directly at the MMS project page through the Everglades Plan public web site: http://cerpmap1.cerpzone.org/arcgisapps/CERPMMS/CerpReport/ProjectReport.aspx?projectID=687

Table B-1. Comprehensive Everglades Planning Project (CEPP) Objectives and Regional Changes to Quantity, Timing, Distribution, and Quality of Water

<table>
<tr><th colspan="2">CERP GOAL: Enhance Ecological Values</th></tr>
<tr><th>CEPP Objective</th><th>Resulting Effect of Recommended Project</th></tr>
<tr><td>Restore seasonal hydroperiods and freshwater distribution to support a natural mosaic of wetland and upland habitat in the Everglades system.</td><td rowspan="2">Increase in water conveyed to WCA 3A and WCA 3B in the dry season, decrease in water conveyed to WCA 2A and WCA 2B, and change in timing to improve ability to meet hydropattern and water quality restoration targets.</td></tr>
<tr><td>Improve sheetflow patterns and surface water depths and durations in the Everglades system in order to reduce soil subsidence, the frequency of damaging peat fires, the decline of tree islands, and saltwater intrusion.</td></tr>
<tr><td>Reduce high volume discharges from Lake Okeechobee to improve the quality of oyster and submerged aquatic vegetation (SAV) habitat in the Northern Estuaries.</td><td>Reduce high flow discharges to the Northern Estuaries by constructing increased water storage within the EAA, redirecting Lake Okeechobee discharges south for ultimate delivery to WCA 3A and the Everglades, and proposed minor modifications to the Lake Okeechobee Regulation Schedule that moderately increase the frequency, duration, and magnitude of peak lake stages.</td></tr>
<tr><td>Reduce water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization.</td><td rowspan="2">Increase in water conveyed to WCA 3A and WCA 3B, decrease in water conveyed to WCA 2A and WCA2B, change in timing to improve ability to meet hydropattern and water quality restoration targets, and increased canal discharges to Biscayne Bay.</td></tr>
<tr><td>Restore more natural water level responses to rainfall to promote plant and animal diversity and habitat function.</td></tr>
<tr><th colspan="2">CERP GOAL: Enhance Economic Values and Social Well Being</th></tr>
<tr><td>Increase availability of water supply.</td><td>Increase water available in Lower East Coast Service Area 2 and Lower East Coast Service Area 3 for other water related needs.</td></tr>
</table>

Table B-2. Key Assumptions based on Summary Tables from EN Appendix and H&H Annex

Condition	Intent	Equivalent for Central Everglades Planning Project (CEPP)	Model Scenario
Pre-CERP Baseline	Conditions on the date of enactment of WRDA 2000 (December 2000), to provide a baseline to compare effects of project	Includes conditions in 2010 and most closely represents the Pre-CERP Baseline for LECSA 3, WCA 3 and ENP. Significant changed assumptions from the Pre-CERP Baseline include the 2008 Lake Okeechobee Regulation Schedule (2008 LORS) and the Interim Operating Plan (IOP) for WCA 3A and the South Dade Conveyance System (SDCS) in the existing conditions baseline (ECB). A Pre-CERP Baseline is not available with the RSM.	**ECB**
Existing Conditions	Actual conditions at the time the Tentatively Selected Plan (TSP) is selected, including land use, operations, and demands. Demand can be either permitted or projected, whichever is greater.	2012 conditions with only the projects and operations approved and in effect. Includes 2008 LORS and the Everglades Restoration Transition Plan (ERTP) for WCA 3A and the SDCS. Permitted demands are included.	**2012EC**
Initial Operating Regime Baseline	Future conditions at the time the TSP is operational including land use, operations, and demands. Demands can be either permitted or projected, whichever is greater.	The future condition when the project will be initially operated, including other Non-CERP projects, CERP projects (with completed PIRs), and associated operations. Includes LORS 2008 and ERTP. Permitted demands are included.	**IORBL1**

B.2.1.1 Volume Probability Curves and Stage Duration Curves

To identify the quantity, timing, and distribution of water for the natural system, a probabilistic approach was selected utilizing volume probability curves to depict the distribution of volumes of water that provide natural system benefits as a result of project features or to determine whether water is eliminated or transferred from natural systems. These volumes of water may include water that is available to meet natural system needs without project features and the water made available from CEPP project features to meet natural system needs through the entire range of historic climatologic conditions. For purposes of identifying the increase in the volume of water for the natural system, volume probability curves were produced depicting the range of the quantities of water delivered for natural system areas and coastal estuaries under all climatic conditions through the RSM period of simulation used to perform project evaluations.

The volume probability curve indicates the probability (percentage of time equaled or exceeded, on the x-axis) that a certain quantity of water (expressed as flow or volume on the y-axis) is made available as a function of historical rainfall distribution. The water quantities are aggregated for each water year within the RSM period of simulation, defined as starting in May of year 1 and continuing through April of year 2 (40 total water years in the 1965-2005 RSM period of simulation). Once computed, the values are ranked from highest to lowest. Volume probability curves quantify the water, along with its timing and distribution to the natural system.

To identify whether the CEPP project reduces the level of service of flood protection, evaluations focus on changes to water stages and their frequency within canals and at selected representative monitoring gauge locations within the LECSAs. The RSM-GL has no capability to precisely measure flood control on individual fields or during relatively short events, but the RSM-GL can be used as a coarse-scale tool to indicate a potential change in flood risk. Like volume probability curves, stage duration curves indicate the probability (percentage of time equaled or exceeded, on the x-axis) that a certain stage (expressed in National Geodetic Vertical Datum [NGVD] on the y-axis) is achieved as a function of historical rainfall distribution. Stages are aggregated for each day in the RSM period of simulation. Once sorted, the values are ranked from highest to lowest. A more localized analysis, with higher resolution hydrologic and/or hydraulic models, will be performed if there is an indication of significant increase in flood risk from the regional analysis.

B.2.2 Analyses for Savings Clause including Intervening non-CERP and CERP Projects

The Regional Changes to quantity, timing, distribution, and quality of water proposed by the CEPP project, as described in Section B.2.1, focus on meeting hydrologic restoration targets for the Everglades (including WCA 2, WCA 3, and ENP) and Florida Bay. The purpose of the Savings Clause analyses is to determine whether there will be an elimination or transfer of existing legal sources of water or reduction to the level of service of flood protection as a result of the project. By comparing stage duration curves and other results from the model simulations in sequential step-wise fashion, the effects of the CEPP project alone can be isolated from intervening non-CERP and/or other CERP project effects. If no reductions to existing legal sources or levels of service for flood protection are indicated at any sequential step during the comparison, then the Savings Clause requirements are determined to have been met. If there is an elimination or transfer of an existing legal source of water, then a new source of water supply to replace the water lost as a result of implementation of the CEPP project will be identified.

Consistent with the approach outlined in Draft Guidance Memoranda 3, which was developed to meet the intent of WRDA 2000 and the Programmatic Regulation, the following guidance will be applied by the CEPP to address the effects of intervening non-CERP activities:

- Savings Clause analysis only applies to changes from date of enactment of WRDA 2000 that result from "Implementation of the Plan";
- Intervening non-CERP activities are changes wholly outside of CERP – e.g., LORS 2008, Modified Waters Deliveries to Everglades National Park (MWD), C-111 South Dade, IOP, ERTP, Everglades Construction Project (ECP), etc.;
- Savings Clause does not require CERP to make up for reductions in quantity or quality of existing legal sources or levels of service for flood protection caused by intervening non-CERP activities, but CERP cannot cause further reductions;
- Savings Clause does not prohibit CERP from reducing quantity or quality of existing legal sources or levels of service for flood protection increased by intervening non-CERP activities, but CERP cannot reduce those increases below those in place on the date of enactment of WRDA 2000.

To determine whether it is the CEPP or other intervening CERP or non-CERP activities are affecting the existing legal sources or levels of service for flood protection, where effects are observed, a series of comparison can be made between the appropriate base conditions and with project conditions. The first potential comparison to the representation of the existing condition at the time of the Recommended Plan selection (2012EC base condition) includes the effects of intervening non-CERP activities since it reflects 2012 conditions. The second potential comparison to the ECB, which represents system condition at the start of CEPP formulation in 2010-2011, does not include effects from implementation of the ERTP for WCA 3A and the SDCS (October 2012), an intervening non-CERP activity. The original Pre-CERP Baseline, which is not used for the CEPP analyses (RSM model representations were not developed), does not include the intervening non-CERP activities and does not reflect revised circumstances under which the project has been formulated and may be implemented.

The only model-based comparison that accurately reflects the effects of the CEPP project only is the Initial Operating Regime with the project (Recommended Plan Alt 4R2) compared to the Initial Operating Regime without the project (IOR Baseline IORBL1). However, based on the plan formulation assumptions established for CEPP, the simulations for Alt 4R2 and the IORBL1 also include the effects of intervening CERP activities that were assumed to be implemented prior to the CEPP for the future without project condition, including: Indian River Lagoon-South Project; Site 1 Impoundment Project; Biscayne Bay Coastal Wetlands Project; Broward County Water Preserve Areas Project; Caloosahatchee River (C-43) West Basin Storage Reservoir; and the C-111 Spreader Canal Western Project. Because of the incremental formulation of CERP projects contemplated under the formulation process described in the Draft Guidance Memoranda, methods to assess the potential effects of intervening CERP activities were not specifically addressed in the Draft Guidance Memoranda. Since each of these CERP projects assumed for the CEPP future without project condition have completed PIR documents that demonstrate Savings Clause compliance for each of these projects, effects to existing legal sources or levels of service for flood protection that are observed in comparisons between the future without project condition (IORBL1) and the updated Existing Condition baseline (2012EC) shall not constitute a Savings Clause violation for CEPP. Non-CEPP Savings Clause impacts that are projected with implementation of intervening CERP activities will need to be addressed during implementation of these non-CEPP CERP projects. Updated supplemental Savings Clause analyses, using the most current available information, may need to be completed prior to implementation of CERP projects if subsequent revisions to the programmatic Integrated Delivery Schedule (IDS) or other new information is determined by the USACE to significantly change the appropriateness of prior CERP PIR analyses.

For the CEPP, the equivalent step-wise comparisons can be found in **Table B-3**.

Table B-3. Summary of Comparisons for Savings Clause for CEPP

Step	Base Condition Model Run	With Project Model Run
1	Existing Conditions Baseline – 2012EC	Initial Operating Regime – Alt 4R2
2	Existing Condition Baseline for formulation (2010) – ECB	Initial Operating Regime – Alt 4R2
3	Initial Operating Regime without the project – IORBL1	Initial Operating Regime – Alt 4R2
If no reduction at any step, then requirements of Savings Clause have been met.		

In this analysis, the focus is to determine the potential effects of CEPP, and the analysis therefore compares the Initial Operating Regime with the project (Alt 4R2) to the Initial Operating Regime baseline without the project (IORBL1). This comparison segregates the effects of the intervening CERP and intervening non-CERP projects. In addition, Alt 4R2 is also compared to the two existing baseline conditions (2012EC and ECB). This additional analysis informs evaluators of the cumulative potential effects of both CEPP and other intervening CERP and non-CERP projects relative to conditions experienced previously.

B.2.2.1 Savings Clause – Elimination or Transfer of Existing Legal Sources of Water

To analyze the potential elimination or transfer of existing legal sources, affected basins or users are evaluated. The basins and users that may be affected by the project are displayed in **Table B-4,** classified according to the categories identified in WRDA 2000.

Table B-4. Existing Legal Sources Evaluated for Elimination and Transfer of Existing Legal Sources

WRDA 2000, Section 601(h)(5)	User or Natural System Evaluated in CEPP
(i) an agricultural or urban water supply;	• Lake Okeechobee Service Area (LOSA), including the Everglades Agricultural Area (EAA) • Lower East Coast Service Area 2 (LECSA-2) • Lower East Coast Service Area 3 (LECSA-3)
(ii) allocation or entitlement to the Seminole Indian Tribe of Florida under section 7 of the Seminole Indian Land Claims Settlement Act of 1987 (25 U.S.C. 1772e);	• Brighton Reservation • Big Cypress Reservation
(iii) the Miccosukee Tribe of Indians of Florida;	• Alligator Alley Reservation (west of WCA 3A) • Tamiami Trail Reservation (south of WCA 3A) • Reservations at Tamiami Trail/Krome Avenue
(iv) water supply for Everglades National Park; or	• ENP
(v) water supply for fish and wildlife.	• Caloosahatchee Estuary • St. Lucie Estuary • WCAs 2 and 3 • Biscayne Bay • Florida Bay

The primary RSM-BN and RSM-GL model results evaluated for effects to agricultural or urban water supply are the volume and/or frequency of cutbacks, which is applicable to the Lake Okeechobee Service Area (LOSA), Lower East Coast Service Areas (LECSAs), and the Seminole Tribe of Florida's Brighton and Big Cypress reservations. Additional information available to evaluate agricultural and urban water supplies includes regional groundwater differences maps, seepage volumes across the East Coast Protective Levee (ECPL), regional water supply deliveries, and canal stages near public water supply wellfields. These metrics are indicators of whether the water supply demand in the LECSAs can continue to be met by the regional system, including Lake Okeechobee, the WCAs, and the surficial aquifer system. The selected metrics provide more direct and higher resolution measures of potential water supply effects for the CEPP Savings Clause assessment than would be provided through assessment of inflow volume probability curves for each user group or basin. Analyses within the LECSAs are performed for LECSA 2 and 3 only (essentially Broward and Miami-Dade Counties, respectively) since these basins are affected by the CEPP. Significant changes to LECSA 1 (Palm Beach County) and the North Palm Beach Service Area are not indicated in the CEPP modeling comparisons, and WCA 1 remains unchanged. For the Miccosukee Tribe of Indians of Florida, stage duration curves for gauges in WCA 3 and hydropattern maps of WCA 3 are evaluated.

For ENP, the RSM-GL water year flows into ENP at the northern boundary will be compared. For the two Northern Estuaries, the analysis focuses on whether the project eliminates or reduces deliveries to meet the low flow criteria targets for the Northern Estuaries. The high flows to the estuaries are not subject to a Savings Clause analysis because these flows are damaging to the estuaries, and one of the CEPP objectives is for reduction of damaging high flows. For WCA 2 and WCA 3, the change in flows relative to CEPP objectives was evaluated. In addition, the hydrologic performance in WCA 2A consistent the mitigation associated with the pre-CEPP construction and operation of Compartment B of the ECP Stormwater Treatment Area (STA) 2 was also evaluated. For Biscayne Bay, the total water conveyed through coastal structures grouped by spatial regions (North, Central, South-Central, and South) within the bay is evaluated. The South-Central region flows were also compared to the target flows identified in the Biscayne Bay Water Reservation Rule recently adopted by the SFWMD. The overland flows to Florida Bay at selected transects, Transect 27 for western Florida Bay and Transect 23 (including T23A, 2T3B, and T23C) for east/central Florida Bay), were also evaluated (**Figure B-1**).

In addition to the potential effects of changing the timing, distribution, or quantity of water due to CEPP implementation, the CEPP project features can directly impact the availability of water supplies. In CEPP, backfilling the Miami Canal directly affects the ability to convey water to the LECSA to meet agricultural and urban needs under certain conditions. The potential to limit conveyance options was evaluated by identifying alternatives routes and their capacities.

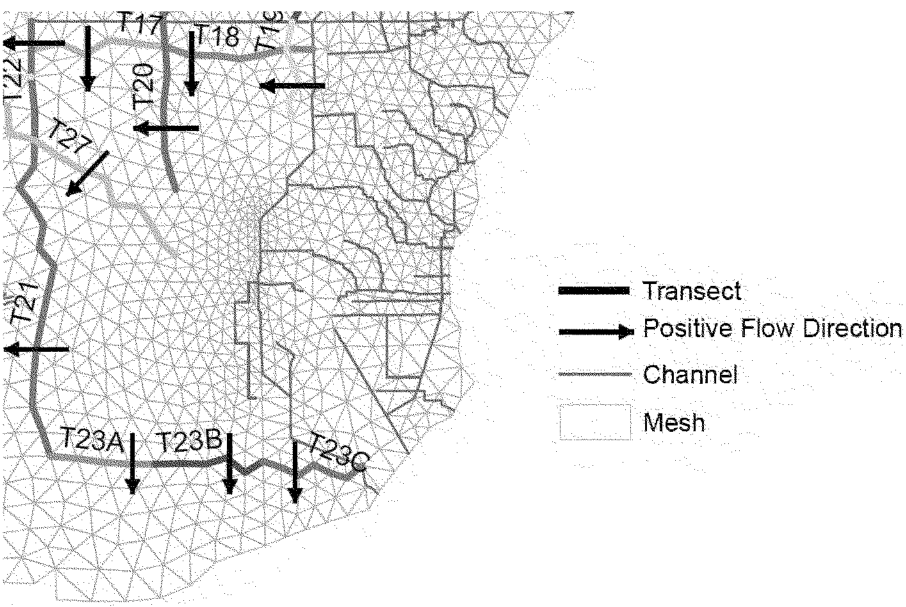

Figure B-1. Location Map for RSM-GL Transects Used for Florida Bay Analysis

B.2.2.1 Savings Clause - Flood Protection

Flood protection is evaluated by a combination of best professional judgment interpreting model results and engineering analyses. Consistent with the Draft Guidance Memoranda, the same models and results used for plan formation were applied for the CEPP Savings Clause assessment. This varies from typical storm event analyses by using a long period of record simulation and focusing on the wet events included within the 1965–2005 simulation period.

As an example of an extreme wet event encompassed within the CEPP RSM-BN/RSM-GL simulation period and therefore included in the CEPP evaluations, Hurricane Irene in late 1999 (13–17 October) may be specifically considered. During this historical storm event, several monitoring sites in Broward, Miami-Dade, and Palm Beach counties, including WCAs 1, 2, and 3, received the 24-hour, 48-hour, and 72-hour maximum rainfall amounts that would be expected to occur once in 100 years, with cumulative rainfall in excess of 9 inches (SFWMD Technical Publication EMA #386, May 2000). Notably, however, as documented within the CEPP RSM model output hydrographs (a link to this data is provided in the CEPP draft PIR main report: http://www.evergladesplan.org/pm/projects/proj_51_cepp.aspx), peak stages within the simulation period of record for the CEPP project area typically occur outside of this 1999 event. The occurrence of the majority of peak stages for WCAs 1, 2, and 3 during 1994–1995 and the occurrence of peak stages for Lake Okeechobee during 1969–1970 indicates that, for these specific areas, these other hydrologic combinations of storm events and wet antecedent conditions also observed within the simulation period may correspond to a lower frequency of occurrence (return period greater than 100 years) than the 1999 event.

The four features or areas affected by the project that will be analyzed include 1) the potential risk to Herbert Hoover Dike (HHD) due to changes in the Lake Okeechobee stages, 2) the Flow Equalization Basin (FEB) located in the EAA, 3) the effects of changed water levels in WCA 3A and WCA 3B on the Everglades Protective levees (L-31N and L-31W), L-67, L-29, and L-30, and 4) the agricultural and urban areas located east of the Everglades Protective levees L-31N and L-31W.

Lake Okeechobee Herbert Hoover Dike

For the HHD, risk and uncertainty associated with increased lake stages were assessed consistent with the HHD formulation assumptions established for the CEPP future without condition. There are structural integrity concerns with the embankment and internal culvert structures that resulted in a Dam Safety Action Classification (DSAC) risk rating of Level 1. DSAC Level 1 represents the highest USACE dam risk of failure rating and requires remedial action. The USACE Major Rehabilitation Report (MRR) from 2000 divided the 143 mile dike into eight (8) Reaches with the initial focus on Reach 1. The current approved and planned remediation measures will address the highest points of potential failure in the system based on known areas of concern. These USACE efforts are intended to lower the DSAC rating from Level 1. The CEPP future without project condition assumes the planned remediation of HHD will lower the DSAC risk rating and be completed by 2022. These remediation measures will not resolve all issues with the HHD dam, nor will all current design criteria be met. To assess other issues and address future modifications with HHD, a comprehensive potential failure mode analysis and risk assessment is being performed and will be included in the ongoing USACE Dam Safety Modification Report (DSMR). This report is scheduled for completion/approval in 2015.

Prior to the 2008 LORS, Lake Okeechobee operated under the Water Supply and Environmental Regulation Schedule (WSE). The 2006-2008 LORS study was initiated because of adverse environmental impacts that WSE had on the lake ecology. Dam safety was later added as a performance criterion since lowering of the lake, as the LORS study was pursuing, is one of the basic Interim Risk Reduction Measures implemented for deficient dams until appropriate remediation is effectuated. The WSE held Lake Okeechobee stages approximately 1.0–1.5 feet higher than the 2008 LORS under wet conditions. Studies for the remediation of HHD are based on the 2008 LORS, which was used as the basis for the development of the Standard Project Flood (SPF) condition. The SPF is the design condition used for the risk assessment and remediation to address internal erosion failure modes.

FEB Located in the EAA

Consistent with CEPP modeling assumptions for the action alternatives, operational stages for the EAA FEB storage feature were typically managed between 1 and 3 feet depth, with no additional structural inflows from Lake Okeechobee allowed when the FEB depth exceeded 3.8 feet. Structural inflows to the FEB would be discontinued when depths exceed 4 feet, although additional rainfall may further increase stages. Hydraulic design of the FEB perimeter levee system included consideration of the stage variability for FEB operations. Within the RSM-BN modeling conducted to support the CEPP preliminary screening and alternative evaluations, the SFWMD Restoration Strategies FEB located on the EAA A-1 parcel and the CEPP FEB on the EAA A-2 parcel are represented as a single storage feature. Consistent with the evaluation approach identified in Draft Guidance Memoranda 3, the FEB assessment for the level of service for flood protection was based on the performance of the flood control system when modeled against the period of record, and the assessment does not further consider specific design flood targets such as the 10-year or 100-year flood event.

Detailed CEPP assessments within the EAA were not conducted because the RSM-BN does not simulate groundwater within the EAA. Therefore, based on the CEPP plan formulation modeling, it could not be determined whether the A-2 FEB meets the Savings Clause requirements to maintain the pre-existing levels of flood protection. Further assessment of potential effects from the A-2 FEB will be deferred to the preconstruction engineering and design phase (PED), and the A-2 FEB will be designed to specifications that meet applicable flood protection requirements. Information regarding the FEB design considerations for flood protection is included in Section B.3.2.2.

WCA 3A and WCA 3B

The USACE Final ERTP EIS and Record of Decision (ROD signed on 19 October 2012) identified the 1960 WCA 3A 9.5 to 10.5 feet, NGVD Regulation Schedule as an interim measure water management criterion for WCA 3A Zone A. This change to Zone A, compared to the previous IOP for WCA 3A regulation, was necessary to mitigate for the observed effects, including discharge limitations of the S-12 spillways. Based upon the interim water management criteria for WCA 3A as well as the current condition of endangered species within WCA 3A, the ERTP EIS concluded that IOP is no longer a viable option for water management within WCA 3A and SDCS. The preliminary USACE Water Resources Engineering Branch (EN-W) analysis of WCA 3A high water levels, which was integrated into the ERTP EIS, also recommended further consideration of additional opportunities to reduce the duration and frequency of Water Conservation Area 3A high water events (ERTP Final EIS, Appendix A-5).

The information on which the USACE relied on to require the ERTP WCA 3A Zone A as an interim risk reduction measure for WCA 3A high water levels did not change prior to CEPP formulation, and no new information was available compared to the July 2010 assessment included as Appendix A-5 of the ERTP Final EIS. Throughout CEPP formulation, the USACE advocated that CEPP formulation efforts attempt to maintain the frequency, duration, and peak stages of high water levels within WCA 3A consistent with the CEPP Future Without Project (FWO) condition used during formulation, which includes ERTP, given recognition of the WCA 3A high water concerns identified with ERTP; prior to CEPP formulation, the USACE explicitly recognized that the ERTP constraint precluded raising of the top of the WCA 3A Regulation Schedule, while simultaneously recognizing that substantial benefits were still expected and that goals to further lower stages in WCA 3A were consistent with the constraint. The WCA 3A analysis provided in Section 3.2 provides comparisons between the final updated future without project baseline developed for CEPP (IORBL1) and the with-project condition (Alt 4R2); comparisons to the existing condition baseline (ECB and/or EC2012) are not provided since these comparisons were not utilized by USACE EN-W, as the ECB used during CEPP formulation included the IOP operations that were identified during ERTP as being no longer viable for water management within WCA 3A. EN-W also indicated that it would continue to rely on the WCA 3A three-gauge average stages for assessment of WCA 3A high water frequency, durations, and peak stages, consistent with the original WCA 3A design assumptions and the ERTP assessment (average of stages at the monitoring gages of 3A-3, 3A-4, and 3A-27); increased weight would not be considered for a single gage, such as 3A-28 (Site 65). It was further noted that if CEPP can provide operational assurances of additional WCA 3A outlet capacity under high water conditions, including adequate consideration of potential WCA 3B seepage management and/or ecological operational limitations, the EN-W may be able to further consider proportional relaxation of the WCA 3A future without project high water duration and frequency targets.

Agricultural and Urban Areas Located East of the East Coast Protective Levees

Flood protection in Miami-Dade County is of special concern due to the proximity of agricultural land uses, urban areas, and the Everglades. A complex network of canals, structures, culverts, impoundments, and pumps work in tandem to minimize seepage losses from the Everglades yet meet water supply and flood protection needs of agricultural and urban users. Selected gauges, groundwater difference maps, seepage from regional system, and other model results were evaluated collectively to determine if the level of service for flood protection was affected.

For the agricultural and urban areas located east of the East Coast Protective Levees (L-31N and L-31W), the RSM-GL has no capability to precisely measure flood control on individual fields or during relatively short events, but the RSM-GL can be used as a coarse-scale tool to indicate a potential change in flood risk. Using the 1983 to 1993 stage duration curve data from the RSM-GL calibration and verification, the percentage of time the stage is above the root zone can be calculated and the information can be used to give an indication that additional flood control evaluation in the vicinity of a particular RSM-GL cell(s) may be needed. Six gauges or cells were evaluated consistent with Restoration Coordination and Verification (RECOVER) performance measure (**Figure B-2**). In addition, a gauge near Tamiami Trail, G-3439, was also evaluated. It is located near the neighborhoods called Belen, Sweetwater, Serena Lakes, and Country Walk, which have experienced flood conditions historically (**Figure B-3**). The most important part of the stage duration curve for flood protection assessment is the range of higher stages. Therefore, exceedances were evaluated for wet periods. Specifically, frequency and magnitude evaluations are made at the highest 1 to 20 percentiles of the curve, and relative magnitude of difference evaluations are made at the 10 percent frequency of stage duration. An alternative is of concern when the stages are noticeably higher than the 1983-1993 curve and when the higher stages occur for longer periods of time. Differences occurring deeper than 2 feet below land surface elevation are disregarded. It should be noted that usefulness of the 1983-1993 calibration data used in the official RECOVER performance measure was determined based on the South Florida Water Management Model (SFWMM). Confirmation that the RSM's calibration data bodes similar results (the RSM-GL calibration period is 1984–1995, and the verification periods are 1981–1983 and 1996–2000) or can be applied in the same manner as SFWMM has not been completed. A more appropriate comparison is the 2012EC and IORBL1 baselines in the SDCS, which include the same water control plan for this part of the system, ERTP.

The stage duration curves for the LEC canals adjacent to WCA 3B and ENP and selected monitoring gauges throughout the LEC were also assessed as part of the Savings Clause flood protection evaluation. The stage duration curves for these canals and gauges were assessed for increased stages within the upper 10 percentile, which were assumed as a representative indicator of potential increased flood protection risk.

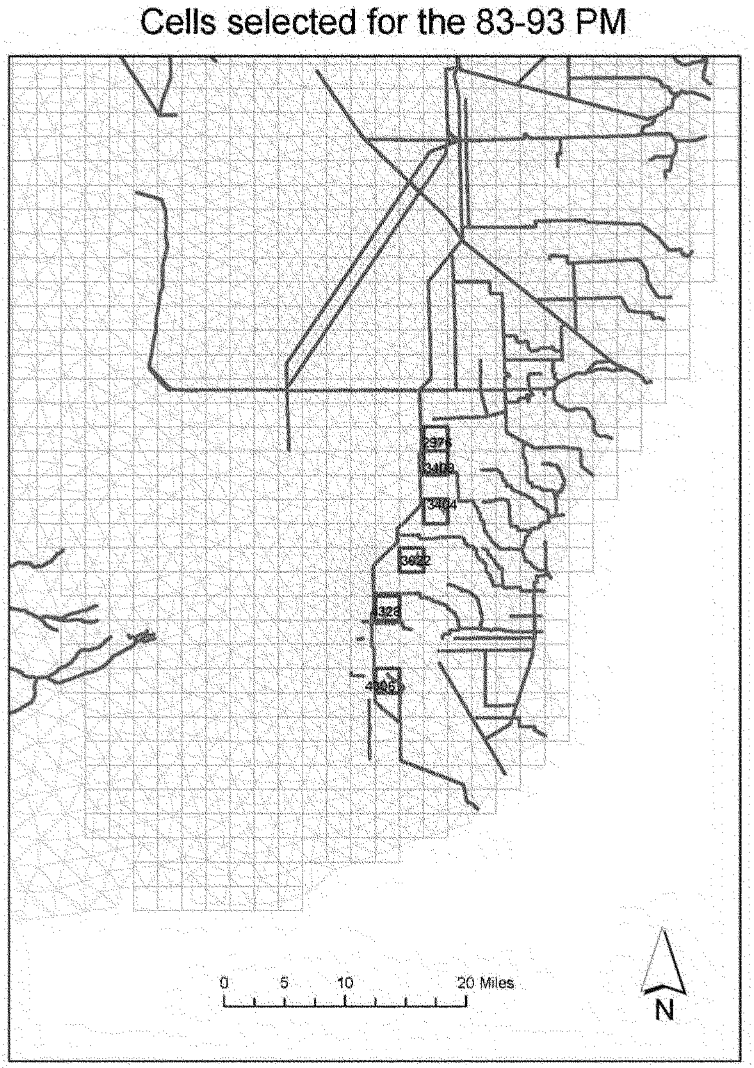

Figure B-2. Location of Cells Evaluation for Potential Effects to Agriculture in South Miami-Dade County

Figure B-3. Location of G-3439 (red dot) Relative to the Neighborhoods

B.2.3 Analyses for Project Assurances – Identifying Water Made Available by the Project for the Natural System and Other Water Related Needs

Identification of water for the natural system is based on the concept of water needed to achieve the benefits of the project and the overarching objective of restoration, preservation, and protection of the South Florida Ecosystem. The water made available for the natural system is the water required for the protection of fish and wildlife, including water that contributes to meeting hydrologic, water quality, and ecologic targets for restoration of natural systems. Hydrologic targets for the natural system applied during plan formulation help to identify water required to meet restoration objectives, in contrast to water that exceeds the targets and may be harmful or otherwise not contribute to meeting the restoration targets.

Water for project assurances is quantified where project benefits accrue, consistent with the habitat unit benefits quantified during CEPP plan formulation resultant from water being made available by the project. The ability of the CEPP project features to provide water to meet other water-related needs in the LOSA, LECSA 2, and LECSA 3 was analyzed for the recommended plan. The basins where the project potentially supplies water for the natural system or other water-related needs are listed below:

- Natural System
  - Everglades
    - WCA 3
    - ENP including Florida Bay
- Other Water-Related Needs
    - LOSA including EAA
    - LECSA-2
    - LECSA-3

Identification of the water made available by the CEPP project requires additional analyses of the RSM-BN and RSM-GL results for the Recommended Plan Alt 4R2. The identification of water involves both 1) existing water in the system at the time of PIR development that is available to the natural system and available for other water-related needs, and 2) water made available by the project to the natural system and for other water-related needs, as depicted in **Figure B-4**. The sum of these two categories is the total water that is expected to be available to the natural system and available for other water-related needs.

For CEPP, both categories of the water can be quantified by calculating the flows in the regional system. The existing water supply in the C&SF Project system includes previously identified or reserved water associated with other CERP projects. For this analysis, the Caloosahatchee River (C-43) West Basin Reservoir, Indian River Lagoon-South C-44 Reservoir, Site 1 (Fran Reich) Reservoir, Broward County Water Preserve Areas, Biscayne Bay Coastal Wetlands (not included in the RSM-GL model), and C-111 Western Spreader Canal were included in the without project initial operating regime (IORBL1). The total water available with the CEPP project is represented by the with project condition. For CEPP, the with project condition is equivalent to the Alt 4R2 model run. The difference between these two conditions represents the water made available by the project (Alt 4R2 minus IORBL1) as depicted in **Table B-5.**

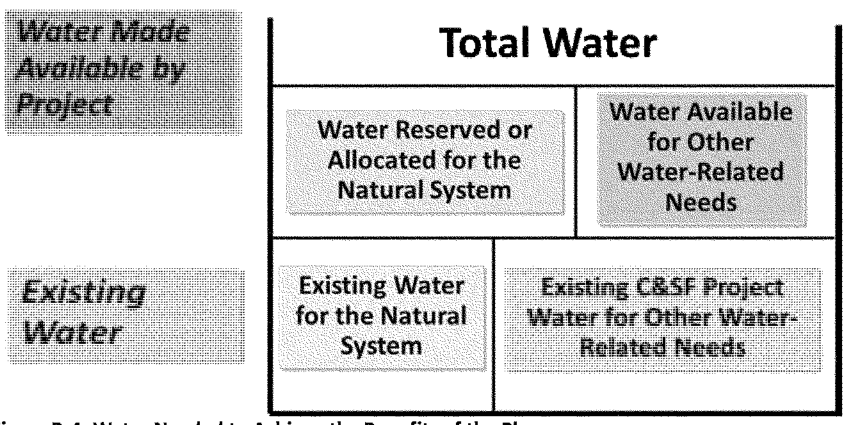

Figure B-4. Water Needed to Achieve the Benefits of the Plan

Table B-5. Summary of Analyses for the Identification of Water Made Available by the Project

Analysis	Water for the Natural System
Existing pre-project water for the natural system	IORBL1
Total water for the natural system	ALT 4R2
Identification of water made available by the project	Difference between ALT 4R2 and IORBL1

To follow the habitat unit benefits calculated during plan formulation, three spatial locations were selected to quantify the water needed to achieve the benefits of the CEPP recommended plan: inflows to WCA 3 (along the formulation redline), inflows to ENP, and overland flows to Florida Bay. These specified locations represent the inflows to the three basins where ecosystem benefits (habitat units) are expected as a result of implementation of the recommended plan. Surface water inflows along the redline to WCA 3A correspond to the sum of structure inflows from the S-8 pump station to the Miami Canal within WCA 3A, the S-150 gated culvert, and STA-5/STA-6 outflows to northwest WCA 3A for the ECB, 2012EC, and IORBL1 base conditions; for Alt 4R2, the combined flows from the S-8 pump station discharges to the Miami Canal and discharges to the S-8A gated culvert (which diverts water to the L-4 Levee degrade gap) are included in addition to S-150 and STA-5/STA-6 outflows to WCA 3A. Inflows to ENP are quantified for the S-12s (A-D), S-333, the S-355s (A&B), S-345 (F&G; Alt 4R2 only) and S-356 (Alt 4R2 only). Overland flows to Florida Bay are quantified for RSM-GL Transect 23 (southeast ENP) and Transect 27 (Central Shark River Slough). Quantification of water made available for the natural system is displayed using volume probability curves. The 10th, 50th, and 90th percentiles will be identified for the Alt 4R2 and the IORBL1. The difference between these conditions is the water made available by the CEPP project for the natural system. CEPP benefits projected for the Northern Estuaries are the result of reduced discharges from Lake Okeechobee, and therefore do not require additional water to be reserved for the natural system.

To evaluate whether additional water is made available by the project to meet other water related needs, specifically water supply in LOSA, the changes to the level of service were evaluated. For the LECSAs, whether additional water has been made available by the project in the regional system is quantified as the increase in demand above the pre-project public water supplies (IORBL1) in LECSA-2 and LECSA-3 that could be met without affecting the benefits accrued to the natural system. The increase in demand is included in the with project condition, Alt 4R2.

B.3 Results

B.3.1 Elimination or Transfer of Existing Legal Sources of Water

B.3.1.1 Lake Okeechobee Service Area

Due to the reduction in irrigated land with the inclusion of the FEB on the EAA A-2 site, the demand for supplemental irrigation is reduced from an annual average of 339 thousand acre-feet (kAF) in the future without project condition (IORBL1) to 328 kAF in Alt 4R2.

Consistent with the WRDA 2000 and the Programmatic Regulations, the Savings Clause analysis removes the effects of the intervening non-CERP projects. The volume of demand not met for the LOSA during the eight years with the largest water shortage cutbacks in the period of simulation is the same or slightly improved when comparing the with project condition, Alt 4R2, and the without project condition, IORBL1. In six of these years, the volume of demand not met is reduced (improved water supply performance) by approximately one to seven percent. In the two remaining years where the volume of demand not met increases compared to the without project condition (1981 and 1982), the increase is one percent or less (**Figure B-5**). Over the entire period of simulation, the average annual volume of demand not met during water shortages declines by 6 kAF (1%) in the with project condition compared to the without-project condition (Alt 4R2 and IORBL1 average 29 kAF and 35 kAF of cutbacks for EAA and Other LOSA combined, respectively) (**Figure B-6.**).

An additional analysis compares the 2012EC and ECB to Alt 4R2. The water supply demands met improve slightly. Of the eight years with the largest water shortage cutbacks, seven years indicate reduced cutbacks ranging between less than one to six percent for the with project condition (Alt 4R2), compared to the existing condition (2012 EC and ECB). In one year, 1989, the cutback percentage is increased by approximately one percent. Over the entire period of simulation, the average annual volume of demand not met during water shortages declines by 4 kAF (<1%) in the with project condition compared to the existing baselines (Alt 4R2 averages 29 kAF of cutbacks, and 2012EC/ECB average 33 kAF of cutbacks for EAA and Other LOSA combined).

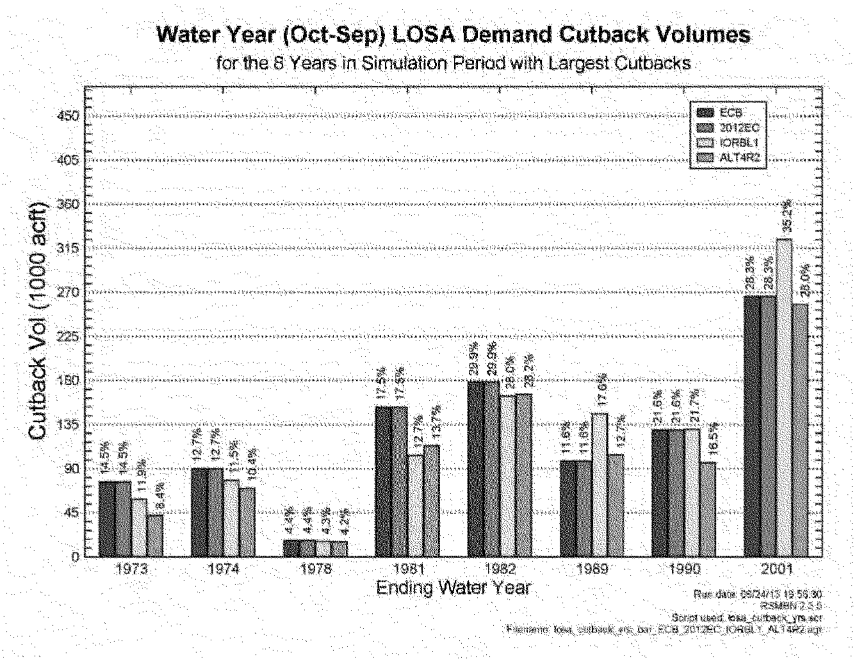

Figure B-5. LOSA Demand Cutback Volumes for the 8 Years with the Largest Cutbacks

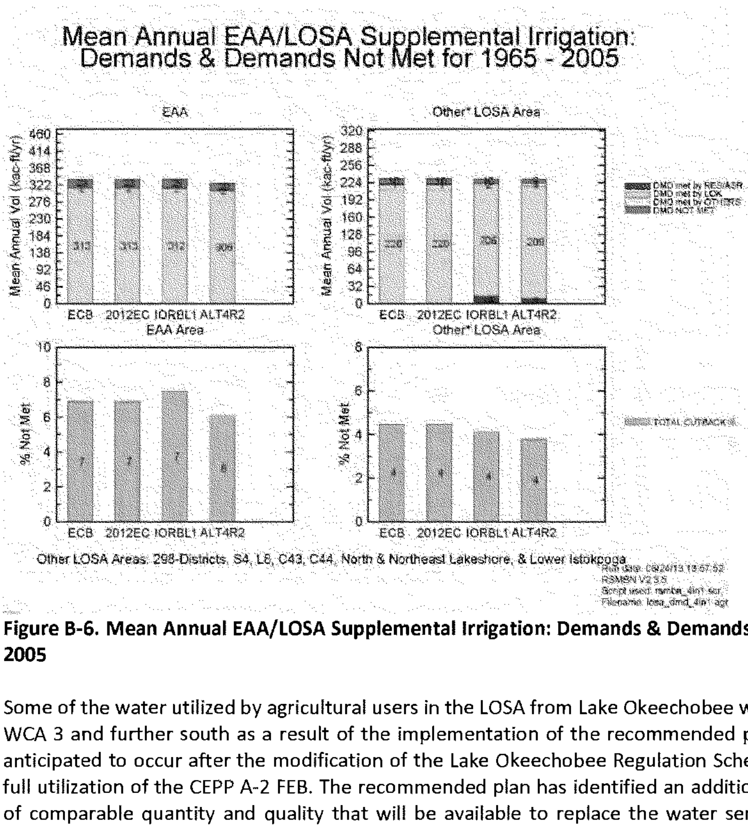

Figure B-6. Mean Annual EAA/LOSA Supplemental Irrigation: Demands & Demands Not Met for 1965–2005

Some of the water utilized by agricultural users in the LOSA from Lake Okeechobee will be transferred to WCA 3 and further south as a result of the implementation of the recommended plan. This transfer is anticipated to occur after the modification of the Lake Okeechobee Regulation Schedule that will allow full utilization of the CEPP A-2 FEB. The recommended plan has identified an additional source of water of comparable quantity and quality that will be available to replace the water sent south. Instead of discharging all water stored in the reservoir to tide via the S-80 or to meet C-44 Basin agricultural water supply demands, as assumed in the future without project IORBL1 baseline condition operations, the recommended plan retains a portion of the water stored in the CERP IRL-S C-44 Reservoir/STA in the regional system for backflow to Lake Okeechobee via the C-44 Canal and raises the Lake Okeechobee stage criteria to allow increased C-44 Canal backflow. This added operation does not affect existing permitted allocations within the C-44 Basin. The additional C-44 Canal backflow operations to Lake Okeechobee included in the CEPP recommended plan improves the ability to meet existing permitted demands in the LOSA by retaining more water in the regional system and making it available to agricultural users. The operations do not benefit agricultural users in the C-23 Basin. The CEPP recommended plan backflow operations capture a portion of releases from the C-44 Reservoir/STA that would otherwise be directed to the Saint Lucie Estuary as excess water.

Specifically, the future without project condition (IORBL1) allows backflow to Lake Okeechobee from the C-44 Canal when S-308 (the Lake Okeechobee discharge structure to the C-44 Canal) is not open for regulatory discharges and when the stage in Lake Okeechobee is 0.25 feet below the base of the 2008 LORS low sub-band (within the baseflow sub-band), which varies between 13.0 and 14.5 feet NGVD seasonally. This operational assumption is consistent with the existing operational protocols of Lake

Okeechobee (2008 LORS) and the SFWMD Lake Okeechobee Water Shortage Management (LOWSM) operations. Discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are otherwise limited to environmental deliveries for the St. Lucie Estuary and C-44 Basin agricultural water supply demands during these backflow operations.

The CEPP recommended plan operations expand on the IORBL1 backflow to Lake Okeechobee through the following operational changes: 1) backflow to Lake Okeechobee from the C-44 Canal is allowed when S-308 is not open for regulatory discharge and the stage in Lake Okeechobee is below 14.5 feet NGVD (no seasonal variability); and 2) discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are made when the stage in Lake Okeechobee is below the baseflow zone of the 2008 LORS schedule (the bottom of this zone varies seasonally between 12.6 and 13.0 feet NGVD) to provide an additional source of backflow water to Lake Okeechobee. Water captured in the C-44 Reservoir/STA, includes excess water conveyed from the C-23 Canal and Basin (approximately 6 kAF on an average annual basis) that is not needed to meet the IRL-S North Fork water reservation target. The recommended plan operational changes result in an average annual increase in C-44 Canal backflow volume to Lake Okeechobee of 57.3 kAF (97.3 kAF in the recommended plan, compared to 40.0 kAF in the IORBL1) and an average annual increase in C-44 Reservoir discharges to the C-44 Canal of 21.3 kAF (37.6 kAF in the recommended plan, compared to 16.3 kAF in the IORBL1).

The transfer of water from Lake Okeechobee to WCA 3 would not be implemented until the CERP C-44 Reservoir/STA, the canal connecting the C-44 Reservoir to both the C-23 Basin and the C-23 Canal, and the CEPP FEB on the EAA A-2 site are operational. If the canal to the C-23 Basin and the C-23 Canal is not operational when the CEPP FEB on the EAA A-2 site is ready to store water, the operations, and ultimately the delivery of water from Lake Okeechobee to the CEPP FEB, may need to be modified to avoid elimination of this portion of the source of water for the LOSA. The water retained in Lake Okeechobee also maintains the level of service for water supply for existing legal users dependent on Lake Okeechobee and its connected conveyance system. Specifically, this includes the agricultural users in the LOSA and the Seminole Tribe of Florida.

B.3.1.2 Lower East Coast Service Area

Existing legal sources of water in the Lower East Coast Service Area (LECSA) include groundwater withdrawn by public utility wellfields, private wells, agricultural irrigation wells, and surface water withdrawals for agricultural uses in the LECSA 2 and LECSA 3. The Seminole Tribe of Florida also withdraws groundwater to meet water supply demands in LECSA 2. CEPP Alt 4R2 project features and operations are designed to maintain canal and groundwater stages, manage additional seepage quantities, and maintain overall flows to the LECSAs and Biscayne Bay. The water the CEPP project provides to WCA 3A will meet State water quality standards as required by Section 385.53(b)(3)(i) of the Programmatic Regulations. This additional water will be conveyed south to ENP, with some portion reaching the LECSA through recharge of the surficial aquifer system.

In the LECSA, the water supply demand continues to be met by the regional system including Lake Okeechobee, the WCAs, and the surficial aquifer system. The ability to continue to meet urban and agricultural demands with CEPP implementation is evaluated by assessing relative changes in the frequency of water supply cutbacks in LECSA 2 and LECSA 3. Although the RSM-GL model predictions of the absolute number of water supply cutback events and the corresponding frequency of occurrence have a high degree of uncertainty, relative comparisons between the RSM-GL base conditions and the RSM-GL with project condition (Alt 4R2) provide a meaningful comparison to quantify potential effects of the CEPP project. Water supply cutbacks to the LECSAs can be triggered by Lake Okeechobee stages or by local groundwater levels. If the local groundwater levels trigger increased water shortage cutbacks, the trigger may either be the result of changed local groundwater conditions resulting directly from the CEPP project or more locally triggered cutback events becoming apparent as the lake triggered cutback events decline in frequency with the moderate to significant increase to Lake Okeechobee stages with Alt 4R2. In the case of the CEPP, increased LECSA water shortage cutbacks triggered by local groundwater stages are the result of the increased stages in Lake Okeechobee.

In the with project condition (Alt 4R2), the number of water years with lake triggered cutbacks during the period of simulation is 13 events and local groundwater triggered cutbacks is 19 events in LECSA 2. For the future without condition (IORBL1), the number of water years with lake triggered cutbacks is 16 events and groundwater triggered cutbacks is 16 events in LECSA 2. The total number of cutbacks events and the resulting frequency for LECSA 2 remains the same for the two conditions at 32 events (**Figure B-7** and **Figure B-8**), indicating no significant change for water supply performance within LECSA 2. For LECSA 3, there are no locally triggered groundwater cutbacks events indicated in the Alt 4R2 or IORBL1 modeling simulations. The number and frequency of water years with cutback events declines since the lake triggered cutback events decline from 16 with the IORBL1 to 13 with Alt 4R2 due to the rise in lake stages with the inclusion of the project (**Figure B-9** and **Figure B-10**), indicating a small water supply improvement within LECSA 3. CEPP implementation will provide increased stages and extended hydroperiods within WCA 3B and NESRS, resulting in a net increase in average annual groundwater seepage flows from these natural areas to the adjacent LECSA 3. The increased seepage flows may slightly alter the water quality composition within the LECSA 3 surficial aquifer, through the relative increased contribution of groundwater seepage flows to the surficial aquifer recharge compared to the contribution from regional C&SF canal flows. These changes should result in either no significant change or a potential minor improvement to the water quality of withdrawals from the proximate public water supply wellfields within LECSA 3.

Comparisons to the existing condition base conditions (2012EC and ECB) indicate one additional water year cutback event with the existing condition compared to Alt 4R2 in LECSA2 (33 cutback events compared to 32 events). For LECSA 3, there are no locally triggered groundwater cutbacks events. The total number and frequency of lake triggered cutback events are the same for Alt 4R2 and the 2012EC/ECB, at 13 events (**Figure B-11** through **Figure B-14**).

A comparison of the regional groundwater stage difference map comparing Alt 4R2 and the IORBL1 was used to identify where systemic groundwater reductions may occur. The April 1989 and April 2001 difference maps were selected to determine whether the CEPP project affects groundwater levels during specific dry year conditions where regional water levels are most likely to be impacted. April is typically the driest month of the year and 1989 was one of severest droughts within the period of simulation. For the comparison of Alt 4R2 and the IORBL1, the average April 1989 regional water levels were maintained (no significant change, compared to the IORBL1) in LECSA 2 and improved (higher levels) in LECSA3 (**Figure B-15**). Although less severe than the 1989 drought across the LEC, 2000–2001 was also a significant drought period for South Florida. For the comparison of Alt 4R2 and the IORBL1, the average April 2001 regional water levels were maintained in LECSA 2, with only localized stage reductions observed for the CERP BCWPA C-11 impoundment (**Figure B-16**). Within LECSA3, April 2001 regional water levels were improved (higher levels) in northern LECSA3 (north of the S-331 pump station along the L-31N Canal, and generally maintained across most of southern LECSA3. However, during April 2001, minor localized groundwater reductions (0.10–0.15 feet) are observed along the C-111 Canal between S-331 and S-18C. Localized changes observed in this area may be addressed through further operational refinements for 8.5 SMA, S-331, and the C-111 detention areas during PED, possibly with some additional water also being routed to Biscayne Bay. The groundwater stage difference map for April 1978, with 1978 being considered an average (non-drought) rainfall year, also warrants further discussion due to significantly drier stages observed across significant portions of LECSA3 east of the L-30 and L-31N Canals (**Figure B-17**). Although this groundwater map indicates groundwater reductions between 0.25 and 1.0 feet during April 1978, minimum stages along the L-30 and L-31N Canals are maintained between 5.25 and 5.50 feet NGVD, which is significantly higher than the groundwater stages of 3.5–4.5 feet NGVD typical of drought conditions. The April 1978 groundwater stage reduction is therefore not indicative of a water supply performance concern with Alt 4R2. The root cause of this significant change is an undesirable dry season stage reversal within the WCA 3A and WCA 3B marsh starting in mid-January 1978, which is apparent in the stage hydrographs for Central WCA 3A (3A-4 gage), Southern WCA 3A (3A-28 gage; **Figure B-18**), and WCA 3B (Site 71) for the IORBL1, ECB, and 2012EC baselines. The ALT4R2 operations were regionally optimized to achieve dry season ecological targets and recession rates within WCA-3A, and the 1978 dry season stage reversal is no longer observed in the Alt 4R2 results. The hydrograph changes associated with this significant operational change within WCA 3A (stages are reduced by approximately 1.5 feet) are, in turn, translated and attenuated within the downstream stage hydrographs within WCA 3B and to the adjacent L-30 Canal (**Figure B-19**), and this change can be traced back to conditions within south-central CA-3A and WCA-3B. The average April groundwater stage difference map for the complete period of simulation (1965–2005) indicates no significant changes within LECSA 2 and LECSA3 (**Figure B-20**).

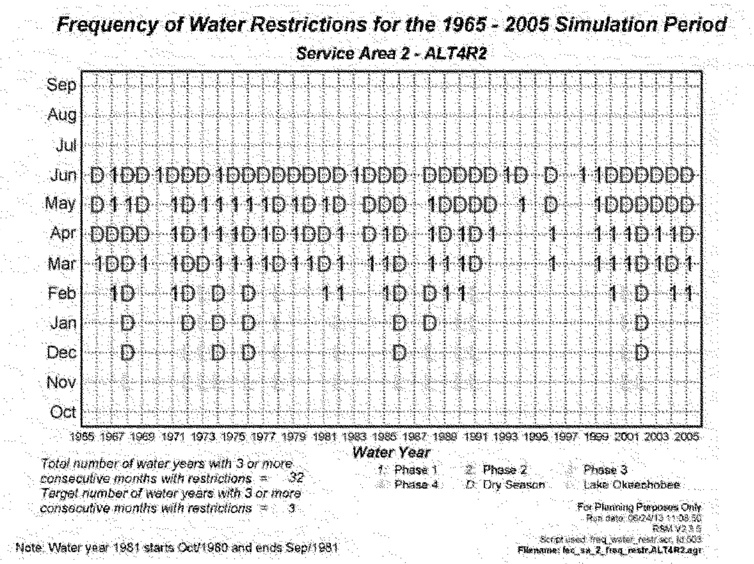

Figure B-7. Frequency of Water Restrictions for the 1965–2005 Simulation Period for the LECSA 2 Alt 4R2 Scenario

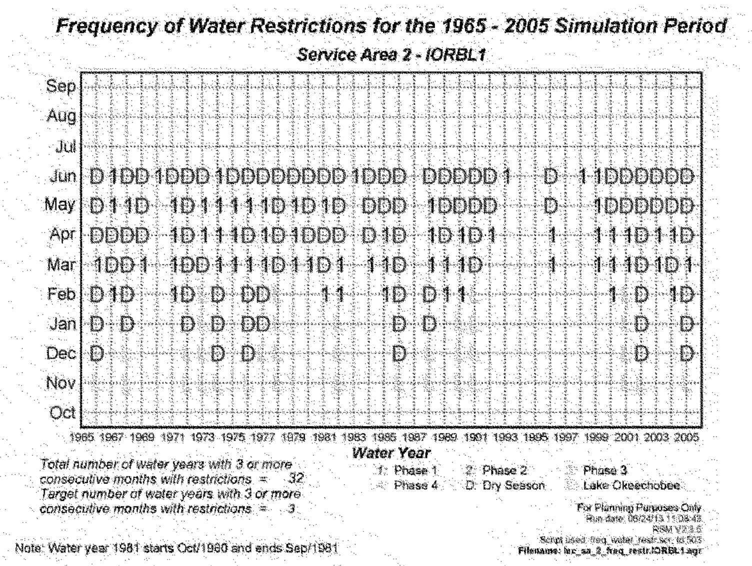

Figure B-8. Frequency of Water Restrictions for the 1965–2005 Simulation Period for the LECSA 2 IORBL1 Scenario

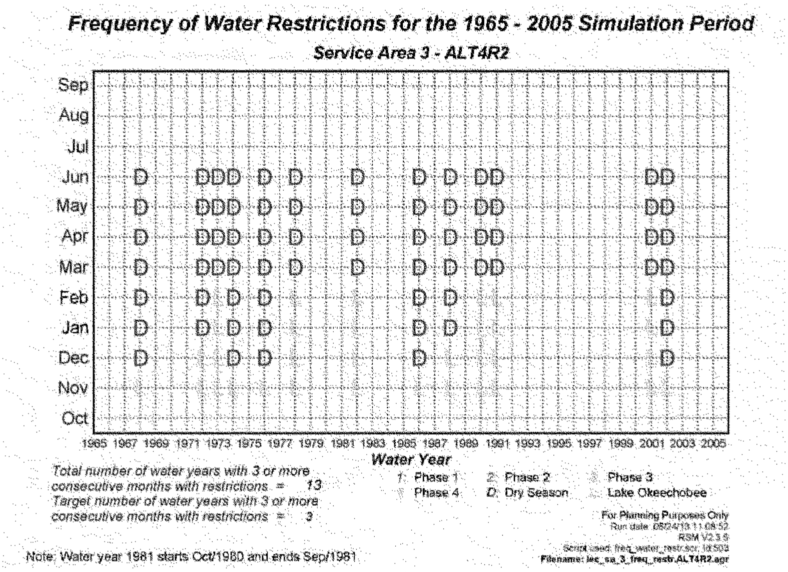

Figure B-9. Frequency of Water Restrictions for the 1965-2005 Simulation Period for the LECSA 3 Alt 4R2 Scenario

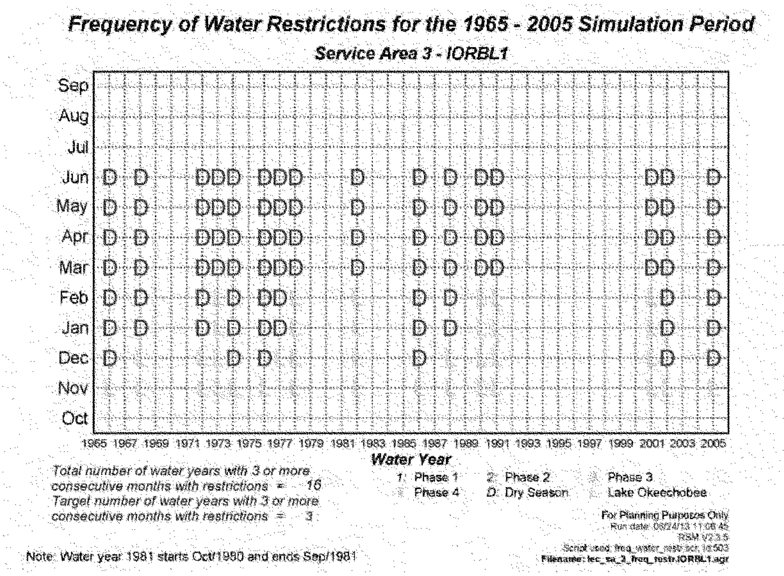

Figure B-10. Frequency of Water Restrictions for the 1965–2005 Simulation Period for LECSA 3 IORBL1 Scenario

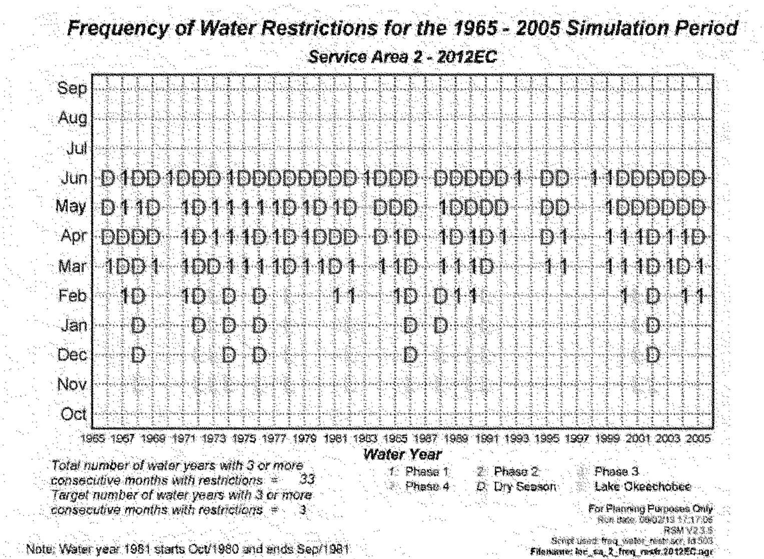

Figure B-11. Frequency of Water Restrictions for the 1965–2005 Simulation Period for LECSA 2 2012EC Scenario

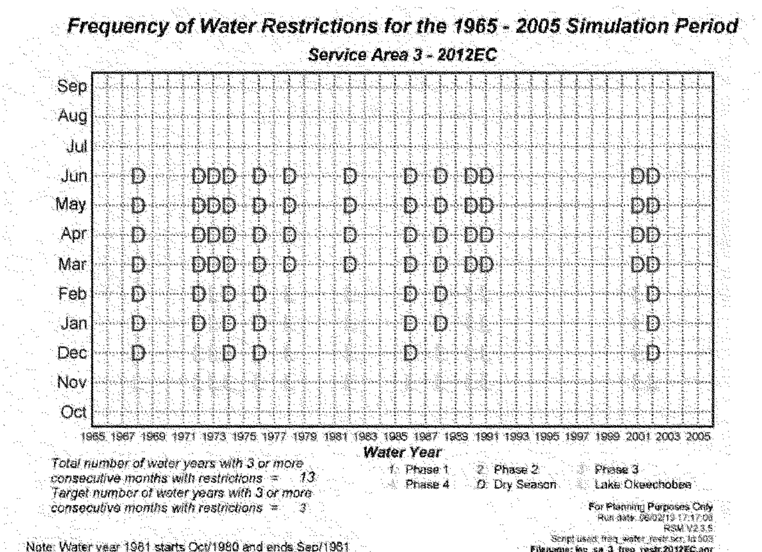

Figure B-12. Frequency of Water Restrictions for the 1965–2005 Simulation Period for LECSA 3 2012EC Scenario

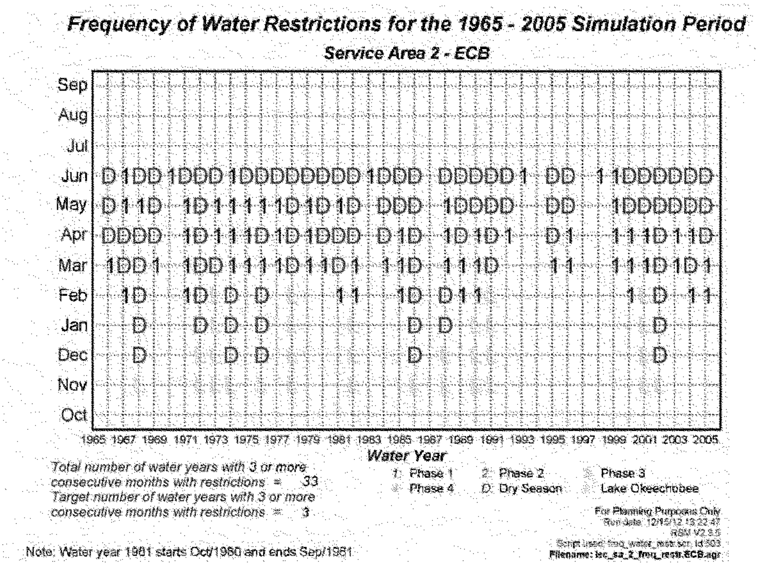

Figure B-13. Frequency of Water Restrictions for the 1965–2005 Simulation Period for LECSA 2 ECB Scenario

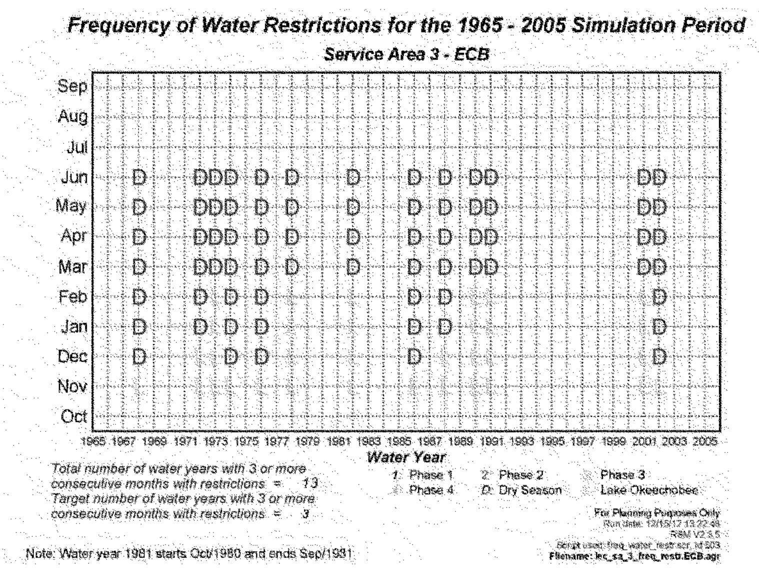

Figure B-14. Frequency of Water Restrictions for the 1965–2005 Simulation Period for LECSA 3 ECB Scenario

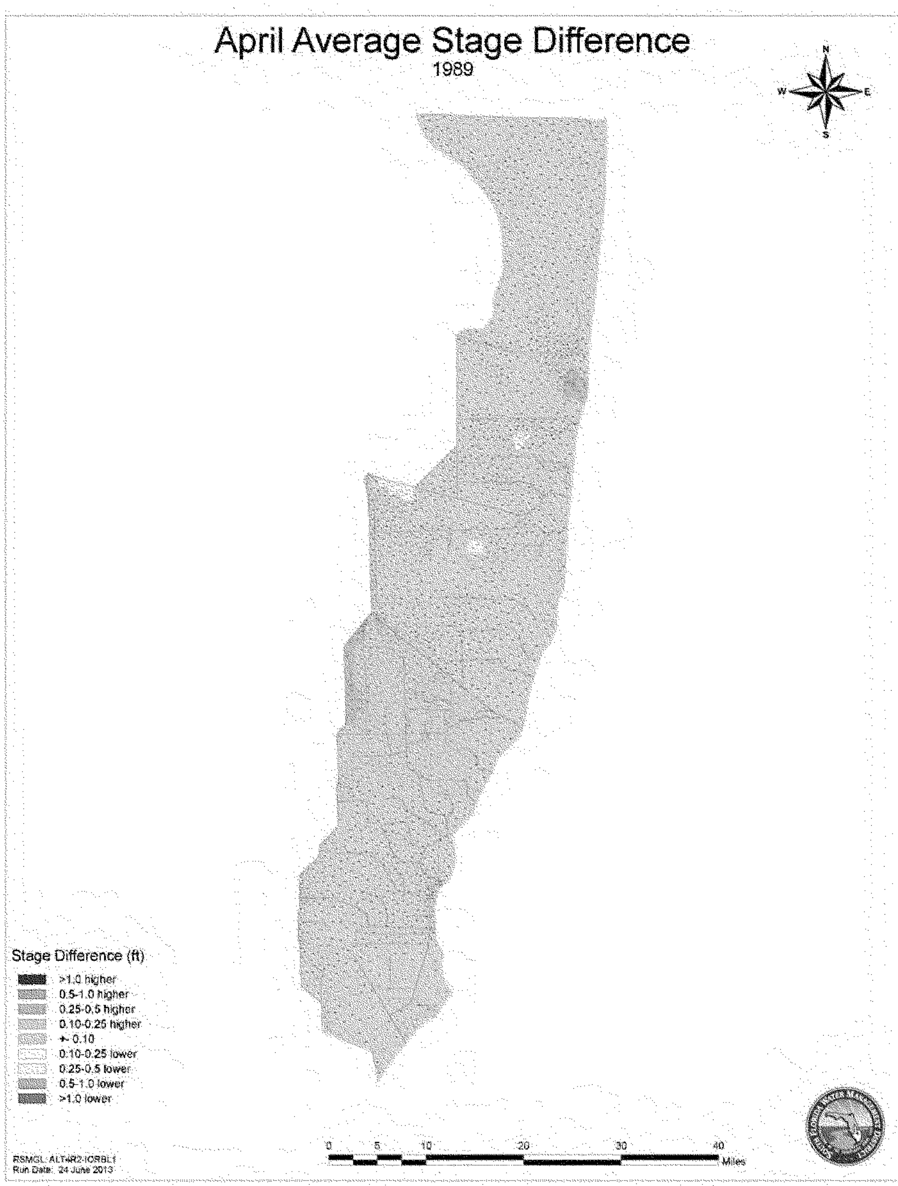

Figure B-15. April 1989 Groundwater Stage Difference Map for Alt 4R2 and IORBL1

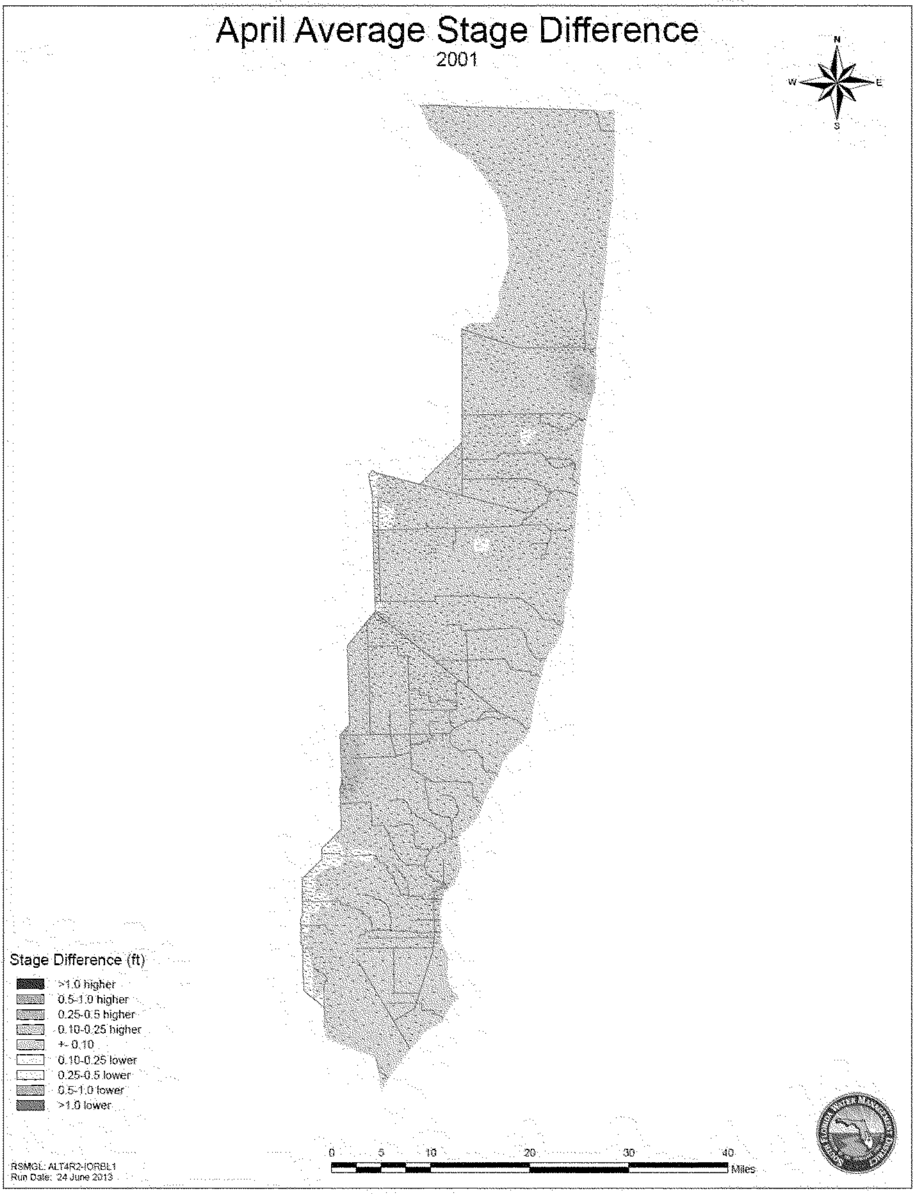

Figure B-16. April 2001 Groundwater Stage Difference Map for Alt 4R2 and IORBL1

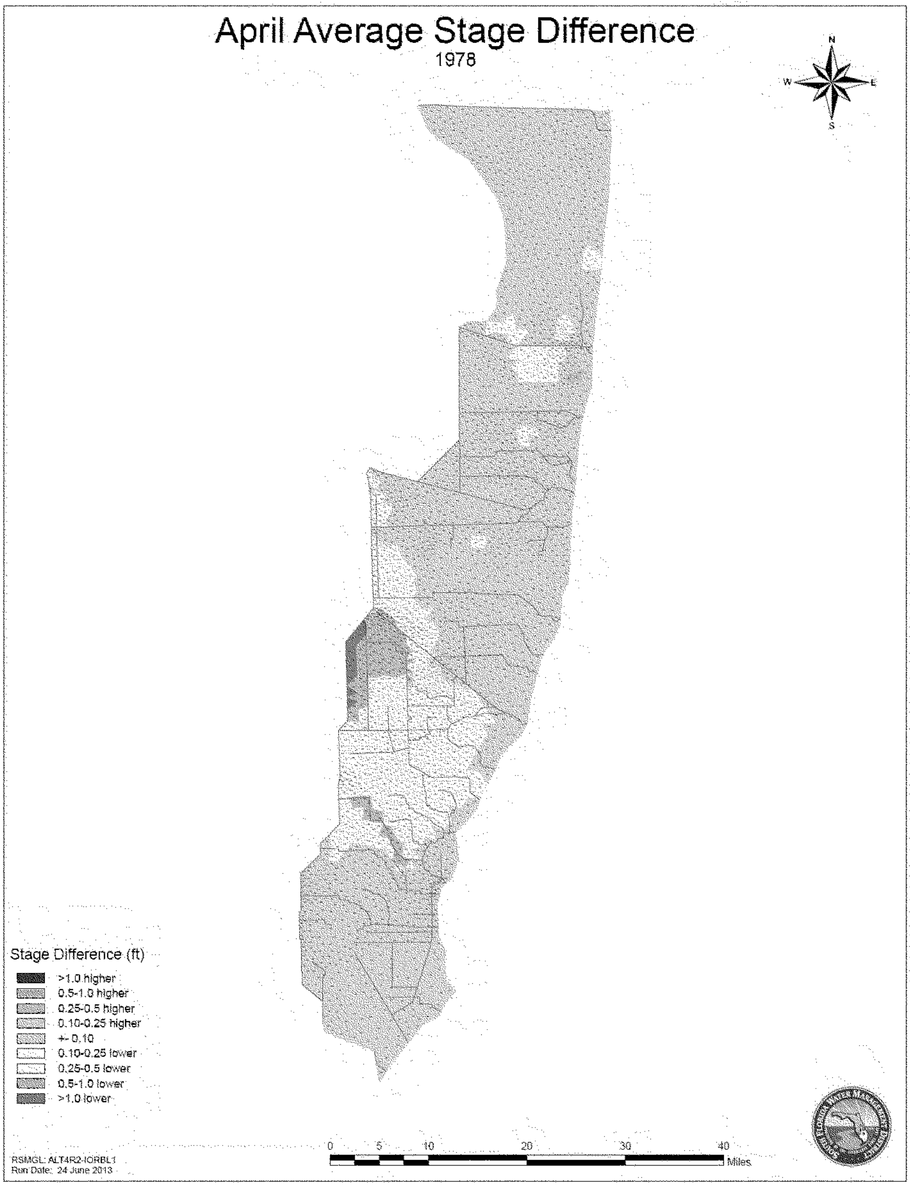

Figure B-17. April 1978 Groundwater Stage Difference Map for Alt 4R2 and IORBL1

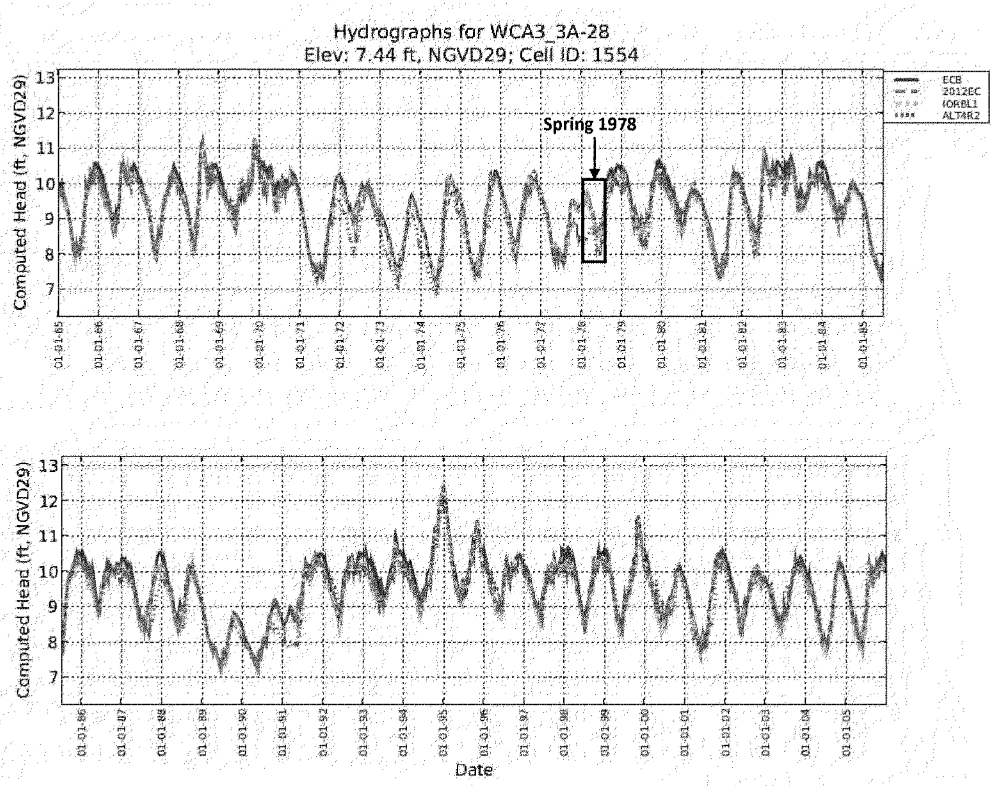

Figure B-18. Stage Hydrograph for Southern WCA 3A (3A-28) for 1965-2005 Period of Simulation

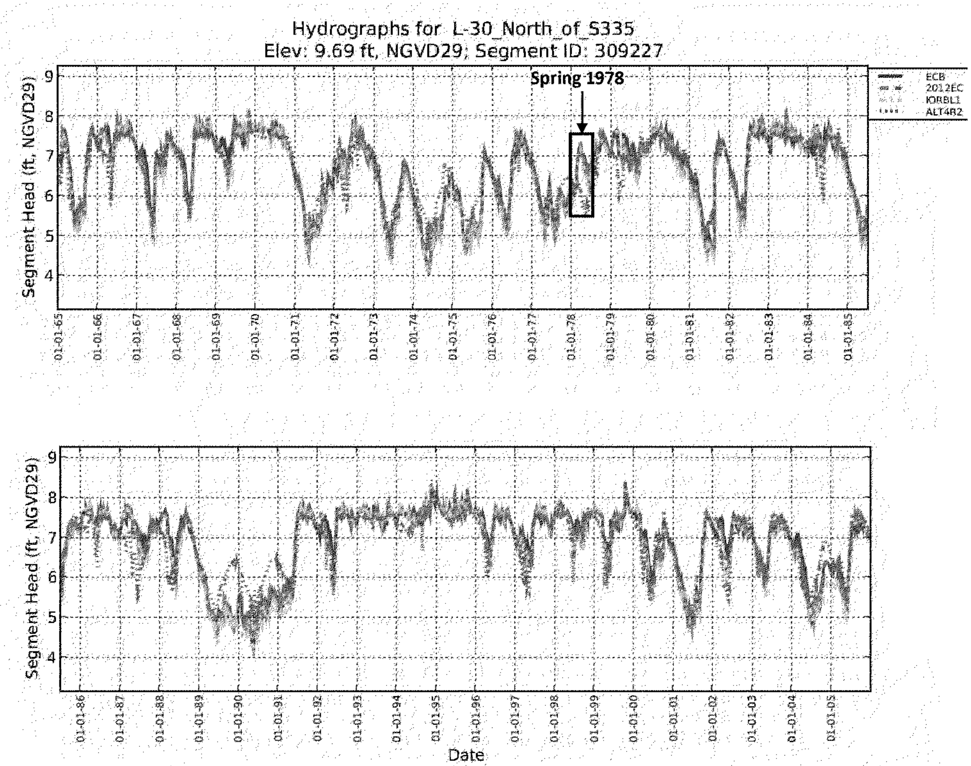

Figure B-19. Stage Hydrograph for L-30 Canal, East of WCA 3, for 1965-2005 Period of Simulation

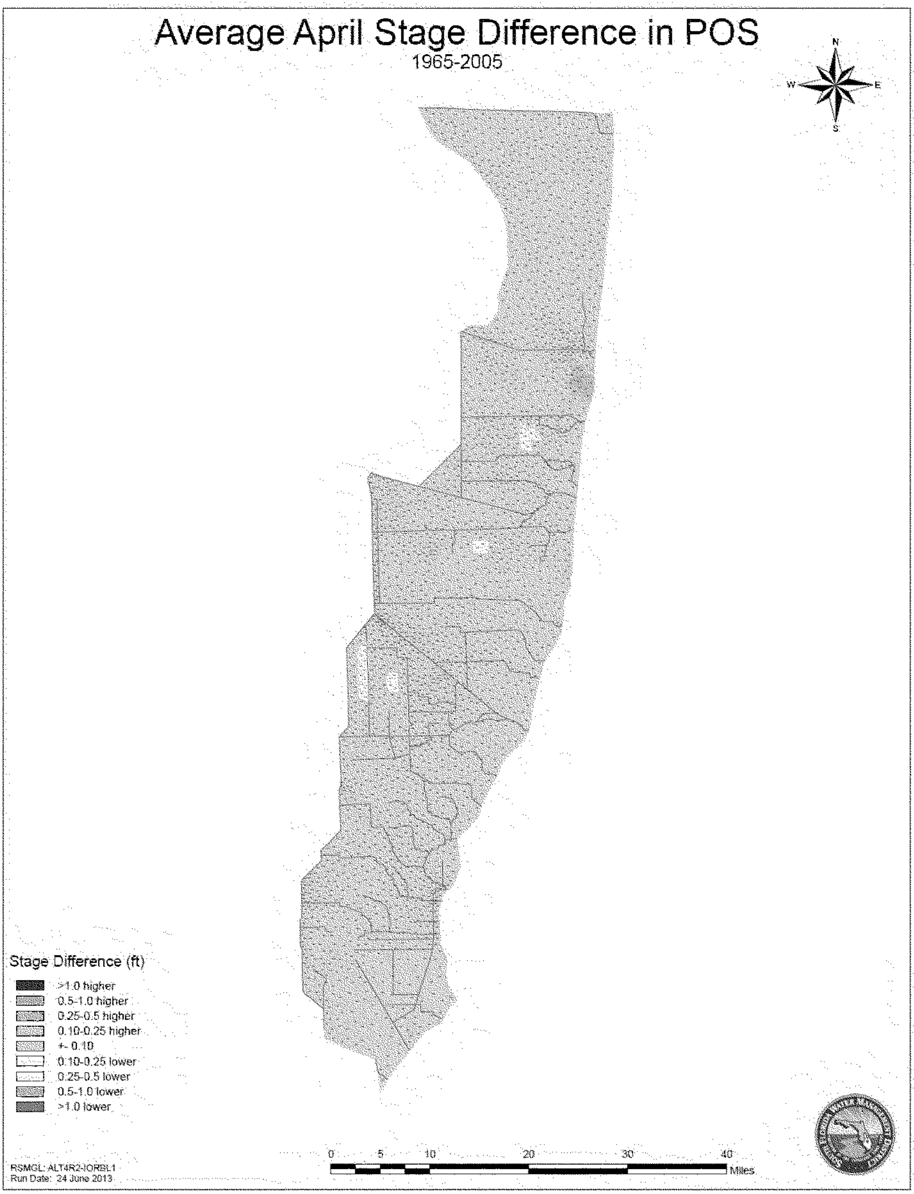

Figure B-20. Average April Stage Difference Map between Alt 4R2 and IORBL1 for 1965–2005

Ability to Delivery Water to LECSA with Miami Canal Backfilled

CEPP Alt 4R2 proposed to backfill the Miami Canal in WCA 3 from one to two miles south of the S-8 pump station to just north of I-75. Water supply deliveries previously made through the Miami Canal would be rerouted through the North New River (NNR) Canal (**Figure B-21**). Since 2003, this eastern route has been preferentially utilized by the SFWMD for water supply deliveries due to its proximity to Stormwater Treatment Area (STA) 3/4.

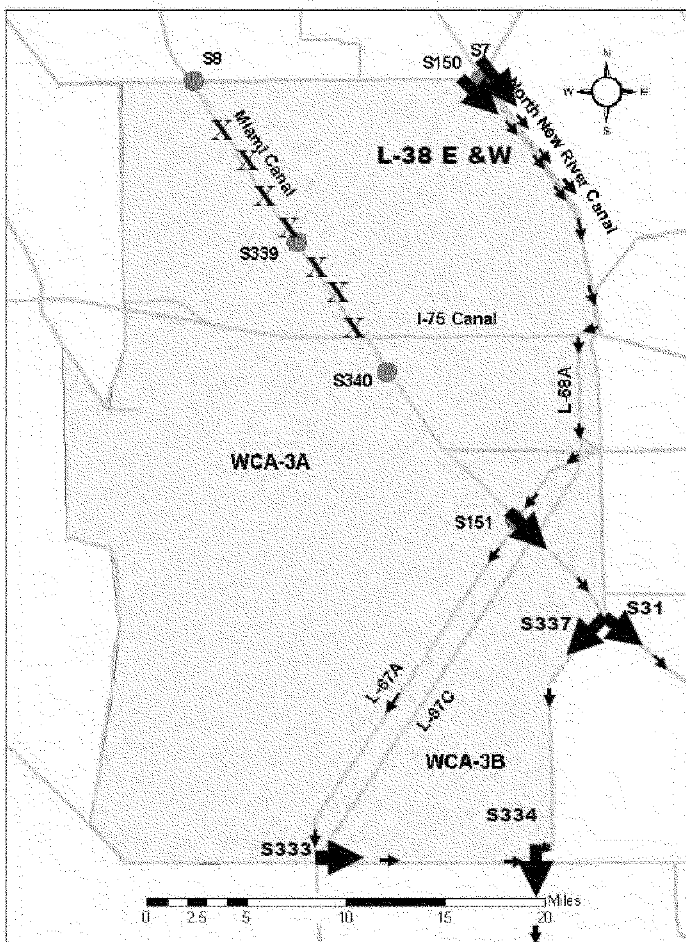

Figure B-21. Water Delivery Route with Miami Canal Filled in WCA 3A

Based on SFWMD's existing operation rules for water delivery to Miami Dade County, water supply deliveries to Miami-Dade County and the SDCS are made from WCA 3A at the S-333 and S-151 structures. When the water level in WCA 3A is at its floor elevation (when headwater at S-333 is at or below 7.5 feet NGVD), a corresponding volume of water is passed into the north end of WCA 3A through S-8, S-7, or S-150 facilities roughly equaling the amount of water released at S-333 or S-151. Based on SFWMD's operation rules for water delivery to LECSA 3 and the WCA 3A Regulation Schedule, water supply is delivered from WCA 3A and not from Lake Okeechobee. Therefore, the conveyance for water supply is more critical at the southern end of the system. Water is taken out of WCA3A at the southeast end and conveyed into WCA 3A at the north end. Through evaporation, rainfall, groundwater and marsh interaction with water in the channel, both quantity and quality of the water entering northern WCA 3A and discharged from southern WCA 3A are different. When WCA 3A is at or below floor elevation, water supply deliveries and corresponding recharge for WCA 3A is based on a conservation of mass approach for WCA 3A; water managers attempt to balance the water anticipated for water supply demands, evaporation and seepage with a roughly equal quantity input into WCA 3A from Lake Okeechobee or the EAA, depending on availability.

Under the CEPP Alt 4R2, the southern one-third of the L-67A/L-67C levees and adjacent borrow canals are proposed to be modified to provide inflows to WCA 3B within the proposed Blue Shanty flowway, and a new spillway divide structure is proposed along the eastern L-29 Canal to allow flexibility for environmental deliveries to Everglades National Park (ENP) across the Tamiami Trail, both east and west of the divide structure. These environmental deliveries may conflict with water supply deliveries to SDCS so the alternate route through structures S-151, S-337 and down the L-30 borrow canal will continue to provide a path for deliveries to the SDCS.

The system-wide conditions have changed considerably since 2000 and these changes to the water supply delivery approach represent intervening non-CERP activities. The original Pre-CERP Baseline, which was developed to represent conditions in place at the time of WRDA 2000 (December 2000), does not include the intervening non-CERP activities and does not reflect revised circumstances under which the project has been formulated and may be implemented. Since 2000, the regional water delivery system has undergone significant changes in operations due to a number of regional and local factors, including implementation of regional operational changes with IOP (2002), ERTP (2012), and the 2008 LORS (2008).

For the CERP WCA 3A Decompartmentalization project (Decomp), the USACE and SFWMD completed an analysis examining the sum of flow at S-7, S-150 and S-8 in cubic feet per second (cfs) over the period from January 1, 1999 to December 31, 2008 (**Figure B-22** and **Table B-6**). Consistent with the operating criteria used to establish water supply delivery mode to LECSA 3, the data was been filtered to show only values when the S-12 structures are not open and there is flow at S-334 or S-337. The periods shown are also consistent with periods when headwater stages at SDCS structures S-176 , S-177 and S-18C would indicate a demand for water (stage less than or equal to 4.0, 3.0 and 2.0 ft NGVD, respectively). Between 1999 and 2008, nine periods were identified when flow at S-7, S-150 and S-8 occurred at the same time as flows from S-334 and/or S-337. For the majority of the days when these conditions were met, the sum of flow at S-7, S-150 and S-8 has been less than 600 cfs. **Figure B-22** and **Table B-6** annotate those times where the total flow exceeded 600 cfs. In all of the cases when the flow exceeded 600 cfs, the discharges resulted from flood control operations, either in response to or in anticipation of wet conditions in the EAA due to a significant rainfall event or high stages in the EAA.

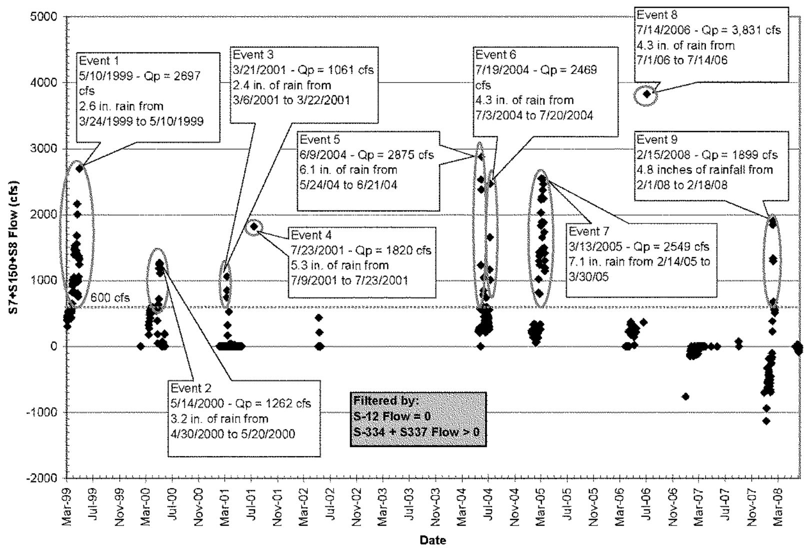

Figure B-22. Decomp Assessment of S-7, S-150, and S-8 Flows for 1999-2008

Table B-6. Summary Table of Pumping/Delivery Events greater than 600 cfs from 1999 to 2008 at S8+S7+S150

Pumping Event (Rainfall Map #)	Pumping Dates (start date to end date)		Peak Pumping Rate (cfs)	Rainfall Period (includes 2 weeks prior to pumping)		Total Rainfall in EAA basin over Rainfall Period (inches)
1	4-6-1999	5-10-1999	2697	3-24-1999	5-10-1999	2.6
2	5-13 -2000	5-20-2000	1254	4-30-2000	5-20-2000	3.2
3	3-20-2001	3-22-2001	1061	3-6-2001	3-22-2001	2.4
4*	7-23-2001	7-23-2001	1820	7-9-2001	7-23-2001	5.3
5*	6-7-2004	6-21-2004	2875	5-24-2004	6-21-2004	6.1
6*	7-17-2004	7-20-2004	2469	7-3-2004	7-20-2004	4.3
7	2-28-2005	3-30-2005	2549	2-14-2005	3-30-2005	7.1
8*	7-14-2006	7-14-2006	3831	7-1-2006	7-14-2006	4.3
9	2-15-2008	2-18-2008	1899	2-1-2008	2-18-2008	4.8

* Denotes Wet Season Event

With most of the northern portion of the Miami Canal backfilled (north of I-75) and WCA 3A below its floor elevation, the eastern water supply delivery route (**Figure B-21**) is the only conveyance route available to provide water from Lake Okeechobee to offset water supply delivery from WCA 3A. The CEPP Alt 4R2 may affect one of the two water supply delivery routes from WCA 3A to the SDCS. The route that continues down L-67A to S-333/S-334 may not always be available due to environmental delivery schedules still under development. However, the route directing water from L-67A in WCA-3A through S-151, S-337 and the L-30 Canal is always available and has sufficient capacity to deliver the pre-existing water supply delivery requirements of 600 cfs. Therefore, the proposed backfill of the northern portion of the Miami Canal will not diminish the capacity for water supply deliveries to the LECSA.

B.3.1.3 Seminole Tribe of Florida

Both the Brighton and Big Cypress Reservations depend partially on Lake Okeechobee for supplemental irrigation water supplies for agricultural and other needs. The unmet demand volume and percentage of water demand not met can be compared to assess the ability of existing legal sources to continue to meet demands. For the Brighton Reservation, the unmet demand volume and percentage of demand not able to be met are essentially the same in the with project condition (Alt 4R2) and the without-project condition (IORBL1). In the with project condition (Alt 4R2), the unmet demand volume and percentage of demand not able to be met are 1 kAF and 3.2 percent, respectively; for the without-project condition (IORBL1), the unmet demand volume and percentage of demand not able to be met are 1 kAF and 3.9 percent, respectively. For the Big Cypress Reservation, the unmet demand volume and percentage of demand not able to be met are essentially the same as well. In the with project condition (Alt 4R2), the unmet demand volume and percentage of demand not met are 1 kAF and 3.6 percent, respectively; for the without-project condition (IORBL1), the unmet demand volume and percentage of demand not met are 1 kAF and 3.9 percent, respectively. Based on this comparison, water supply performance for the Seminole Tribe of Florida Brighton and Big Cypress Reservations is slightly improved with CEPP implementation.

For the additional evaluations, the base conditions 2012EC and ECB perform similar to the IORBL1 and therefore essentially the same as Alt 4R2. For the Brighton Reservation, the baselines, 2012EC and ECB, volume and percentage of demand not met are 1 kAF and 3.8 percent. For the Big Cypress Reservation, the baselines, 2012EC and ECB, the volume and percentage of demand not met for both conditions are 1 kAF and 4.8 percent (**Figure B-23** and **Figure B-24**).

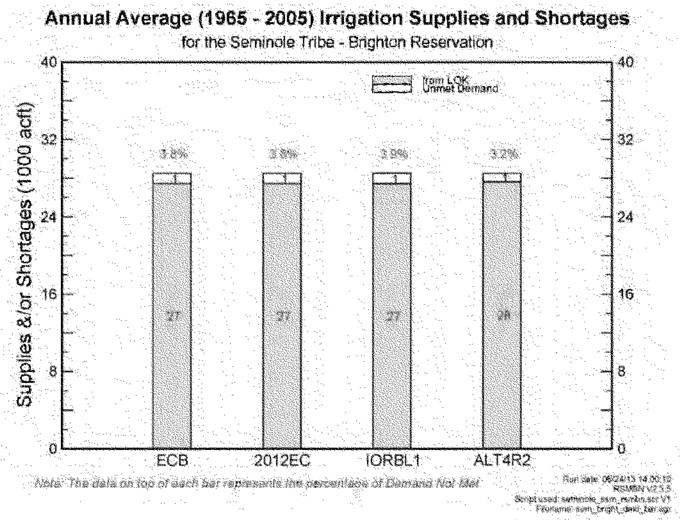

Figure B-23. Annual Average (1965–2005) Irrigation Supplies and Shortages for the Seminole Tribe of Florida – Brighton Reservation

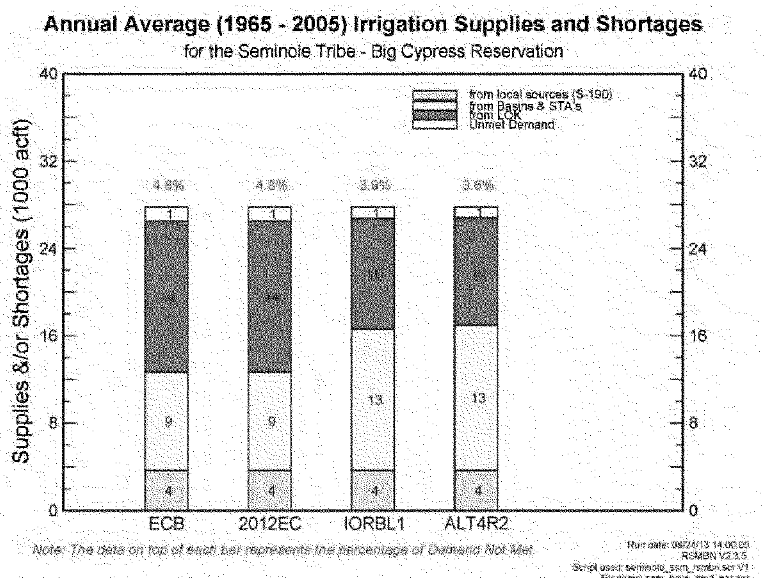

Figure B-24. Annual Average (1965–2005) Irrigation Supplies and Shortages for the Seminole Tribe of Florida – Big Cypress Reservation

B.3.1.4 Miccosukee Tribe of Indians of Florida

The Miccosukee Tribe of Indians of Florida has several reservation areas and resorts in the project area. The reservation areas utilize groundwater as their source of water. The resort, located in Miami-Dade County, utilizes potable water supplied by Miami-Dade Water and Sewer Department. These sources will not be reduced or negatively affected by CEPP.

B.3.1.5 Everglades National Park

For ENP, water deliveries at Tamiami Trail are displayed in **Figure B-25**. This is the average annual delivery volume probability curve for the 41-year period of simulation. Inflows to ENP are quantified for the S12s (A-D), S333, the S355s (A&B), S345 (F&G; Alt 4R2 only) and S356 (Alt 4R2 only). The with project condition, Alt 4R2, deliveries exceed the without project condition, IORBL1, for each year.

Comparisons to the existing condition baselines (2012EC and ECB) also indicate that the with project condition deliveries exceed the existing condition deliveries for each year as well.

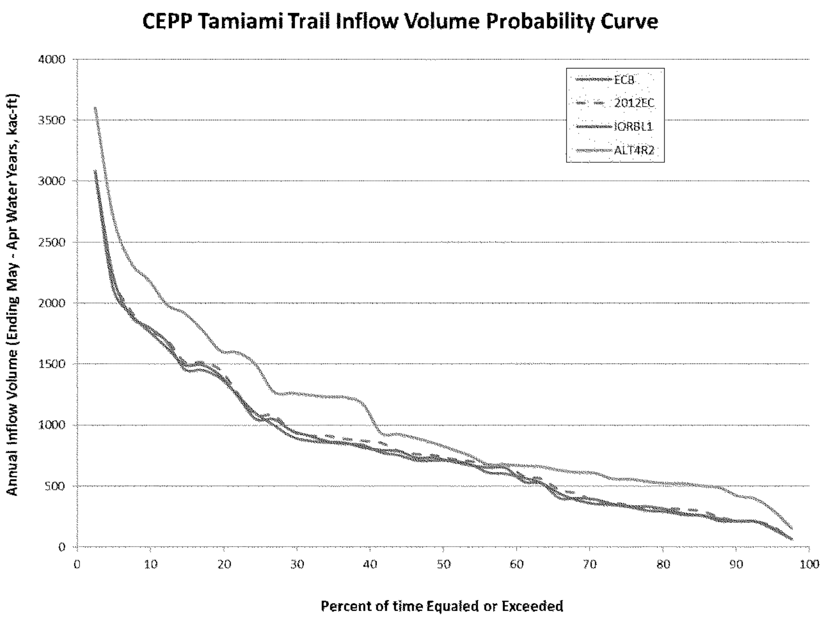

Figure B-25. CEPP Tamiami Trail Inflow Volume Probability Curve

B.3.1.6 Water Supply for Fish and Wildlife

Caloosahatchee Estuary

The low flow criteria for the Caloosahatchee Estuary is an average monthly flows of less than 450 cfs. In the Caloosahatchee Estuary, the number of months the low flow criteria is not met is similar in the with project (Alt 4R2) and without-project (IORBL1) conditions (**Figure B-26**). The estuary low flow criteria are not met for 23 months out the 41-year period of simulation (492 total months) in Alt 4R2 and 27 months in the IORBL1.

Comparisons to the existing condition baselines show significant improvement in low flow performance with Alt 4R2. Both the 2012EC and ECB show 116 months when average monthly flows are less than 450 cfs, compared to 23 months in Alt 4R2. Neither of the existing condition baselines benefit from the inclusion of the CERP Caloosahatchee River (C-43) West Basin Reservoir, which is included in the future without (IORBL1) assumptions.

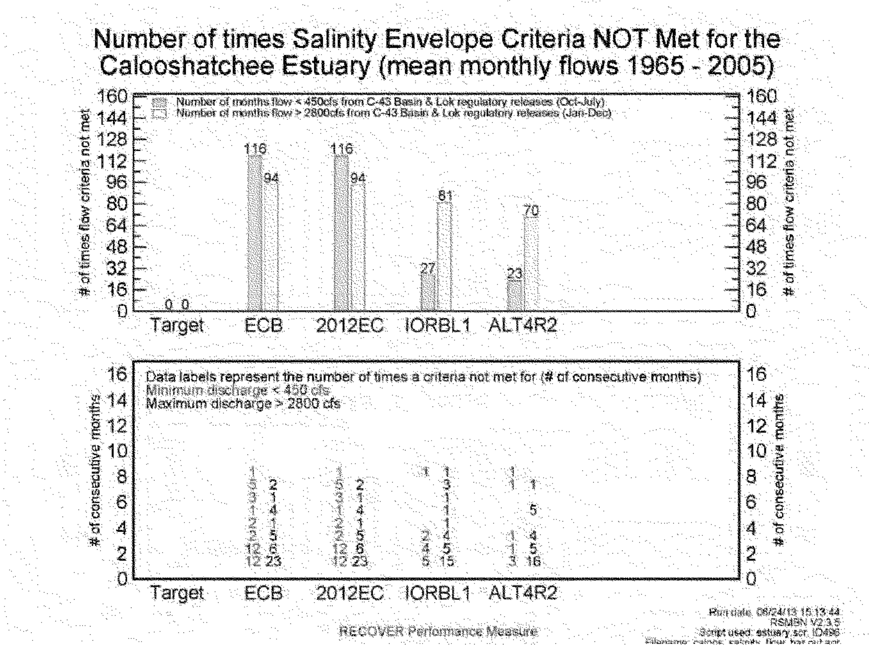

Figure B-26. Number of Times Salinity Envelope Criteria Not Met for the Caloosahatchee Estuary (mean monthly flows 1965–2005)

St Lucie Estuary

The low flow criteria the St. Lucie Estuary is an average monthly flows of less than 350 cfs. In the St. Lucie Estuary, the number of months the low flow criteria is not met increases in the with project (Alt 4R2) condition, compared to the without-project condition (IORBL1) (**Figure B-27**). The low flow criteria are not met in 65 months out the 41-year period of simulation in Alt 4R2 and 53 months in the IORBL1. The CEPP with project condition reduces the frequency of achieving the low flow target.

Comparisons to the existing condition baselines show a significant improvement in low flow performance with Alt 4R2. Both the 2012EC and ECB show 89 months when average monthly slows are less than 350 cfs, compared to 65 months for Alt 4R2. Neither of the existing condition baselines benefit from the inclusion of the Indian River Lagoon-South Project's C-44 Basin Reservoir, which is included in the future without (IORBL1) assumptions.

Consideration of overall estuary performance indicates that Alt 4R2 provides an improvement over IORBL1 for both the St. Lucie Estuary (SLE) and Caloosahatchee Estuary (CE). In all cases, the high flow monthly exceedance counts in both the moderately high categories (SLE: 2000-3000 cfs; CE: 2800-4500 cfs) and the extremely high categories (SLE: >3000 cfs; CE: >4500 cfs) are improved. The low flow counts in the SLE warranted further review under the Savings Clause evaluation. The number of low flow exceedances increases from 53 in the IORBL1 to 65 in Alt 4R2. Detailed evaluation of these 12 additional months over the 41 year period of simulation, when the low flow criteria was not met for Alt 4R2, included evaluation of the magnitude of the monthly flow volume difference and the timing and duration of the events. In most cases flows came close to meeting the target (350 cfs) and only occurred one or two months in a row. However during the following four years; 1977, 1981, 1989 and 1990, the differences compared to the low flow criteria were either more extreme (flows closer to 200 cfs or less) or occurred for several months (5-6) in a row. It is worth noting also that during the entire period of record flows, mean monthly flows were not below 150 cfs. It has been observed over the past 25 years that the salinity in the middle Saint Lucie Estuary, at the (US1) bridge site, requires many months of extremely dry conditions in order for salinity to increase into ranges outside the preferred ecological envelope of 8-20 practical salinity units (psu). Although no formal study proves the hypothesis, anecdotal evidence (including monitoring and modeling) shows that currently the majority of the 350 cfs minimum target is provided to the SLE through subsurface, groundwater and un-gauged tributary flows. Consistent with this hypothesis, when there are several months in a row of zero flow out of the major gauged canals in the watershed, often the SLE salinity stays within the preferred ecological envelope. More substantial overall improvements to the health of the SLE will be realized by the reduction in high flows with Alt 4R2 when compared to IORBL1, as moderate high flows are reduced by a 10 months and extreme high flows are reduced by 5 months.

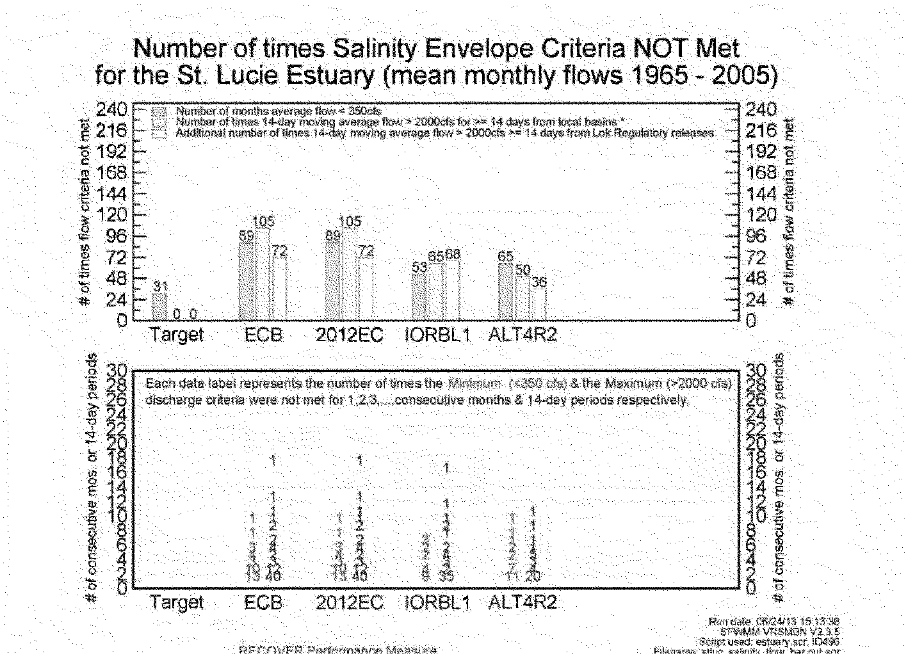

Figure B-27. Number of Times Salinity Envelope Criteria Not Met for the St. Lucie Estuary (mean monthly flows 1965–2005)

WCA 2A

The IORBL1 condition has higher inflows to WCA 2A from STA-2 than the ECB/2012EC condition (377 kAF for IORBL1, as compared to 230 kAF for the ECB/2012EC), resultant from assumed implementation of STA-2 Compartment B, the SFWMD Restoration Strategies project, and the associated water deliveries to WCA2A. The S-7 pump station also contributes inflows to WCA 2A; S-7 inflows are reduced from 115 kAF in the ECB/2012EC to 75 kAF in the IORBL1, with this WCA 2A inflow operational shift accounting for 27 percent of the increase from STA-2 to WCA 2A. The IORBL1 provides more water than WCA 2A needs, especially when considering that 90 percent of the tree islands in WCA 2A were previously "drowned" due to deep water stress in the 1960s. Alt 4R2 utilizes some of this excess IORBL1 water, in addition to the additional flows redirected south from Lake Okeechobee, to increase the hydroperiods and achieve restoration objectives in WCA-3 and ENP through the L-6 diversion operations. With the L-6 diversion operations, for Alt 4R2, average annual inflows from STA 2 (including Compartment B) to WCA 2A are significantly decreased from 377 kAF in the IORBL1 to 236 kAF in Alt 4R2 (a 37% decrease); S-7 inflows are also reduced from 75 kAF in the IORBL1 to 68 kAF in Alt 4R2, due to operations to redirect a portion of STA-3/4 discharges away from WCA 2A to WCA 3A via the S-8 pump station. The with project condition (Alt 4R2) deliveries to WCA 2A are reduced compared to the without project condition (IORBL1) for each of the forty individual water years. The average annual water year decrease in WCA 2A inflows is 148 kAF less than IORBL1, decreasing the mean WCA 2A inflow from 438 in the IORBL1 to 290 kAF with Alt 4R2. The WCA 2A water year inflows reductions range between 43 kAF (water year 1990) to a decrease of 315 kAF (water year 1970). The following analysis compares the hydrological and ecological implications within WCA 2A for the ECB, IORBL1, and Alt 4R2. The comparison indicated little or no difference between ECB, IORBL1, and Alt 4R2.

Comparing ponding depths for a representative wet year of 1995 (**Figure B-28**), there is no significant difference between the ECB and Alt 4R2. There is however, deeper water, on average, in the northwestern region of WCA 2A with the IORBL1. This additional water during a wet year is not ecologically valuable as it may confound restoring the ghost tree islands that remain.

On-the-other-hand, ponding depths during a representative dry year of 1989 (**Figure B-29**) indicate a very different pattern than seen during the wet year example. Here, Alt 4R2 is similar to the IORBL1 rather than the ECB. Both the IORBL1 and Alt 4R2 do a better job of protecting the northwestern region of WCA 2A from soil oxidation and peat loss than the ECB.

During average and wet years, difference maps (Alt 4R2 minus IORBL1 or Alt 4R2 minus ECB) for stage and hydroperiods indicated no significant differences for WCA 2A. Stage and hydroperiod differences between the ECB, IORBL1, and Alt 4R2 were best seen during dry years. For example, the spatial distribution of hydroperiods in 1989 showed three slightly different patterns (**Figure B-30**). The ECB had two cells with a hydroperiod of 0-60 days and a relatively large number of cells with hydroperiods of only 60-120 days, indicating a high potential for soil oxidation and peat fires for 1989 hydrologic conditions. Alt 4R2 improves upon the ECB performance by reducing the areal extent of regions with hydroperiods less than 120 days and increasing the areal extent of regions with hydroperiods of more than 330 days (especially in the NW region of WCA 2A). The IORBL1 performed better than Alt 4R2 for preventing soil oxidation because 95 percent of the WCA had a hydroperiod greater than 120 days.

Surface water flow vectors between Alt 4R2 and the IORBL1 were not found to be significantly different. However, differences in surface water flow vectors between Alt 4R2 and the ECB are apparent, but only for dry years (**Figure B-31**). The 1989 Alt 4R2 and IORBL1 surface water flow vector maps indicate a general northwest-to-southeast flow directionality and movement of water into WCA 2B. The 1989 ECB flow map indicates a general north-to-south flow directionality, no flow in a large area along the eastern boundary of WCA 2A, and little movement of water into WCA 2B. In conclusion, Alt 4R2 is an improvement over the ECB because it does a better job of moving water through to WCA 2B and WCA-3A, while preventing soil oxidation during dry years. Alt 4R2 is similar and likely not different from the IORBL1 in terms of moving water through to WCA 2B and WCA-3A and preventing soil oxidation during dry years.

In addition, Alt 4R2 hydrologic performance in WCA 2A is consistent with the mitigation associated with construction and operation of the Compartment B of ECP STA-2. The hydroperiod targets identified in the FDEP permit were applied during CEPP plan formulation and were maintained despite the L-6 diversion operations.

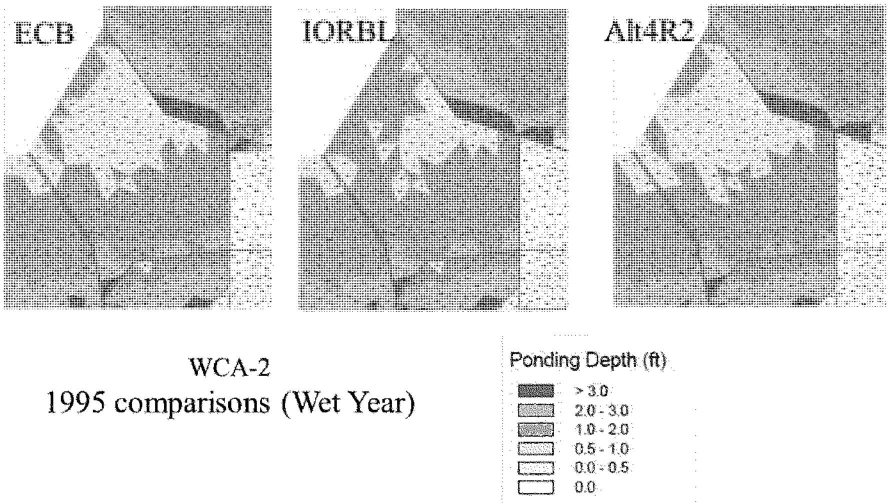

Figure B-28. Wet Year (1995) Ponding Depth Comparisons for WCA 2A for ECB, IORBL1 and Alt 4R2

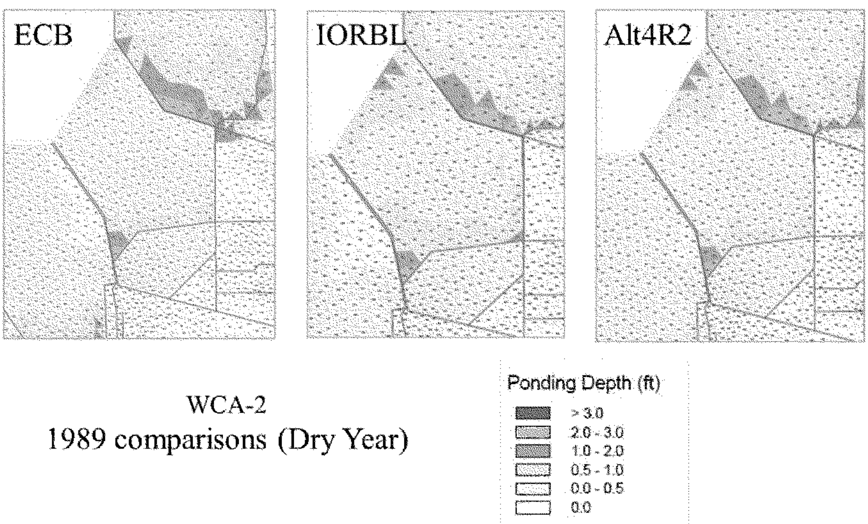

Figure B-29. Dry Year (1989) Ponding Depth Comparisons for WCA 2A for ECB, IORBL1 and Alt 4R2

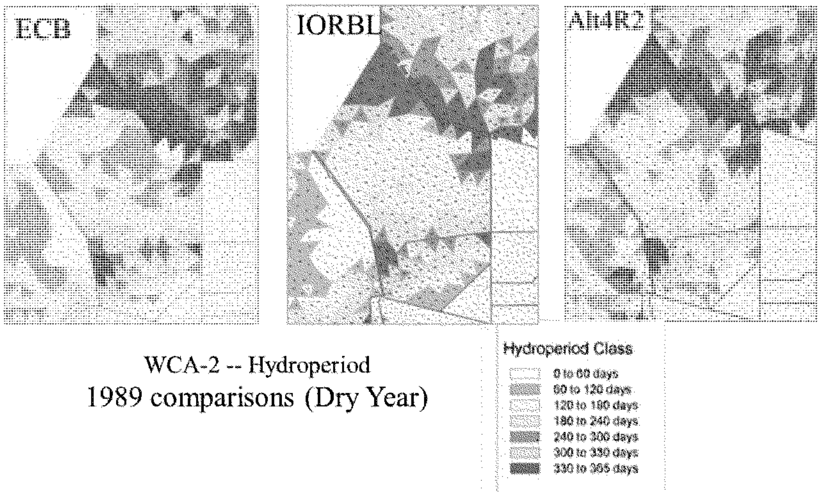

Figure B-30. Dry Year (1989) Hydroperiod Comparisons for WCA 2A for ECB, IORBL1 and Alt 4R2

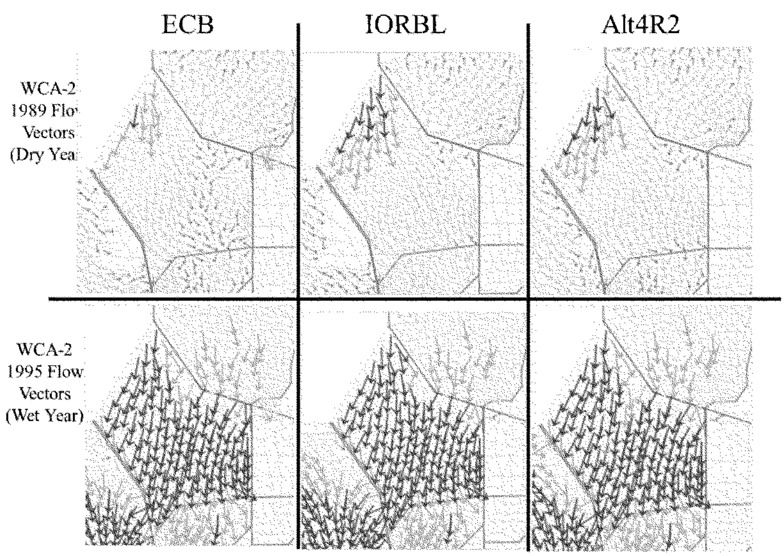

Figure B-31. Surface Water Flow Vector Comparisons for WCA 2A for ECB, IORBL1 and Alt 4R2

WCA 3A

For WCA 3A, water deliveries into WCA 3A are displayed in **Figure B-32**. This probability exceedance plot displays the average annual water year delivery for the 41 year period of simulation. Surface water inflows along the redline to WCA 3A correspond to the sum of structure inflows from the S-8 pump station to the Miami Canal within WCA 3A, the S-150 gated culvert, and STA-5/STA-6 outflows to northwest WCA 3A for the ECB, 2012EC, and IORBL1 base conditions; for Alt 4R2, the combined flows from the S-8 pump station discharges to the Miami Canal and discharges to the S-8A gated culvert (which diverts water to the L-4 Levee degrade gap) are included in addition to S-150 and STA-5/STA-6 outflows to WCA 3A. Compared to the existing condition (ECB/2012EC), inflows to WCA 3A are reduced in the future without condition (IORBL1) due to the increased utilization of STA-2 associated with the IORBL1 assumed implementation of STA-2 Compartment B and the SFWMD Restoration Strategies project; STA-2 discharges to WCA 2A, resulting in a corresponding reduction to WCA 3A inflows. The with project condition (Alt 4R2) deliveries exceed the without project condition (IORBL1) for each of the forty total individual water years. The average annual water year increase in WCA 3A inflows is 362 kAF greater than IORBL1, increasing the mean WCA 3A inflow from 538 in the IORBL1 to 900 kAF with Alt 4R2. The WCA 3A water year inflow increases range between 35 kAF (water year 1990) to an additional 924 kAF (water year 1996).

The following quantification for the change in combined inflows to WCA 2A and WCA 3A (the CEPP formulation redline) is provided for consistency with the quantification of additional redline flows provided in the PIR main report. The average annual Alt4R2 water year increase for combined WCA 2A and WCA 3A inflows is 214 kAF greater than IORBL1 (210 kAF greater than the FWO), with the mean combined WCA 2A and WCA 3A inflow increased from 976 in the IORBL1 to 1190 kAF with Alt 4R2. Eight of the forty total individual water years (1972, 1973, 1977, 1978, 1982, 1986, 1990, and 1991) indicate slight reductions of 8 to 43 kAF for combined WCA 2A and WCA 3A inflows, while water years 1987 and 2002 indicate larger reductions of 123 kAF and 86 kAF, respectively; the remaining 30 water years indicate increased combined inflows to WCA 2A and WCA 3A.

Based on comparison of the existing conditions, 2012EC and ECB, the with project Alt 4R2 inflows to WCA 3A are greater at all times except at the most extreme dry time, the 98^{th} percentile.

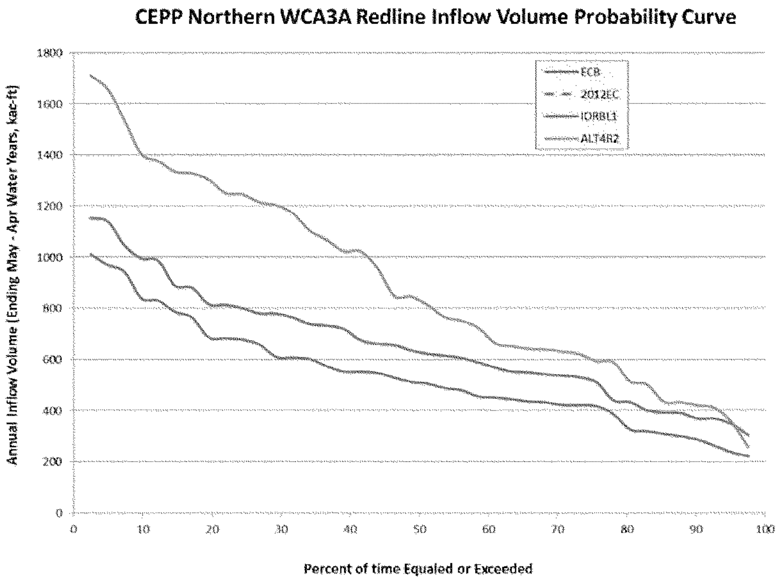

Figure B-32. CEPP Northern WCA 3A Redline Inflow Volume Probability Curve

Biscayne Bay

For the Savings Clause evaluation, surface water flows through multiple structures are evaluated. The structures are summed across all of Biscayne Bay and grouped by spatial sub-regions as well. Comparison of the sum of mean annual structure flows in the with project condition (Alt 4R2) to the without-project condition (IORBL1) indicates the total inflows are slightly increased with Alt 4R2 (839 kAF for IORBL1; 865 kAF for Alt 4R2). Each of the sub-regions is unchanged, with the exception of the South-Central sub-region (**Table B-7**).

The with project condition (Alt 4R2) was also compared to the existing condition baselines (2012EC and ECB). The total mean flows are slightly increased for Alt 4R2, with a slight reduction observed for the Central sub-region.

The South-Central sub-region flows were also compared to the target flows identified in the Biscayne Bay Water Reservation Rule recently adopted by the SFWMD (518,759 AF/yr). The with project condition (Alt 4R2) quantity and timing of flows performs similar to the without-project condition (IORBL1) (**Figure B-33**).

Table B-7. Mean Annual Structure Flows to Biscayne Bay for Each Condition

Sub-region: Structures	Mean Annual Structure Flows to Biscayne Bay (kAF)			
	ECB	2012EC	IORBL1	Alt 4R2
North: S29, S28, S27	334	333	356	356
Central: S26, S25B, S25, G93, S22	274	276	259	259
South-Central: S123, S21, S21A, S20G, S20F	214	218	220	246
South: S20	4	4	4	4
Total	826	831	839	865

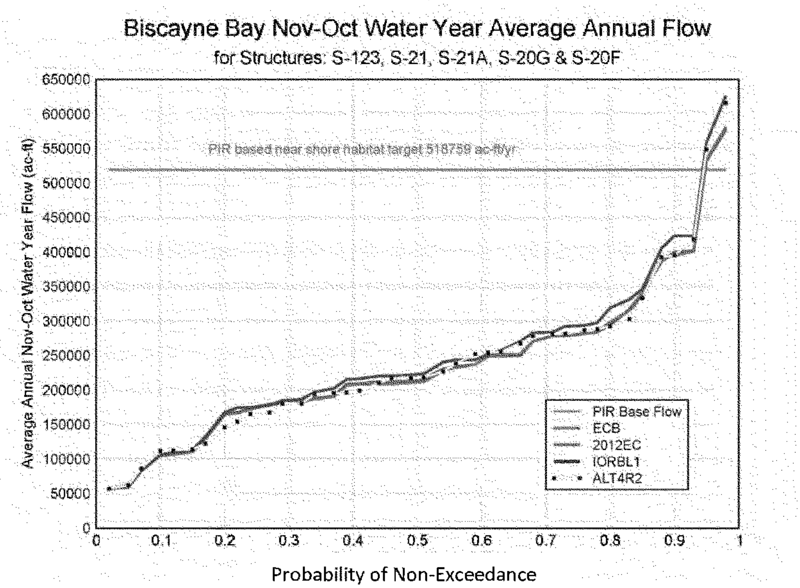

Figure B-33. Biscayne Bay November–October Water Year Average Annual Flow

Manatee Bay – S-197

The S-197 gated culvert structure, at the southern end of the C-111 canal, is the terminal structure of the SDCS. The S-197 is operated with the primary purpose of flood control and prevention of saltwater intrusion and strongly influences hydrologic conditions in the southeastern Everglades, the Model Lands, and developed areas of southern Miami-Dade County. Discharges passing through the structure's four rectangular box culverts flow into Manatee Bay, which is directly connected to Barnes Sound. These water bodies are the most southerly portion of the Biscayne Bay system, but also have a relatively small exchange of water with eastern Florida Bay through culverts under U.S. Highway 1 and the highway's bridges.

An objective of the C-111 South Dade Project and CERP's C-111 Spreader Canal Western Project has been to minimize pulse flood control releases from S-197 and maximize sheetflow of water toward and within Everglades National Park (ENP), including Taylor Slough and the ENP panhandle marshes that receive water overflowing the southern bank of the lower C-111 Canal. Pulse releases from S-197 can rapidly and harmfully decrease local salinity in downstream estuaries and also create water column density stratification, which increases the risk of hypoxia at the bay bottom. Such problems were observed following Hurricane Katrina in 2005. However, it is notable that salinity conditions in Manatee Bay and Barnes Sound are currently much higher than before drainage of the Everglades in the early twentieth century and construction of the SDCS in the 1970s; salinity levels tend to be close to that of ocean water. While water supply to estuaries via canals is unnatural and generally undesirable, the watershed of Manatee Bay and Barnes Sound is isolated by highways and canals flowing east toward Biscayne Bay proper. Given this isolation from fresh water flow, Manatee Bay and Barnes Sound can gain some benefits from modest C-111 discharges via S-197.

CEPP modeling of S-197 discharges showed that mean annual discharges from S-197 were much higher under ECB than under the IORBL1 or any of the evaluated CEPP restoration alternatives, including Alt 4R2 (**Table B-8**). This is likely because the C-111 Spreader Canal Western PIR Project operations were included in all scenarios other than ECB and this project's features (including pump stations S199 and S200, as well as the associated Frog Pond Detention Area) effectively minimizes flood control discharges from S-197, while providing resultant sheetflow benefits to ENP wetlands and Florida Bay. Only slightly more water is discharged into Manatee Bay through S-197 with Alt 4R2 than with IORBL. The overall shape of the discharge rate – frequency curves shown in **Figure B-34** remained similar for all alternatives, but for any given discharge rate, the frequency with ECB was roughly double that of any other with project alternative.

In conclusion, CEPP can be expected to have little effect on S-197 discharges and consequently not alter its current effects, whether negative or positive, on Manatee Bay and Barnes Sound. Restoration of these downstream estuaries will require further CERP progress, with implementation of the second phase of the CERP C-111 Spreader Canal Western Project.

Table B-8. Mean Annual Discharges from S-197

Mean annual discharges from S-197 (ac-ft)	
ECB	16.5
IORBL1	6.7
Alt 4R2	8.2

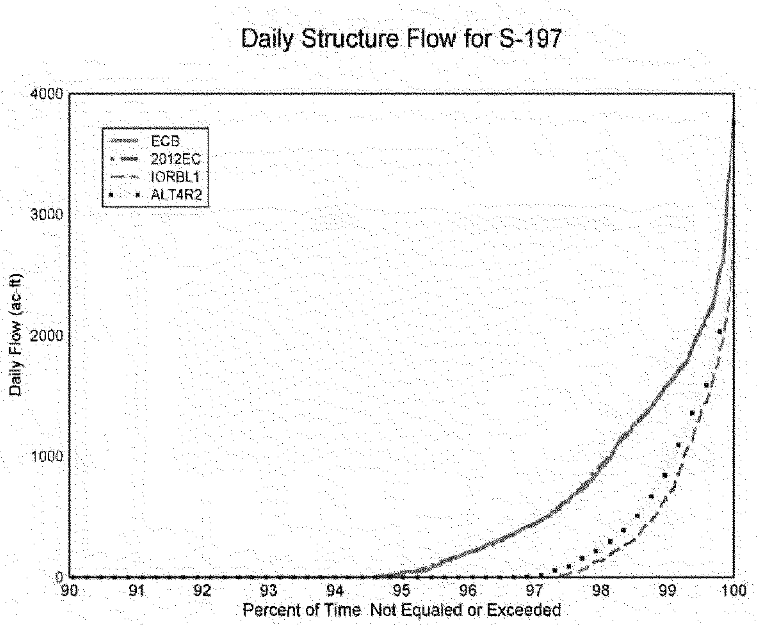

Figure B-34. Exceedance Probability of Daily Structure Flow for S-197

Florida Bay

For the Savings Clause evaluation, overland flows towards Florida Bay at two different locations are evaluated. Specifically, the volume probability curves for the average annual water year flows for the 41 year period of simulation for Transect 23 and Transect 27 are evaluated. For Transect 23, the with project condition (Alt 4R2) deliveries exceed or are similar to the without project condition (IORBL1) for most rank-sorted probabilities. Although the volume probability curves increase from 90 to 50 to 10 for both conditions they do not necessarily progress in the same way across the distribution (**Figure B-35**). At four of the rank-sorted probabilities, the without project condition exceeds the with project condition by between less than 1 kAF to less than 6 kAF. To place this volume in perspective, 6 kAF represents 2.6 percent of the mean annual flows (the 50th percentile). For Transect 27, the with project condition (Alt 4R2) deliveries exceed or are similar to the without project condition (IORBL1) for each probability (**Figure B-36**).

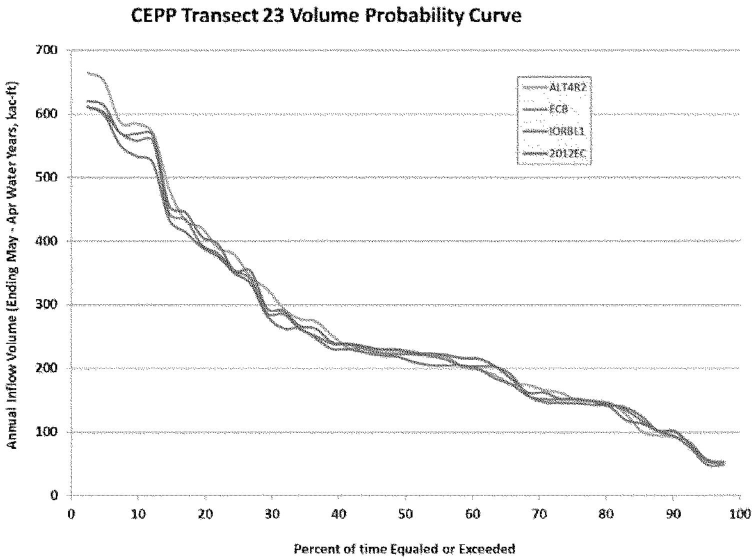

Figure B-35. CEPP Transect 23 Volume Probability Curve

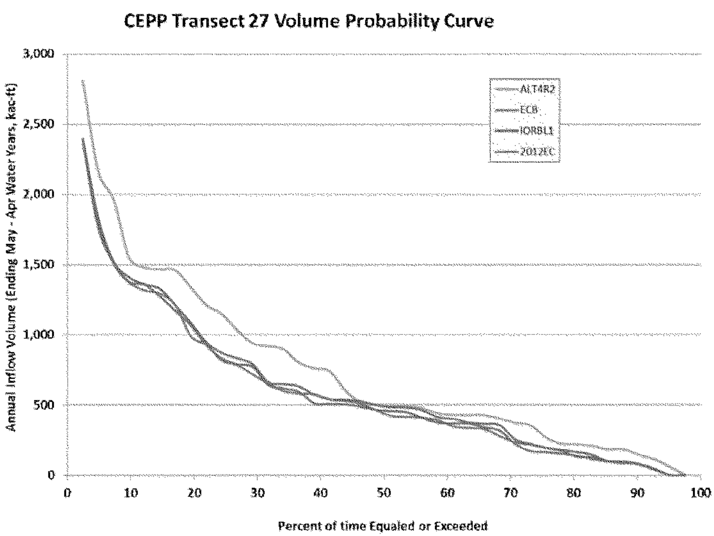

Figure B-36. CEPP Transect 27 Volume Probability Curve

B.3.2 Savings Clause - Flood Protection

The four features or areas affected by the project that will be analyzed include 1) the potential risk to HHD due to changes in the lake's stages, 2) the FEB located in the EAA, 3) the effects of changed water levels in WCAs 3A and 3B on the East Coast Protective levees L-67 and L-30, and 4) the mix of agricultural and urban areas located east of the East Coast Protective levees L-31N and L-31W. In addition, areas of interest to the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida, including Tribal reservations, are assessed in **Section 3.2.6** and **Section 3.2.7**, respectively.

B.3.2.1 Lake Okeechobee Herbert Hoover Dike

CEPP benefits gained from sending new water south from Lake Okeechobee are derived in part from operational refinements that can take place within the existing, inherent flexibility of the 2008 LORS, and in part with refinements that are beyond the schedule's current flexibility. Modifications to 2008 LORS will be required to optimally utilize the added storage capacity of the A-2 FEB to send the full 210,000 ac-ft/yr of new water available in CEPP south to the Everglades, while maintaining compliance with Savings Clause requirements for water supply and flood control performance levels.

The hydrologic modeling conducted for all CEPP alternatives to optimize system-wide performance incorporated the current Regulation Schedule management bands of the 2008 LORS. The hydrologic modeling of the CEPP alternatives included proposed revisions to the 2008 LORS flowchart guidance of maximum allowable discharges, which are dependent on the following criteria:

- Class limits for Lake Okeechobee inflow and climate forecasts, including tributary hydrologic conditions, seasonal climate outlook, and multi-seasonal climate outlook
- Stage level, as delineated by the Regulation Schedule management bands
- Stage trends (whether water levels are receding or ascending)

Most of the 2008 LORS refinements applied in the CEPP modeling lie within the bounds of the operational limits and flexibility available in the current 2008 LORS, with the exception of the adjustments made to the class limits for the Lake Okeechobee inflow and climate forecasts. Under some hydrologic conditions, the class limit adjustments made to the Lake Okeechobee inflow and climate forecasts reduced the magnitude of allowable discharges from the lake, thereby resulting in storage of additional water in the lake to optimize system-wide performance and ensure compliance with Savings Clause requirements. However, these class limit changes represent a change in the flowchart guidance that extends beyond the inherent flexibility in the current 2008 LORS. As detailed in Section 6.7.2.1, the CEPP recommended plan operations also expand on the 2008 LORS backflow operations to Lake Okeechobee through the following operational changes: 1) backflow to Lake Okeechobee from the C-44 Canal is allowed when S-308 is not open for regulatory discharge and the stage in Lake Okeechobee is below 14.5 feet NGVD (no seasonal variability); and 2) discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are made when the stage in Lake Okeechobee is below the baseflow zone of the 2008 LORS schedule to provide an additional source of backflow water to Lake Okeechobee. Additional information and documentation of the CEPP Recommended Plan modeling assumptions for Lake Okeechobee operations are found in Section A.8.3.2.3.3 of Appendix A (Engineering) of the CEPP PIR.

Independent of CEPP implementation, there is an expectation that revisions to the 2008 LORS will be needed following the implementation of other CERP projects and Herbert Hoover Dike infrastructure remediation. The USACE expects to operate under the 2008 LORS until there is a need for revisions due to the earlier of either of the following actions: 1) system-wide operating plan updates to accommodate CERP "Band 1" projects, as described in Section 6.1.3.2, or 2) completion of sufficient HHD remediation for reaches 1, 2 and 3 and associated culvert improvements, as described in Section 2.5.1. When HHD remediation is completed and the HHD DSAC Level 1 rating is lowered, higher maximum lake stages and increased frequency and duration of high lake stages may be possible to provide the additional storage capacity assumed with the CEPP Recommended Plan. The future Lake Okeechobee Regulation Schedule, which may be developed in response to actions 1 and/or 2, is unknown at this time. It is anticipated that the need for modifications to the 2008 LORS will be initially triggered by non-CEPP actions and that these actions will occur earlier than implementation of CEPP. Therefore, the CEPP PIR will not be the mechanism to propose or conduct the required NEPA evaluation of modifications to the Lake Okeechobee Regulation Schedule. However, depending on the ultimate outcome of these future Lake Okeechobee Regulation Schedule revisions, including the level of inherent operational flexibility provided with these revisions, CEPP implementation may still require further Lake Okeechobee Regulation Schedule revisions to optimize system-wide performance and ensure compliance with Savings Clause requirements.

Lake Okeechobee stage duration curves for the RSM-BN model representation of the ECB/2012EC (2008 LORS; note that plot lines overlap), IORBL1 (2008 LORS, plus additional CERP and non-CERP projects), and Alternatives 4R2 (LORS 2008, additional CERP and non-CERP projects, and prescribed assumed operational flexibility) are included as **Figure B-37** (note: upper 25% of the stage duration curve is displayed). Peak stages for the CEPP Savings Clause baselines and Alt 4R2 are summarized as follows: 17.54 feet NGVD for the 2012EC; 17.52 feet NGVD for the IORBL1; and 17.66 feet NGVD for Alt 4R2. The baselines and the Recommended Plan Alt 4R2 all show simulated stages above 17.25 feet NGVD: 18 days for the 2012EC; 9 days for the IORBL1; and 29 days for Alt 4R2 (note: 14,975 days in the RSM-BN 41-year period of simulation). The USACE 2008 LORS Environmental Impact Statement (EIS) assessment recognized that minimizing the frequency of exceedance of the 17.25 feet elevation offers additional protection for public safety and the HHD, for the condition prior to completion of the current approved and planned HHD remediation measures, and this criterion was evaluated as a LORS project performance measure. The assumed modified Lake Okeechobee operations with the CEPP alternatives (including Alt 4R2) do not cause significant increases in the frequency, duration, and magnitude of Lake Okeechobee peak stages (compared to the IORBL1), despite the assumed completion of HHD remediation measures, because the adverse ecological effects associated with increased lake stages and the associated increases in high volume releases to the estuaries were effectively balanced during the CEPP preliminary screening (for additional discussion of screening metrics, refer to **Section 3** of the PIR main report). Following completion of the HHD remediation of Reaches 1, 2, and 3, the degree to which higher maximum lake stages and increased frequency and duration of high lake stages would be accepted, if at all, will be contingent on the conclusions identified in the 2015 DSMR (note: this process is independent and separate from the CEPP project).

Given recognition of the DSMR uncertainty and the continued utilization of the 2008 LORS Lake Okeechobee Regulation Schedule for CEPP, the USACE assessment of the Lake Okeechobee high water performance with CEPP indicated consistency with the HHD formulation assumptions established for the CEPP future without project condition (FWO/IORBL1), which included general consideration of potential risk and uncertainty associated with increased lake stages. Lake Okeechobee high water performance requirements will likely need to be revisited following completion of the 2015 DSMR, but the CEPP stage duration curve trends for increased high water conditions appear reasonable based on the USACE current best available information and current expectations for the HHD remediation.

Extreme high lake stages have also been documented to adversely impact the plant and animal communities, through processes which include the following: physical uprooting of emergent and submerged plants; reduced light levels in the water column due to increased suspended sediment; and littoral zone exposure to increased nutrient levels from the water column. The frequency of occurrence for lake stages above 16.0 feet, 16.5 feet, 17.0 feet, and 17.25 feet are summarized in **Figure B-38**. Lake Okeechobee stages between 16.0 and 17.25 feet NGVD correspond to the seasonal range of the top zone of the 2008 LORS Regulation Schedule, and this performance metric was considered by the USACE during the LORS Regulation Schedule study. Refer to **Section 5** of the main PIR report and Appendices C.2.1 and C.2.2 for the environmental effects evaluations for Lake Okeechobee, which were determined to be approximately equivalent across the CEPP future with project alternatives. As documented in **Section 4** of the main PIR report, habitat units were not calculated for Lake Okeechobee since the performance of these areas were considered a constraint during formulation.

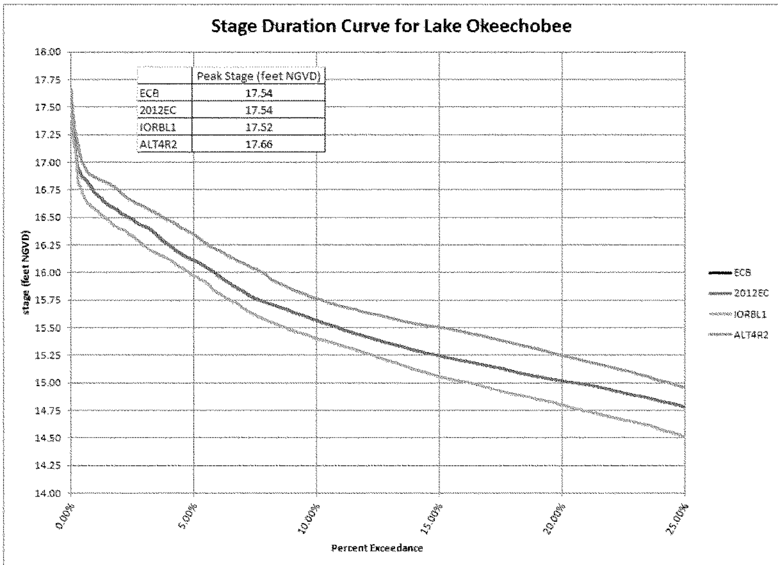

Figure B-37. Lake Okeechobee Stage Duration Curve

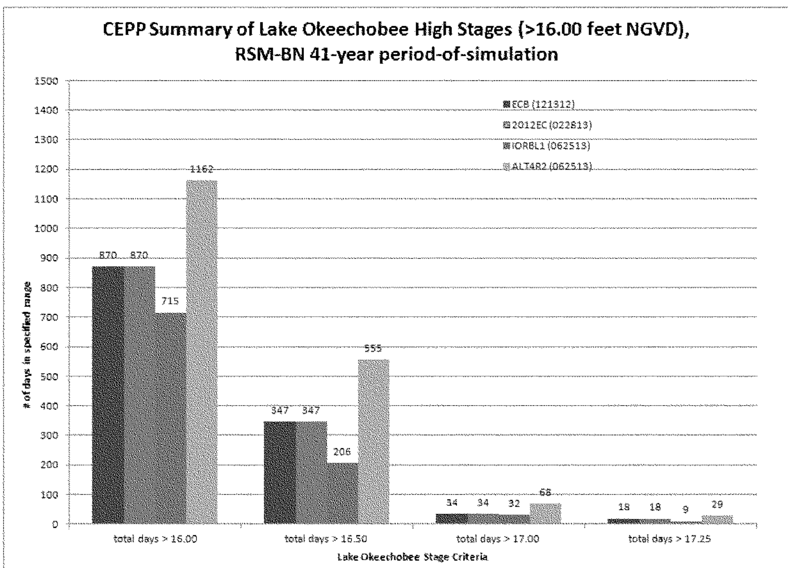

Figure B-38. Occurrence Frequency of Lake Okeechobee High Stages

B.3.2.2 FEB located in the EAA

Stage duration curves for the combined CEPP A-1 and A-2 FEB are shown in **Figure B-39** for the IORBL1 (14k acre A-1 FEB only) and Alt 4R2. Ground surface elevations within the FEB were assumed at 9.63 feet NGVD for the RSM-BN modeling. Minor changes to groundwater levels are expected adjacent to the CEPP A-2 FEB (14,000 acres), compared to the future without project condition (IORBL1) which includes the SFWMD Restoration Strategies A-1 FEB.

The A-2 FEB design includes perimeter seepage collection canals and associated seepage pumps to limit potential impacts. The FEB at this time carries a low hazard potential classification (HPC) per CERP Design Criteria Memoranda (DCM) 1, which is extended to embankment design. Embankment top widths are 14 feet wide per DCM-4, with dam heights based on analysis of the following criteria (USACE Engineer Regulations (ER) 1110-8-2(FR), ER-1110-2-1156, DCM-2, and risk). The FEB perimeter levee elevation is established at 20.3 feet NGVD, three feet above the maximum surcharge pool elevation. As described in further detail in the Engineering Appendix accompanying the CEPP PIR (Appendix A), the maximum surcharge pool elevation is based on the greatest elevation resulting from the following storm routings: a. The Inflow Design Flood (IDF), which is identified as the 100-yr 24-hr storm event for the CEPP FEB, per DCM-2; b. the 50 percent 72-hr PMP per ER-1110-8-2(FR); and c. wind setup and wave run-up analysis on critical fetch lengths with the impoundment at full pool. An orifice-type spillway will provide uncontrolled discharge from the A-2 FEB during extreme events, when FEB discharges are required to protect the embankment integrity. The spillway will include a 265 foot long weir with crest elevation set at 13.50 ft NGVD. The spillway will discharge into the adjacent seepage canal along the northern portions of the A-1 and A-2 FEBs. The spillway will be located in line with the northern extent of the eastern perimeter levee, adjacent to structure S-628.

Within the RSM-BN simulated period of record (1965–2005), the maximum simulated stage in the A-1/A-2 FEB is 13.54 feet NGVD for the CEPP Recommended Plan. Based on the assumed ground surface elevation of 9.63 feet NGVD used in the RSM-BN model, the peak depth is 3.91 feet over the period of record. The FEB emergency overflow spillway (S-627) was designed with a crest elevation of 13.50 feet NGVD, based on the average assumed ground surface elevation of 9.00 feet NGVD used for the preliminary (pre-PED survey) hydraulic design, as described in Appendix A of the PIR; based on this design, the FEB emergency overflow spillway would only discharge if the FEB depth exceeds 4.5 feet. As the FEB stages over the simulated period of record do not overtop the FEB emergency spillway (simulated peak depth condition of 3.91 feet), the FEB emergency spillway preliminary design details, including discharge location, did not warrant further analysis for the CEPP Savings Clause evaluation of Alt 4R2. During CEPP formulation, no detailed modeling was performed to determine the extent or frequency of emergency discharges under extreme event outside of the 1965–2005 period of record that was analyzed for the CEPP PIR.

Detailed CEPP assessments within the EAA were not conducted because the RSM-BN does not simulate groundwater within the EAA. Further assessment of potential effects from the A-2 FEB will be deferred to the PED phase of CEPP.

For flood protection in the EAA, the additional storage volume provided by the construction and operation of impoundments is expected to incidentally improve flood protection in the vicinity of the impoundments. For the FEB, available storage in the impoundments will be utilized to maximize flood control and reduce or eliminate discharges to the WCAs or released to tide associated with anticipated heavy rainfall from tropical storms or hurricanes. The control of seepage from project components will also help to assure that the existing level of service for flood protection is maintained and surrounding lands are not adversely impacted. An emergency overflow spillway for the A-2 FEB will provide protection for project embankments integrity during extreme storm events.

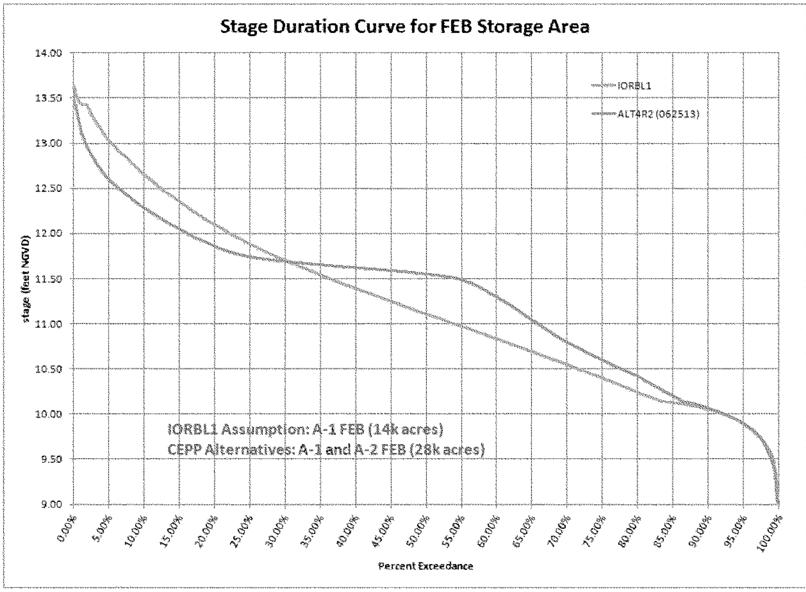

Figure B-39. FEB Stage Duration Curves

B.3.2.3 EAA/Northern WCA 3A – Backfilling of Miami Canal

The CEPP Alt 4R2 proposes to backfill the Miami Canal downstream starting 1 ½ miles south of the S-8 pump station (refer to **Figure B-21** for map) and extending to I-75. Without maintenance of the existing capacity for flood control within the EAA, flood control capability would be diminished. The CEPP plan formulation process assumed that the pre-project flood protection level of service for the EAA would be maintained under CEPP by providing the same total pumping capacity at the S-8 (4170 cfs) and S-7 (2490 cfs) pump stations, which provide drainage for the upstream EAA basin. No new structures are proposed under CEPP to further supplement the G-404 and S-8 pump stations for deliveries from the Everglades Agricultural Area (EAA) to WCA 3A.

CEPP will maintain this existing design capacity for the S-8 complex through a combination of pump station design modifications, a new hydraulic connection from S-8 to the degraded L-4 Levee, utilization of the existing G-404 pump station (570 cfs design capacity), and leaving the 1-2 mile segment of the Miami Canal as available getaway conveyance capacity during peak flow events. S-8 modifications should be completed to permit the diversion of L-6 flows and must maintain flood control operation capability during implementation of S-8 modifications. The Alt 4R2 cost estimate includes placeholder funding for any required modifications of the S-8 outlet works, to address potential increased tailwater conditions with CEPP that may diminish the S-8 pump efficiency. Modifications of the S-8 pump station complex for CEPP operations will be further analyzed during the PED phase of CEPP, since the RSM-GL model applied for CEPP formulation is inadequate for detailed hydraulic design of the S-8 pump station complex; potential design modifications to be assessed/reassessed in further detail during PED will likely include the following: modifications to S-8 and/or G-404, to address pump efficiency concerns; the proposed S-8A culvert and associated canal connecting the Miami Canal to the L-4 Canal; and the required length of the unmodified Miami Canal to maintain hydraulic getaway conveyance capacity.

No design modifications to S-7 are proposed with Alt 4R2, and the S-621 gated spillway proposed on the STA-3/4 outlet canal has been initially designed at 2500 cfs to maintain the capability to deliver the S-7 design capacity flows from STA-3/4 to the S-7 pump station.

B.3.2.4 WCA 3A and WCA 3B

Compared to the CEPP FWO (final December 2012 release), the CEPP Alt 4R2 stages are lowered by approximately 0.1–0.3 feet in the upper 10 percent of the stage duration curve for the WCA 3A three-gauge average stage, as shown in **Figure B-40** (upper 25 percent of the stage duration curve); the same performance is observed in the IORBL1. In order to consider potential differences during specific years, the EN-W assessment also considered the annual duration of exceedance of the ERTP WCA 3A Zone A stage levels for the complete period of simulation (**Figure B-41**). The annual durations were also displayed and assessed as a frequency curve (**Figure B-42**). The total number of days above Zone A is summarized as follows for the IORBL1 and CEPP alternatives (with percent of total period of simulation, 14975 days, in parentheses): CEPP IORBL1 – 2751 days (18.37%); and Alt 4R2 – 3323 days (22.19%).

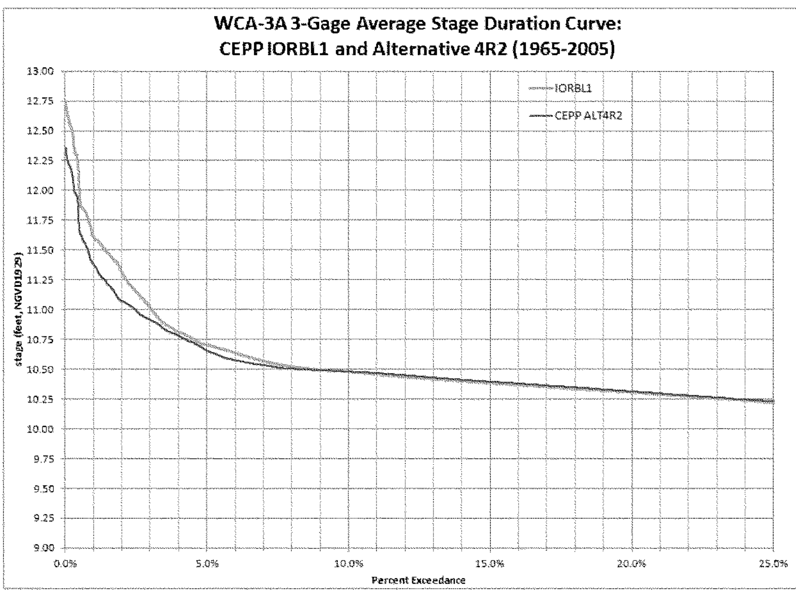

Figure B-40. WCA 3A Three-Gauge Average Stage Duration Curve

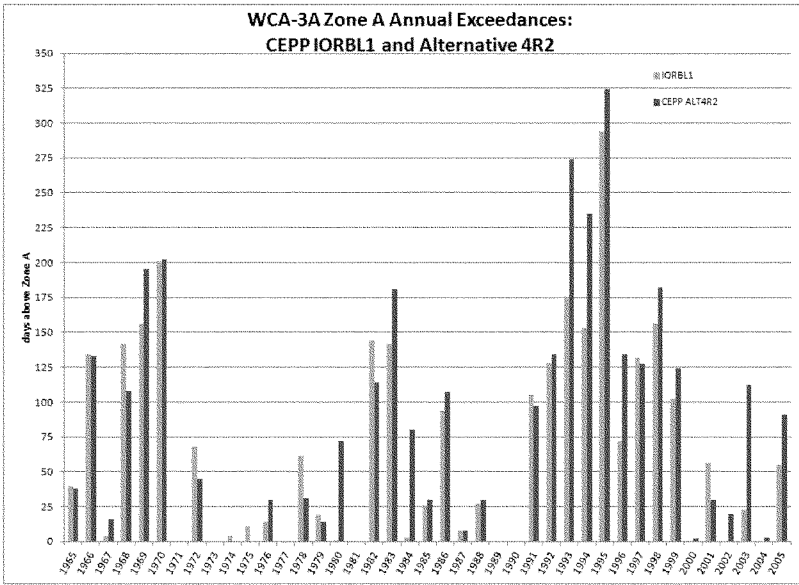

Figure B-41. WCA 3A Three-Gauge Average Annual Zone A Exceedance Summary

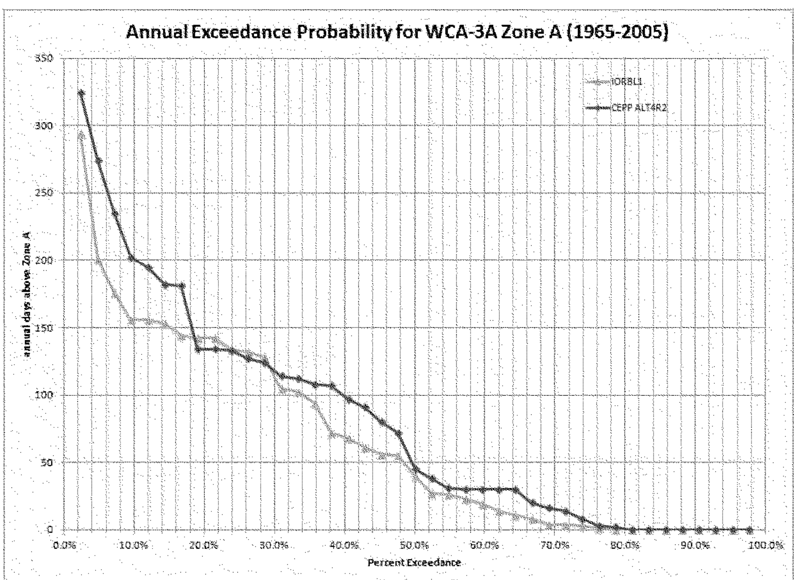

Figure B-42. WCA 3A Three-Gauge Average Probability Exceedance Curve for Annual Zone A Exceedance

The EN-W performance assessment for the final array of alternatives also included review of the WCA 3A stage hydrographs for individual years in which the number of days above Zone A increased by more than 20 percent between the CEPP FWO and any of the CEPP alternatives. Additional summary tables, annual hydrographs, and annual stage hydrograph statistical distribution plots are available in the CEPP PIR Engineering Appendix and the associated Hydrologic Modeling Annex A-2.

The detailed EN-W assessment of the frequency, duration, and peak stages of high water levels within WCA 3A concluded: 1) WCA 3A peak stages are lowered (these stages are most critical for WCA 3A design limitations); 2) the frequency and durations of Zone A exceedance are increased; 3) the increased frequency and durations occur during periods of the year when WCA 3A water levels are below peak critical levels; 4) CEPP infrastructure modifications (increased WCA 3A outlet capacity) and operations demonstrate that increased WCA 3A stages at the end of the dry season and start of the wet season can be effectively managed to avoid exacerbating high water conditions at the end of the wet season when Zone A levels off at 10.5 feet NGVD; and 5) CEPP infrastructure and operations utilized to achieve these performance levels need to be codified in the CEPP Project Operating Manual (POM). The requirements to maintain the frequency, duration, and peak stages of high water levels within WCA 3A consistent with the CEPP FWO (the IORBL1 performance is similar) were, therefore, successfully achieved based on EN-W assessment of the overall performance of the CEPP final array, including the Recommended Plan Alt 4R2.

Concurrent with CEPP alternative formulation and modeling efforts, EN-W conducted a review of WCA 3B high water levels compared to the WCA 3B design criteria and independent of any previous SPF stage considerations. WCA 3B is currently bounded by the L-29 Levee (Section 3) to the south, the L-67A Levee and the L-67C Levee to the west, and the L-30 Levee to the east; the design grades for these WCA 3B perimeter levees range between 13.0 feet NGVD for the L-29 Levee (note: typical sections range from 13.5-17.5 feet NGVD, due to subsequent stockpiling of spoil material from L-29 Canal improvements, and all L-29 Section 3 Levee sections meet or exceed the design grade) to 20.0 feet NGVD for the L-30 Levee (the design grades for the L-67A and L-67C Levees are 17.5 and 12.5 feet NGVD, respectively), such that the L-29 Levee design grade represents the limiting factor for peak WCA 3B stages for CEPP. Stage duration curves (upper 25%) for the CEPP ECB, CEPP FWO (the IORBL1 performance is similar), and Alt 4R2 are provided in the CEPP PIR Engineering Appendix for the two RSM-GL monitoring gage locations within WCA 3B at Site 71 and Shark-1 (also alternatively referred to as SRS-1) that are produced with the model standard output information; corresponding RSM-GL model GSE elevations for these gauges are 6.64 and 6.61 feet NGVD, respectively. For CEPP Alt 4R2, peak stages within WCA 3B (outside of the Blue Shanty Flow-way in Alt 4R2) were 9.25 and 9.24 feet NGVD at Site 71 and Shark-1, respectively, or approximately 0.15-0.20 feet greater than the CEPP ECB/FWO baselines (9.05-9.06 feet NGVD) and the IORBL1 (9.08 feet NGVD); however, the WCA 3B peak stages for the CEPP Recommended Plan remains approximately 3.75 feet below the L-29 Section 3 design grade of 13.0 feet NGVD. The SPF rainfall for WCA 3B is approximately 1.5 feet (17.5 inches; based on the localized 3-day, 100-year maximum rainfall event of 14 inches). Based on EN-W assessment of these WCA 3B peak water depths less than 3 feet (2.61-2.63 feet peak depth for Alt 4R2 stages), maximum wind and wave run-up potentials would not be expected to exceed 1-2 feet.

For this preliminary EN-W assessment of WCA 3B (further analysis will be conducted during PED), a presumed worst-case scenario was defined for the CEPP Recommended Plan, with peak Alt 4R2 stages exacerbated by the additional SPF rainfall and maximum wind and wave run-up depths. Under this assumed worst-case scenario (9.25 feet NGVD stage + 1.5 feet SPF rainfall + 2.0 feet run-up potential), the L-29 Section 3 Levee would not be expected to be overtopped at the two lowest elevation points (with approximately 0.25 feet of remaining freeboard, compared to the minimum L29 Section 3 Levee elevation of 13.0 feet NGVD). Given no predicted L-29 Section 3 Levee overtopping for this conservative assumed combination of events and recognition that CEPP inflows to WCA 3B (both within the Blue Shanty flow-way and eastern WCA 3B) will utilize controllable structures that may be closed in anticipation of extreme rainfall events, the EN-W preliminary assessment of the WCA 3B design criteria concluded that the proposed CEPP water levels of Alt 4R2 would not adversely affect the flood control capability of the unmodified eastern segment of the L-29 Levee (or other perimeter levees, which have higher design elevations) bordering WCA 3B. Within the Blue Shanty flow-way, the peak stage with Alt 4R2 is 9.70 feet NGVD. The proposed L-67D Levee, which has a preliminary design elevation of 12.0 feet NGVD based on engineering design considerations (refer to Appendix A for additional details), would prevent the relatively higher stages within the Blue Shanty flow-way from further raising stages within eastern WCA 3B. The USACE currently anticipates revisiting the WCA 3B SPF stage during PED, pending final authorization of the CEPP and the establishment of operating criteria for WCA 3B water management structures for a System Operating Manual revision for CEPP implementation.

B.3.2.5 Agricultural and Urban Areas Located East of the East Coast Protective Levees

For the agricultural and urban areas located east of the East Coast Protective Levees (L-31N and L-31W), the RSM-GL has no capability to precisely measure flood control on individual fields or during relatively short events, but the RSM-GL can be used as a coarse-scale tool to indicate a potential change in flood risk. Using the 1983 to 1993 stage duration curve data from the RSM-GL calibration and verification, the percentage of time the stage is above the root zone can be calculated and the information can be used to give an indication that additional flood control evaluation in the vicinity of a particular RSM-GL cell(s) may be needed. Six gauges or cells were evaluated consistent with RECOVER performance measure. Of the six RSM-GL cells compared to the 1983–1993 calibration data (**Figure B-2**), the without project condition (IORBL1), and the existing condition baselines (2012EC and ECB), only one cell has stages that warrant detailed attention: cell 4328, located between the C-103 and C-113 Canals and immediately east of the C-111 Canal. For the other five indicator cells (**Figure B-2**), stages in the with project condition (Alt 4R2) are either the same or below the 1983-1993 calibration data, IORBL1, and 2012EC, or groundwater stages are more than two feet below ground at levels that would not affect crops. The stage duration curve for indicator cell 4328 (**Figure B-43**) for the with project condition (Alt 4R2) is essentially the same as the without project condition (IORBL1) during the wettest hydrologic conditions, up to the 20th percentile, with stages approximately 0.5 feet above the calibration values. Stages for cell 4328 are only slightly higher, by approximately 4 inches, between the 5th and 15th percentile when comparing the with project condition (Alt 4R2) to the existing condition baselines (2012EC and ECB). None of the simulated stages for the baselines or Alt 4R2 fall below the calibration data. Closer examination indicates that the stage is correlated to the adjacent C-111 Canal. In the RSM-GL model, final calibration of the Manning's coefficient (a roughness or resistance term) for the C-111 Canal resulted in selection of the maximum value (highest resistance) allowed under the calibration criteria. In general, selecting the extremes in the calibration range tends to lend less confidence in the results of the particular calibration parameter and, in this specific case, it is likely an indication that the C-111 Canal Manning's coefficient parameter was insensitive to conditions observed during the calibration period. Since the model performs well for the existing condition (2012EC) but shows high canal stages in the upstream reaches for the IORBL1 and Alt 4R2, the calibrated roughness coefficient is likely too high and the resulting upstream canal stages (and adjacent groundwater levels) are predicted higher by the RSM-GL than would be truly expected for the future with project conditions. This artifact of the model can only be addressed during model calibration and, in this specific case, should not be evaluated as representative of the predicted project performance.

Comparison of the regional groundwater stage difference maps for the IORBL1 and Alt 4R2 simulation results can identify where systemically higher groundwater levels, which may adversely impact flood protection, may occur. The October 1995 map was selected to determine if the CEPP project affected groundwater levels when regional ground water levels are most likely to rise. The month of October typically has the highest rainfall of the year, and 1995 is one of years with the highest wet season rainfall in the period of simulation. The with project condition (Alt 4R2) and the without project conditions (IORBL1) were compared. The 1995 regional water levels are generally maintained (grey shading) or flood protection slightly improved (lower levels – white and yellow shading) for LECSA 2 and LECSA 3 (**Figure B-44**). With project (Alt 4R2) stages are increased by less than 0.25 feet for some areas east of the 8.5 SMA detention cell, the C-111 South Dade North Detention Area, and the C-111 South Detention Area, which are operating at higher stages for Alt 4R2 to manage increased seepage during this period. Localized changes observed in this area may be addressed through further operational refinements for the 8.5 SMA, S-331, and the C-111 detention areas during PED, possibly with some additional water also being routed to Biscayne Bay. The average October groundwater stage difference map for the complete period of simulation (1965–2005) indicates no significant changes within the urbanized LECSA 2 and LECSA3 for Alt 4R2, compared to the IORBL1 (**Figure B-45**). Stage increases of 0.15–0.25 feet are observed within the Pennsuco wetlands, and localized stage increases are indicated along C-1W as additional seepage flows are discharged via S-338 towards Biscayne Bay.

When comparing the with project condition (Alt 4R2) to the existing condition baselines (2012 EC and ECB) (**Figure B-46** and **Figure B-47**), stages near the Broward County Water Preserve Area Project in LECSA 2 increase consistent with that project's purpose. Groundwater stages east of Pennsuco in LECSA 3 decrease between 0.10 and 0.25 ft. Further south, in the vicinity of the SDCS within LECSA 3, groundwater stages increase between 0.1 and 0.5 ft when comparing Alt 4R2 to the 2012EC/ECB. This is consistent with the simulated higher seepage rates along L31N and L31W (**Table B-9**) and shows the effects of intervening projects assumed for the CEPP future without condition.

The stage duration curves for the LEC canals adjacent to WCA 3B and ENP and selected monitoring gauges throughout the LEC were also assessed as part of the Savings Clause flood protection evaluation. The stage duration curves for these canals and gauges do not indicate significant increased stages within the upper 10 percentile, which was assumed as a representative indicator of potential increased flood protection risk. Compared to the IORBL1 and the ECB/2012EC, L-30 Canal stages (north of S-335) for Alt 4R2 indicate a moderate reduction of 0.1-0.2 feet to flood control stages within the wettest 10 percent of hydrologic conditions, with no significant change observed for the upper 1 percent of the stage duration curve (**Figure B-48**). The L-31N Canal stages (north of G-211) indicate a significant (up to 1.0 feet) reduction to flood control stages within the wettest 5 percent of hydrologic conditions for Alt 4R2 (**Figure B-49**). C-111 Canal stages between S-176 and S-18C indicate no significant change for the upper 10 percent of the stage duration curve compared to the IORBL1, with a small stage reduction of 0.1 feet observed compared to the ECB (**Figure B-50**).

G-3439, a monitored well located along the C4 Canal, was also evaluated (**Figure B-51**). The with project condition (Alt 4R2) performs the same as the without project condition (IORBL1) during the highest 20 percent of the period of simulation. Comparison of the with project to the existing condition baselines (2012EC and ECB) shows the water stages slightly reduced with Alt 4R2.

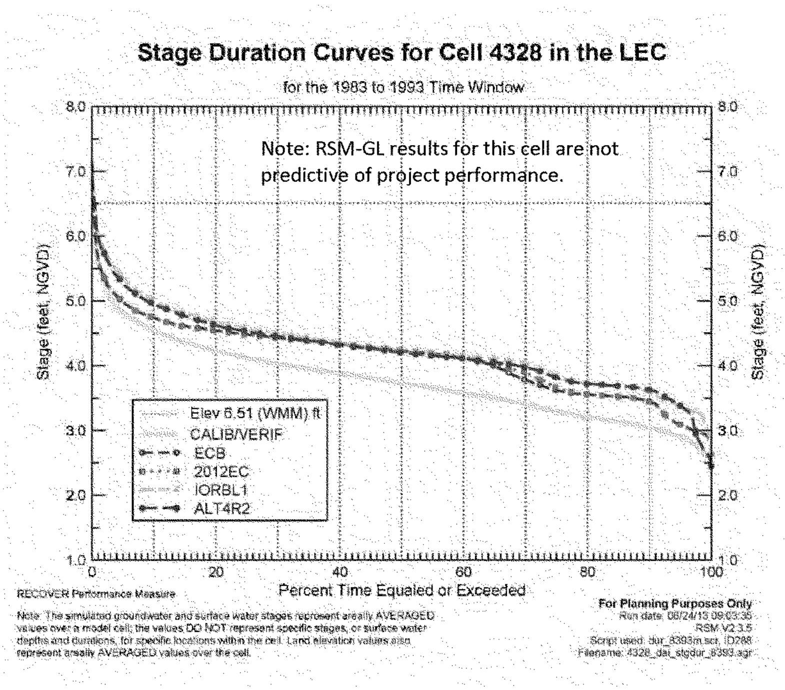

Figure B-43. Stage Duration Curves for Cell 4328 in the LEC showing anomalous results

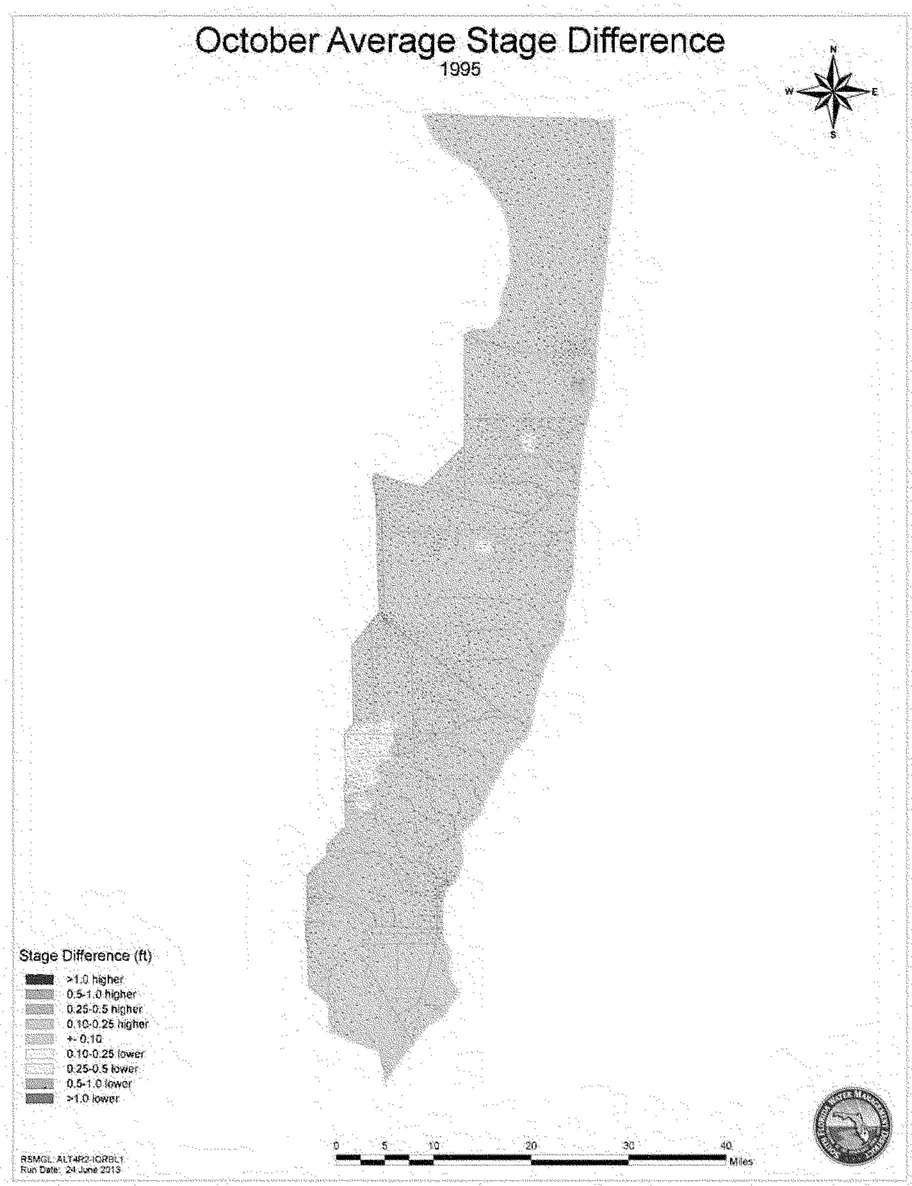

Figure B-44. October 1995 Average Stage Difference between Alt 4R2 and IORBL1

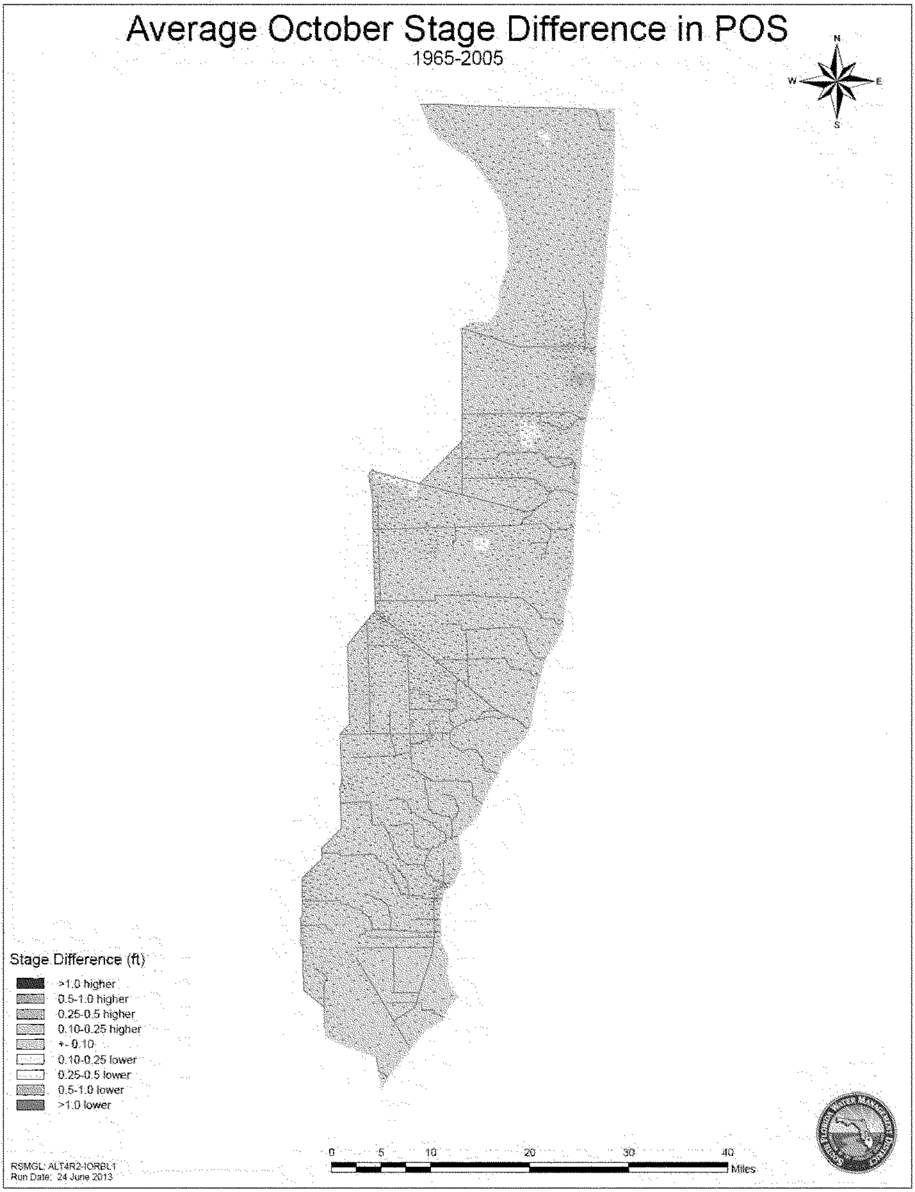

Figure B-45. Average October Stage Difference Map between Alt 4R2 and IORBL1 for 1965–2005

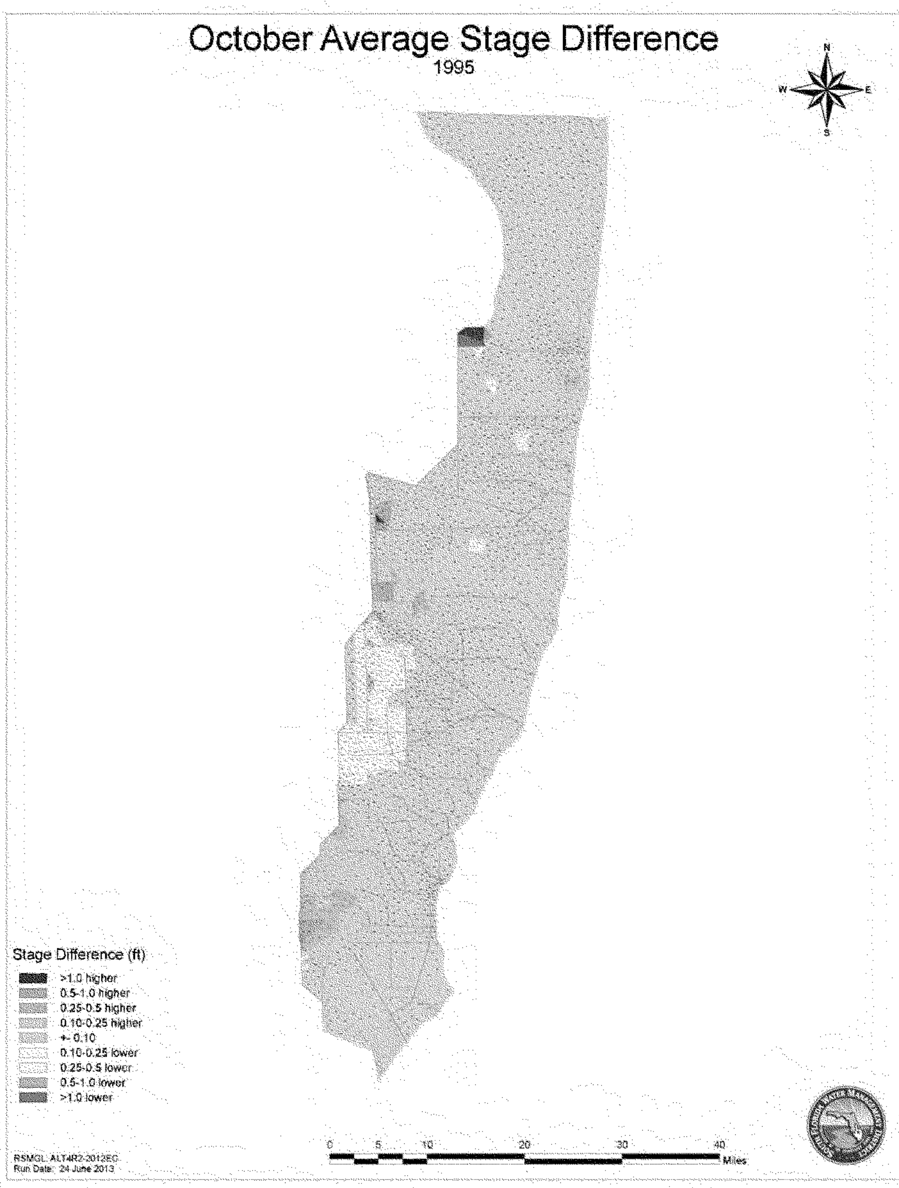

Figure B-46. October 1995 Average Stage Difference Map between Alt 4R2 and 2012EC

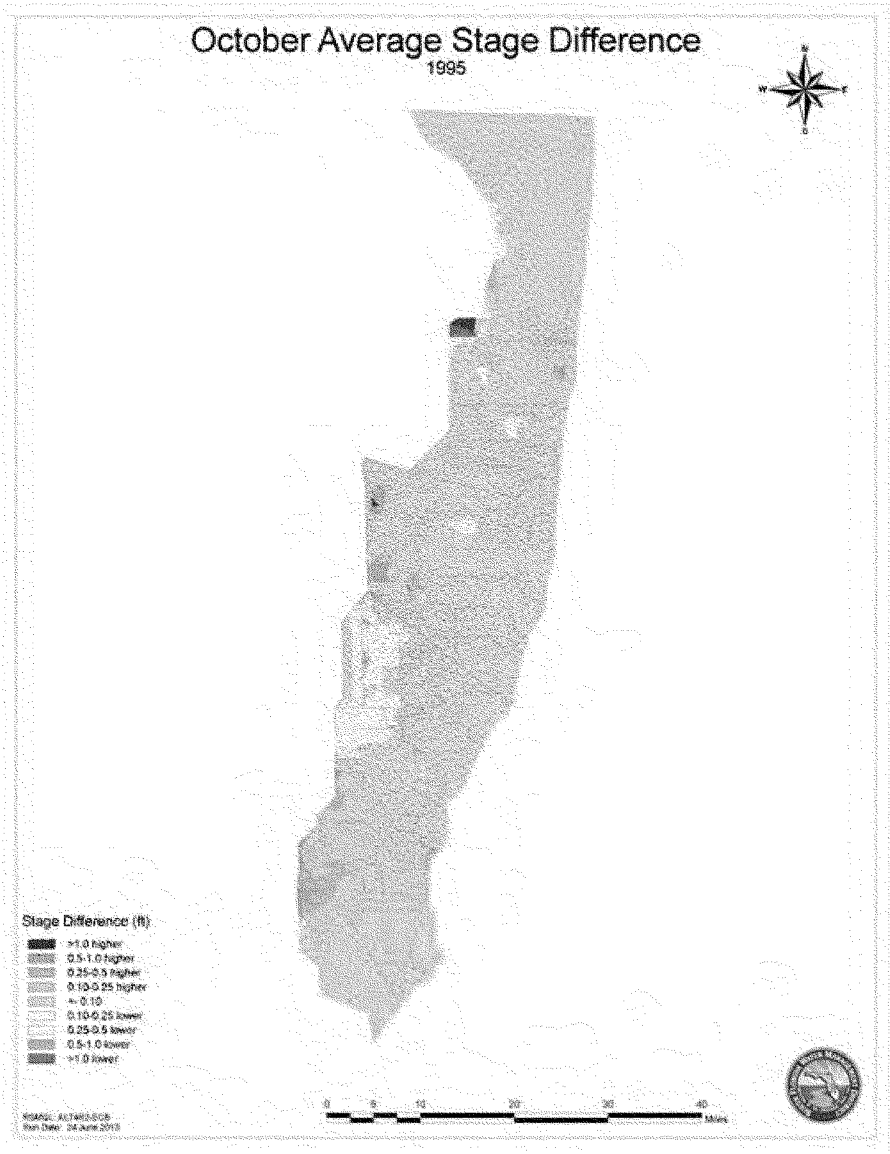

Figure B-47. October 1995 Average Stage Difference Map between Alt 4R2 and ECB

Table B-9. Groundwater Seepage under the East Coast Protective Levee to the LECSA 3

Seepage Direction	Levee Seepage from Marsh Cell (kAF)				
	ECB	2012EC	IORBL1	ALT4R	ALT4R2
L30 north of the bridge	218	215	211	203	201
L30 between S335 and the bridge	111	111	106	141	141
L30 south of S335	92	92	84	98	100
L31N north of G211	149	171	160	211	251
L31N from G211 to S331	29	29	30	28	28
L31N from S331 to S176	209	207	227	329	322
C111 from S176 to S177	98	107	201	217	214
C111 from S177 to S18C	29	30	44	49	47

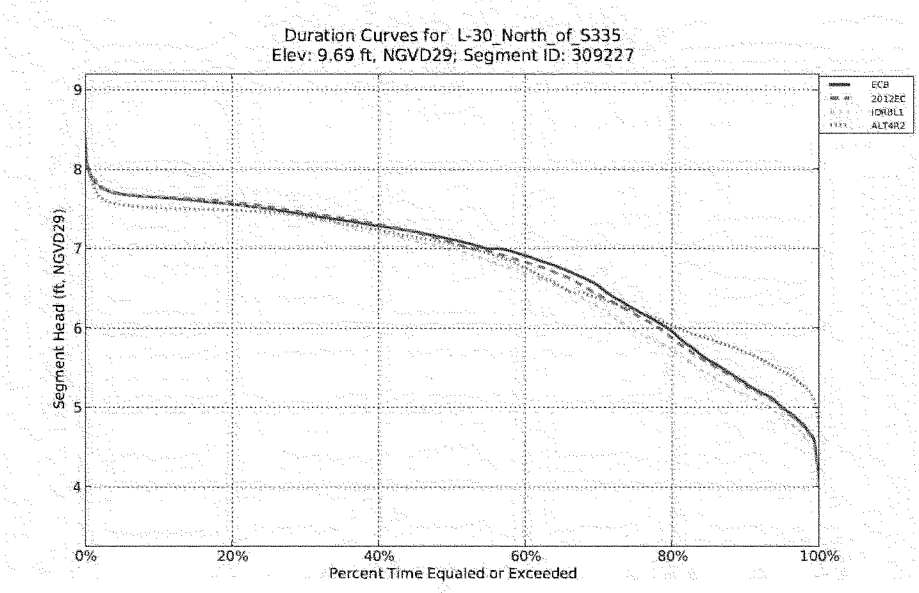

Figure B-48. Duration Curves for L-30 Canal, adjacent to WCA 3B

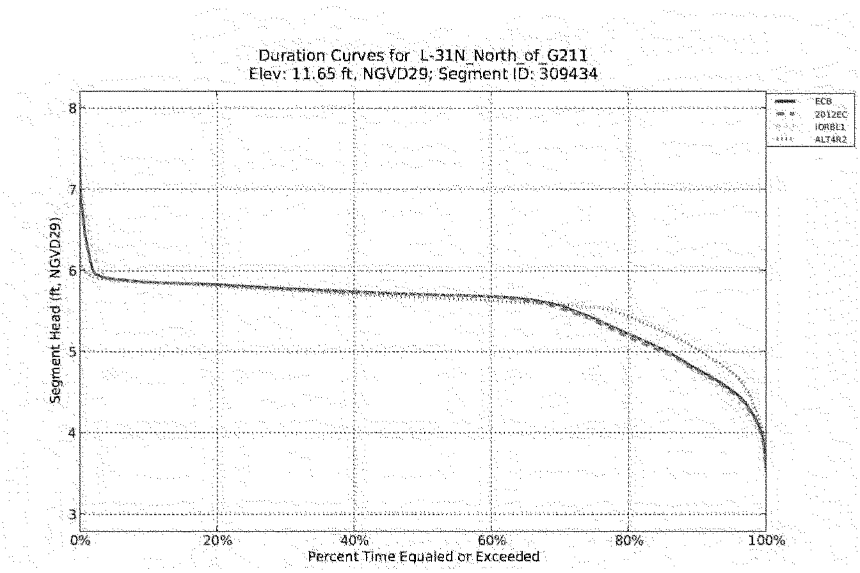

Figure B-49. Duration Curves for L-31 N Canal, Adjacent to Northern ENP

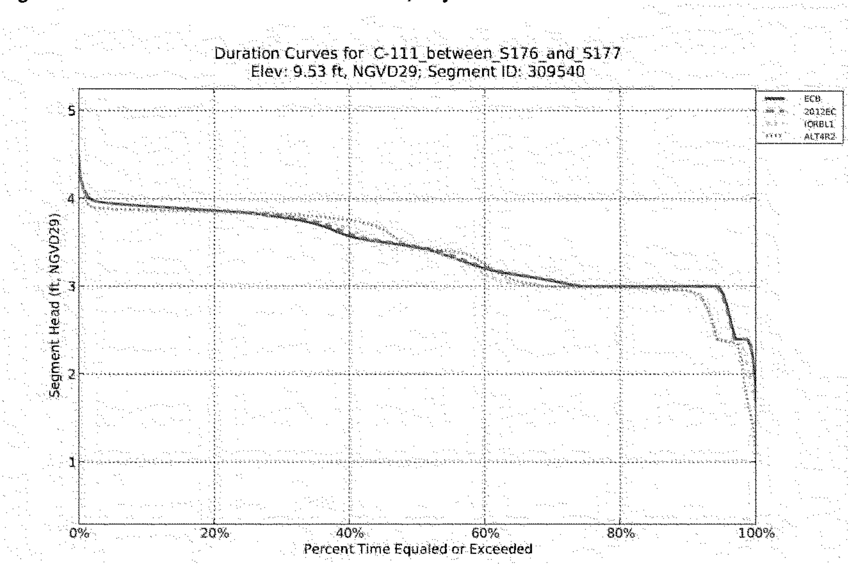

Figure B-50. Duration Curves for C-111 Canal, Adjacent to Southern ENP

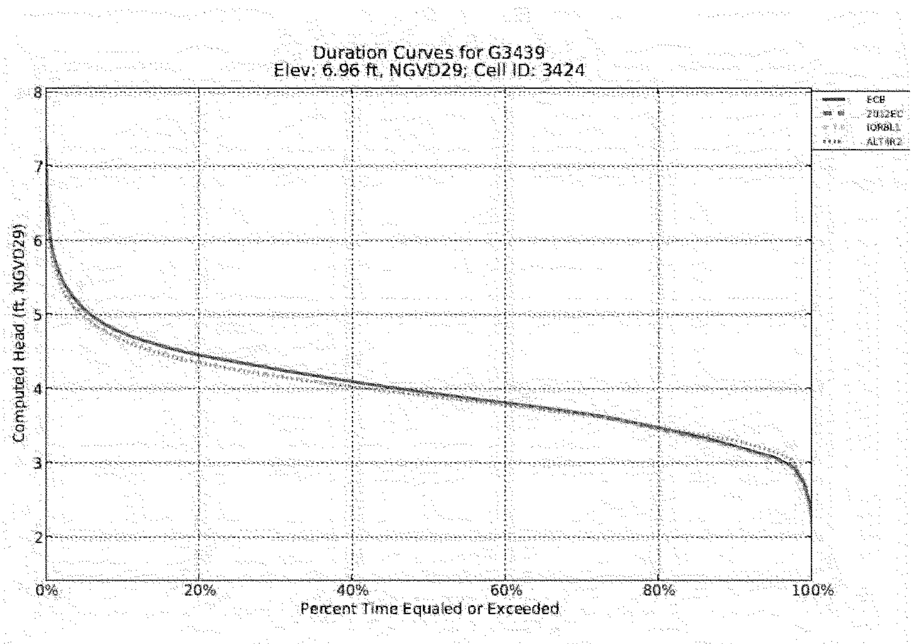

Figure B-51. Stage Duration Curves for G-3439

B.3.2.6 Seminole Tribe of Florida

CEPP deliveries to northern WCA 3A will benefit the Tribe's hunting, fishing, trapping and frogging rights (1987 Tribe and State of Florida Settlement Agreement) along the approximate 14,720 acres on the NW corner of the WCA 3A. As a result of reduced freshwater inflow and drainage by the Miami Canal, northern WCA 3A is currently dominated largely by mono-specific sawgrass stands and lacks the diversity of communities in central and portions of southern WCA 3A. Implementation of any of the CEPP action alternatives is expected to rehydrate much of northern WCA 3A by redistributing treated STA discharges from the L-4 and L-5 Canals north of WCA 3A in a manner that promotes sheetflow and by removing the drainage effects associated with the Miami Canal. Compared to the FWO, Alt 4R and Alt 4R2 stages immediately west of the L-28 Levee are increased by 0.1-0.2 feet under wet to normal hydrologic conditions and increased by 0.2-0.3 feet under normal to dry hydrologic conditions, with no significant change indicated for extreme wet or dry conditions. Stage increases are only observed for the RSM-GL cells located immediately west of the L-28 Levee, which correspond to the areas approximately 1-2 miles west of L-28. Average annual hydroperiods for the southernmost cells within the Seminole Tribe of Florida Big Cypress Reservation are increased by 10 to 60 days with Alt 4R and Alt 4R2 (FWO hydroperiods range from 25-150 days), with no significant hydroperiod changed indicated for the northernmost cells 2-3 miles south of L-4 (FWO hydroperiods range from 0-15 days) .

Resumption of sheetflow and related patterns of hydroperiod extension and increased water depths will significantly help to restore and sustain the micro-topography, directionality, and spatial extent of ridges and sloughs and improve the health of tree islands in the ridge and slough landscape. Although none of the alternatives would provide the necessary inundation pattern for complete slough vegetation restoration, all alternatives act to rehydrate northern WCA 3A, promoting peat accretion, reducing the potential for high intensity fires and promoting transition from upland to wetland vegetation.

B.3.2.7 Miccosukee Tribe of Indians of Florida

All of the CEPP alternatives show marked improvement in hydroperiod and hydropatterns in northwestern WCA 3A. Resumption of sheetflow and related patterns of hydroperiod extension and increased water depths will significantly help to restore and sustain the micro-topography, directionality, and spatial extent of ridges and sloughs and to improve the health of tree islands in the ridge and slough landscape. Although none of the alternatives would provide the necessary inundation pattern for complete slough vegetation restoration, all alternatives act to rehydrate northern WCA 3A, promoting peat accretion, reducing the potential for high intensity fires, and promoting transition from upland to wetland vegetation.

All CEPP alternatives result in similar patterns of rehydration within northern WCA 3A and all significantly decrease the amount of time when this region experiences dryout conditions. Gauge 3A-3 in northeastern WCA 3A, used to track droughts, indicates that with the FWO this area will continue to experience water levels below ground 25–30 percent of the time and that water depths will exceed three feet approximately 1–2 percent of the time. Tree islands are connected to the surrounding peat marshes via the roots of the trees. Although tree roots are still receiving water from wicking within the peat (unless the tree island is rocky), when the water table drops below these roots, the microclimate of these islands gets too dry and they can burn. All CEPP action alternatives create the hydrology necessary to restore tree islands and reduce the potential for devastating fires. Rehydration of northern WCA 3A is expected to prevent further tree island degradation and peat fires, and set in motion trends to restore ridge-slough-island patterns. With all CEPP action alternatives, northern WCA 3A will no longer have extremely short hydroperiods. Instead, this area will have more spatially uniform hydroperiods that vary between 120 and 240 days.

Compared to the FWO, Alt 4R2 stages immediately west of the L-28 Levee (north of I-75) are increased by 0.1-0.2 feet under wet to normal hydrologic conditions and increased by 0.2-0.3 feet under normal to dry hydrologic conditions, with no significant change indicated for extreme wet or dry conditions. Stage increases are only observed for the RSM-GL cells located immediately west of the L-28 Levee, which correspond to the areas approximately 1-2 miles west of L-28. Average annual hydroperiods for these cells within the Miccosukee Indian Reservation, north of Interstate 75, are increased by 10 to 60 days with Alt 4R2 (FWO hydroperiods range from 25-150 days), with no significant hydroperiod changed indicated for the 2-3 miles south of L-4 (FWO hydroperiods range from 0-15 days) .

Although Alt 4R2 does not include modifications to the L-28 Levee or the adjacent canal south of I-75, stages within the L-28 Triangle are slightly increased by 0.1-0.2 feet during nearly all hydrologic conditions, with no stage increases indicated during extreme wet hydrologic conditions, due to groundwater interactions with the down-gradient western WCA 3A marsh. Within central WCA 3A (3A-4), stages are generally increased by 0.1-0.2 feet during average to dry conditions with Alt 4R2, with a slight depth reduction during the wettest 10 percent of conditions and no significant change during extreme dry conditions. Southern WCA 3A (3A-28) stages for Alt 4R2 are decreased by 0.1-0.2 feet during the wettest 5 percent of conditions and slightly decreased during normal to dry conditions. This information has been provided to representatives of the Tribe through PDT meetings and additional individual meetings with representatives of the Tribe.

For Alt 4R2, WCA 3B stages at Site 71 are increased under all hydrologic conditions, including stage increases of 0.1 feet during the upper 20 percent of the stage duration curve, stage increases of 0.2-0.3 feet for normal to dry conditions, and a slight stage increase during extreme dry conditions. The peak stage within the Blue Shanty flow-way is 9.70 feet NGVD and stages exceed 8.0 feet NGVD for approximately 45 percent of the period of simulation.

Compared to the FWO, Alt 4R2 stages within northwest ENP are generally significantly decreased by 0.1-0.3 feet under both wet and dry hydrologic conditions; stages are slightly increased or unchanged from the FWO for normal hydrologic conditions between approximately 35 percent and 55 percent on the stage duration curve. To the south and west, the NP-205 monitoring gage indicates a potentially significant stage decrease of 0.1-0.2 feet under all hydrologic conditions for all alternatives, compared to the FWO (**Figure B-52**).

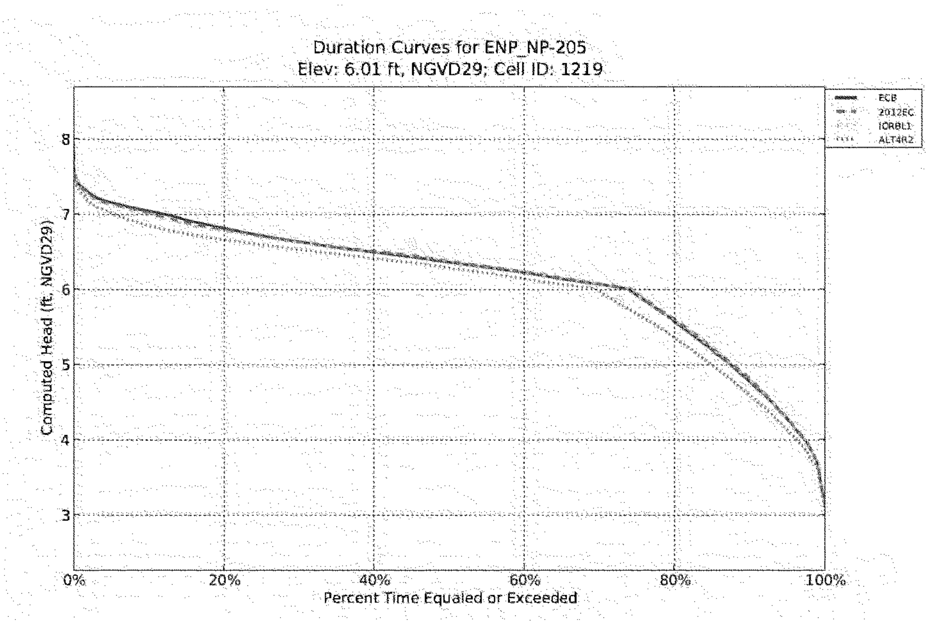

Figure B-52. Stage Duration Curves for ENP NP-205

B.3.3 Project Assurances – Identification of Water Made Available by the Project

The total water and the water made available for the natural system and other-water related needs are quantified when all project features are constructed and the project is expected to be operational as identified in the with project condition, Alt 4R2. The pre-project water expected to be available when the project is operational is represented by IORBL1.

B.3.3.1 Natural System

The total water available for the natural system with the CEPP project is represented by the with project condition, Alt 4R2. The pre-project water in the system, including the other CERP projects assumed in place prior to CEPP implementation, is represented by the IORBL1 model simulation. The difference between these two conditions, which is computed for each water year within the RSM period of simulation, represents the water made available by the project (Alt 4R2 minus IORBL1). To follow the habitat unit benefits calculated during plan formulation, three spatial locations were selected: the inflows to WCA 3 (along the formulation redline), inflows to ENP, and overland flows to Florida Bay. These specified locations represent the inflows to the three basins where ecosystem benefits (habitat units) are expected as a result of implementation of the recommended plan. Surface water inflows along the redline to WCA 3A correspond to the sum of structure inflows from the S-8 pump station to the Miami Canal within WCA 3A, the S-150 gated culvert, and STA-5/STA-6 outflows to northwest WCA 3A for the ECB, 2012EC, and IORBL1 base conditions; for Alt 4R2, the combined flows from the S-8 pump station discharges to the Miami Canal and discharges to the S-8A gated culvert (which diverts water to the L-4 Levee degrade gap) are included in addition to S-150 and STA-5/STA-6 outflows to WCA 3A. Quantification of flows into WCA 3 can be found in **Figure B-53**.

Inflows to ENP are quantified for the S-12s (A-D), S-333, the S-355s (A&B), S-345 (F&G; Alt 4R2 only) and S-356 (Alt 4R2 only). Quantification of flows into ENP can be found in **Figure B-54.** Overland flows to Florida Bay are quantified for RSM-GL Transect 23 (southeast ENP; transects 23-A, 23-B, and 23-C combined) and Transect 27 (Central Shark River Slough) (**Figure B-55** and **Figure B-56**).

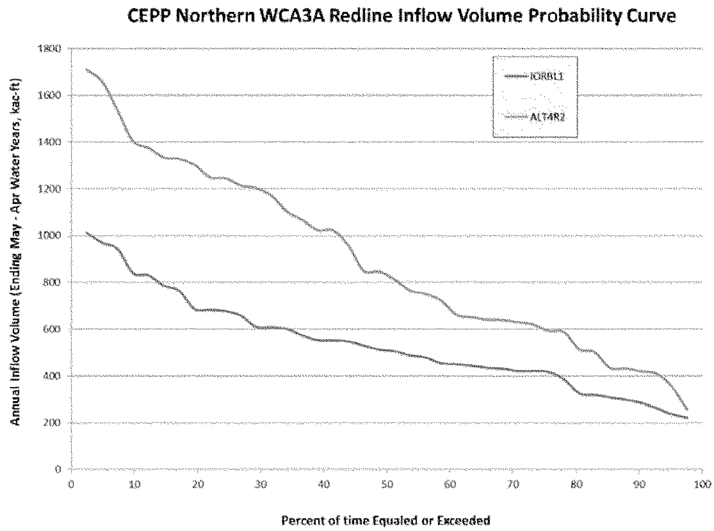

Figure B-53. CEPP Northern WCA 3A Redline Inflow Volume Probability Curve for IORBL1 and Alt 4R2

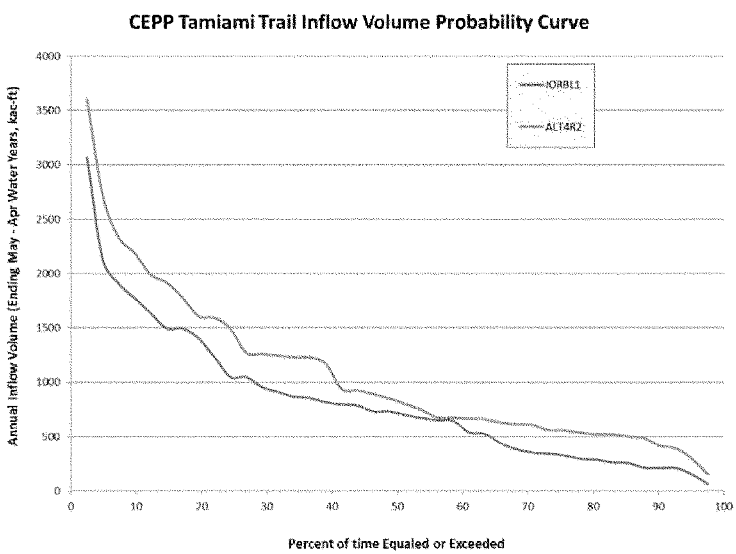

Figure B-54. CEPP Tamiami Trail Inflow Volume Probability Curve for IORBL1 and Alt 4R2

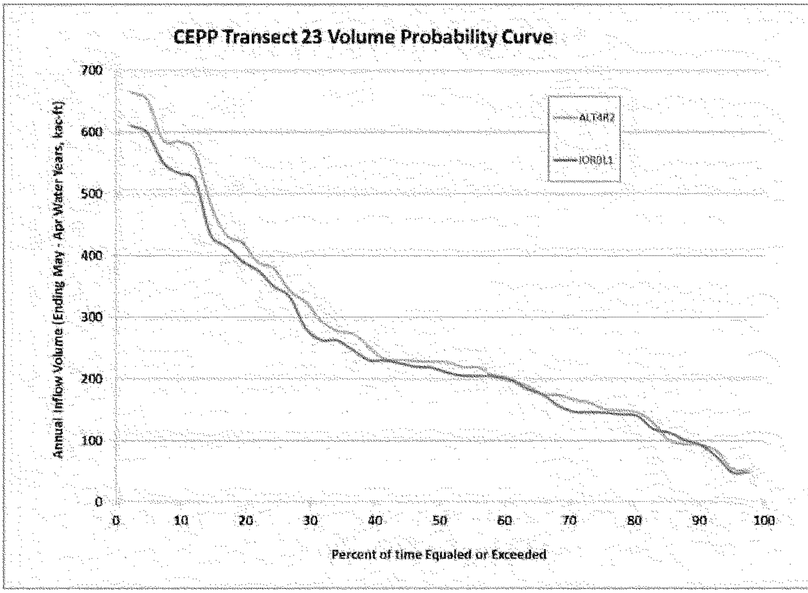

Figure B-55. CEPP Transect 23 Volume Probability Curve

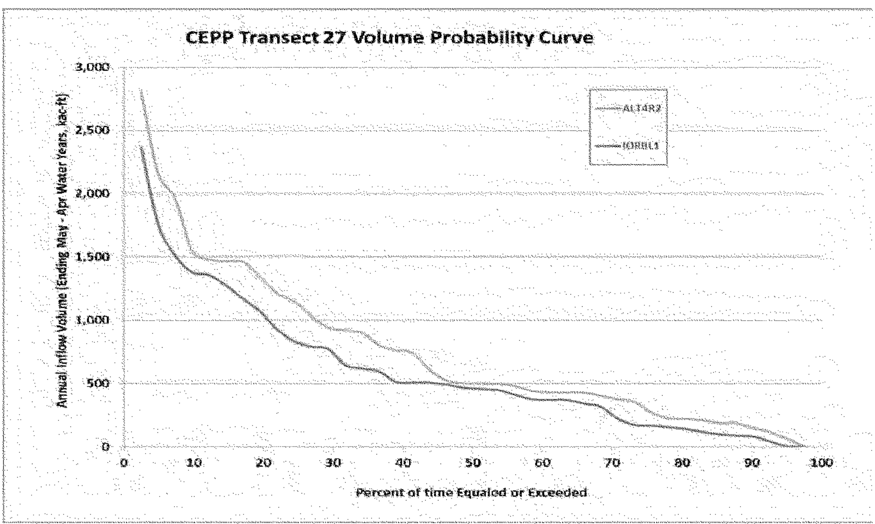

Figure B-56. CEPP Transect 27 Volume Probability Curve

B.3.3.2 Water for Other Water Related Needs

The CEPP components do not directly provide water to meet other water-related needs in LOSA, LECSA 2, or LECSA 3. By virtue of additional water being stored in Lake Okeechobee, additional water may reach water users located in LOSA; however, the level of service for LOSA water supply has not improved, nor has it been degraded by CEPP. Therefore, no water was quantified for other water related needs in the LOSA for this project.

For LECSA, additional water has been made available by the project for municipal, industrial, and agricultural users in the regional system and has been quantified for LECSA 2 and LECSA 3. An increased demand of 12 million gallons per day (MGD) in LECSA 2 and 5 MGD in LECSA 3 was included in Alt 4R2 above the demands in the initial operating regime baseline (IORBL1); the public water supply demands assumed for the IORBL1 are also equivalent to the demands assumed for the ECB and 2012EC existing condition baselines (on average, 277 MGD in LECSA 2 and 412 MGD in LECSA 3). This increase in demands for other water related needs (4 percent for LECSA 2; 1 percent for LECSA 3) could be met without affecting the benefits accrued in the natural system.

B.4 Conclusions

B.4.1 Savings Clause - Elimination or Transfer of Existing Legal Sources of Water

The recommended plan would decrease high volume freshwater discharges from Lake Okeechobee that are currently sent to the Northern Estuaries. Additional water from Lake Okeechobee would be sent southward through the canals of the EAA to the A-2 FEB. The A-2 FEB would provide storage capacity, attenuation of high flows, and limited pre-treatment prior to delivery of the redirected water to existing STAs, which would reduce phosphorus concentrations in the water to meet required water quality standards. The treated water would be distributed across the northwestern boundary of WCA 3A to flow through and help restore more natural quantity, timing, and distribution of water to WCA 3A, WCA 3B, ENP, and Florida Bay.

With implementation of the recommended plan, sources of water to meet agricultural and urban demand in the LOSA and LECSAs will continue to be met by their current sources, primarily Lake Okeechobee, the Everglades (including the WCAs), surface water in the regional canal network, and the surficial aquifer system. Sources of water for the Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida are influenced by the regional water management system (C&SF Project, including Lake Okeechobee); however, these sources will not be affected by the CEPP project. In addition, water supplies to ENP with implementation of the recommended plan exceed future without project and existing condition baseline volumes. Water sources for fish and wildlife located in the Northern Estuaries, WCA 2, WCA 3, Biscayne Bay, and Florida Bay will not be diminished. Therefore, as a result of the CEPP project, there will be no elimination or transfer of existing legal sources of water supply for the following:

- Agricultural or urban water supply in the LECSA
- Allocation or entitlement to the Seminole Tribe of Florida under Section 7 of the Seminole Indian Land Claims Settlement Act of 1987 (25 U.S.C. 1772e)
- The Miccosukee Tribe of Indians of Florida
- Water supply for ENP
- Water supply for fish and wildlife

Some of the water utilized by agricultural users in the LOSA from Lake Okeechobee will be transferred to WCA 3 and further south as a result of the implementation of the recommended plan. This transfer is anticipated to occur after the modification of the Lake Okeechobee Regulation Schedule that will allow full utilization of the CEPP A-2 FEB. The recommended plan has identified an additional source of water of comparable quantity and quality that will be available to replace the water sent south. Instead of discharging all water stored in the reservoir to tide via the S-80 or to meet C-44 Basin agricultural water supply demands, as assumed in the future without project IORBL1 baseline condition operations, the recommended plan retains a portion of the water stored in the CERP IRL-S C-44 Reservoir/STA in the regional system for backflow to Lake Okeechobee via the C-44 Canal and raises the Lake Okeechobee stage criteria to allow increased C-44 Canal backflow. This added operation does not affect existing permitted allocations within the C-44 Basin. The additional C-44 Canal backflow operations to Lake Okeechobee included in the CEPP recommended plan improves the ability to meet existing permitted demands in the LOSA by retaining more water in the regional system and making it available to agricultural users. The operations do not benefit agricultural users in the C-23 Basin. The CEPP recommended plan backflow operations capture a portion of releases from the C-44 Reservoir/STA that would otherwise be directed to the Saint Lucie Estuary as excess water.

Specifically, the future without project condition (IORBL1) allows backflow to Lake Okeechobee from the C-44 Canal when S-308 (the Lake Okeechobee discharge structure to the C-44 Canal) is not open for regulatory discharges and when the stage in Lake Okeechobee is 0.25 feet below the base of the 2008 LORS low sub-band (within the baseflow sub-band), which varies between 13.0 and 14.5 feet NGVD seasonally. This operational assumption is consistent with the existing operational protocols of Lake Okeechobee (2008 LORS) and the SFWMD Lake Okeechobee Water Shortage Management (LOWSM) operations. Discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are otherwise limited to environmental deliveries for the St. Lucie Estuary and C-44 Basin agricultural water supply demands during these backflow operations.

The CEPP recommended plan operations expand on the IORBL1 backflow to Lake Okeechobee through the following operational changes: 1) backflow to Lake Okeechobee from the C-44 Canal is allowed when S-308 is not open for regulatory discharge and the stage in Lake Okeechobee is below 14.5 feet NGVD (no seasonal variability); and 2) discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are made when the stage in Lake Okeechobee is below the baseflow zone of the 2008 LORS schedule (the bottom of this zone varies seasonally between 12.6 and 13.0 feet NGVD) to provide an additional source of backflow water to Lake Okeechobee. Water captured in the C-44 Reservoir/STA, includes excess water conveyed from the C-23 Canal and Basin (approximately 6 kAF on an average annual basis) that is not needed to meet the IRL-S North Fork water reservation target. The recommended plan operational changes result in an average annual increase in C-44 Canal backflow volume to Lake Okeechobee of 57.3 kAF (97.3 kAF in the recommended plan, compared to 40.0 kAF in the IORBL1) and an average annual increase in C-44 Reservoir discharges to the C-44 Canal of 21.3 kAF (37.6 kAF in the recommended plan, compared to 16.3 kAF in the IORBL1).

The transfer of water from Lake Okeechobee to WCA 3 would not be implemented until the CERP C-44 Reservoir/STA, the canal connecting the C-44 Reservoir to both the C-23 Basin and the C-23 Canal, and the CEPP FEB on the EAA A-2 site are operational. If the canal to the C-23 Basin and the C-23 Canal is not operational when the CEPP FEB on the EAA A-2 site is ready to store water, the operations, and ultimately the delivery of water from Lake Okeechobee to the CEPP FEB, may need to be modified to avoid elimination of this portion of the source of water for the LOSA. The water retained in Lake Okeechobee also maintains the level of service for water supply for existing legal users dependent on

Lake Okeechobee and its connected conveyance system. Specifically, this includes the agricultural users in the LOSA and the Seminole Tribe of Florida.

B.4.2 Savings Clause – Flood Protection

Implementation of the project will not reduce the levels of service for flood protection within the areas affected by the project, including LOSA, EAA, LECSA 2, and LECSA 3. However, one area in the South Dade Conveyance System, specifically located adjacent to C-111 Canal (RSM-GL cell 4328), has shown increased stages relative to the existing base conditions simulated in the RSM (refer to Section B.3.2.5 for additional discussion). Since the model performs well for the existing condition (2012EC), but shows high canal stages in the upstream reaches for the IORBL1 and ALT 4R2, the calibrated roughness coefficient is likely too high and the resulting upstream canal stages (and adjacent groundwater levels) are predicted higher than would be truly expected for the future conditions. This artifact of the model can only be addressed during model calibration, and in this specific case should not be evaluated as representative of the predicted project performance.

Implementation of the project will not reduce the levels of service for flood protection within the areas affected by the project including the Seminole Tribe of Florida's Big Cypress Reservation. Implementation of the project will not reduce the levels of service for flood protection within the areas affected by the project including the Miccosukee Tribe of Indians of Florida's reservations and resort.

The CEPP recommended plan maintains the pre-project flood protection level of service for the EAA by providing the same total pumping capacity at the S-8 (4,170 cfs) and S-7 (2,490 cfs) pump stations, which provide drainage for the upstream EAA basin. CEPP will maintain this existing design capacity for the S-8 complex through a combination of pump station design modifications, a new hydraulic connection from S-8 to the degraded L-4 Levee, utilization of the existing G-404 pump station (570 cfs design capacity), and leaving the 1-2 mile segment of the Miami Canal as available getaway conveyance capacity during peak flow events. Modifications of the S-8 pump station complex for CEPP operations will be further analyzed during the PED phase of CEPP, including further confirmation that CEPP construction and implementation sequences will not adversely impact the pre-project level of service for flood protection within the EAA.

The USACE did not identify opportunities for increased flood protection as part of the CEPP formulation.

B.4.3 Project Assurances - Identifying Water for the Natural System

The identification of water for the natural system captures the quantity, timing, and distribution of water. Hydrologic model data extracted from the RSM-GL simulations were used to develop the volume probability curves at three specified locations in the regional system: inflows to WCA 3 (along the formulation redline), inflows to ENP, and overland flows to Florida Bay. These specified locations represent the inflows to the three basins where ecosystem benefits (habitat units) are expected as a result of implementation of the recommended plan. Specifically, the volumes of water at the 10th, 50th, and 90th percentiles are identified and compared for the pre-project (future without) condition and the recommended plan (future with project) conditions. The pre-project available water (IORBL1), the with project total water available (Alt 4R2), and the water made available by the project (differences between Alt 4R2 and IORBL1, which were computed for each water year within the RSM period of simulation) for the natural system can be found in **Table B-10** through **Table B-12**.

The water made available by the project to WCA 3 (quantified at the redline), ENP (quantified at Tamiami Trail), and Florida Bay (quantified for the total combined flows at Transect 23 and Transect 27) is displayed as a volume probability curve in **Figure B-57**. Compared to the without project condition (IORBL1), inflows to WCA 3 are higher for the with project condition (Alt 4R2) during all 40 water years analyzed with the CEPP hydrologic modeling. Similarly, based on the CEPP methodology applied to identify water for the natural system, the with project inflows to ENP are higher than the future without project inflows during 37 of 40 water years (93 percent), and the with project inflows to Florida Bay are higher than or equivalent to the future without project inflows during 36 of 40 water years (90 percent). The total accumulated volume of the net reductions in water year inflows to ENP and Florida Bay during the 3 or 4 water years with net inflow reductions observed for the with project condition compared to the without project condition (water years 1977, 2002, and 2003 for ENP inflows; water years 1977, 1979, 2002, and 2003 for Florida Bay inflows) corresponds to only approximately 1.0 and 2.5 percent, respectively, of the total accumulated volume of net increased inflows to ENP and Florida Bay during all of the other remaining water years which provide a net increase in inflow volumes to these locations.

Table B-10. Pre-Project Volume of Water (kAF/yr) Available for the Natural System

Pre-Project Water Available for the Natural System (IORBL1)			
Location	*Water Available equaled or exceeded 10% of Water Years (kAF)*	*Water Available equaled or exceeded 50% of Water Years (kAF)*	*Water Available equaled or exceeded 90% of Water Years (kAF)*
WCA 3	839	513	286
ENP	1,771	732	212
Florida Bay	1,969	704	218

Table B-11. Total Volume of Water (kAF/yr) Available for the Natural System

Total Water Available for the Natural System (Alt 4R2)			
Location	*Water Available equaled or exceeded 10% of Water Years (kAF)*	*Water Available equaled or exceeded 50% of Water Years (kAF)*	*Water Available equaled or exceeded 90% of Water Years (kAF)*
WCA 3	1,404	846	420
ENP	2,187	850	419
Florida Bay	2,113	729	287

Table B-12. Water Made Available by the Project (kAF/yr) for the Natural System

Water Made Available by the Project (difference between Alt 4R2 and IORBL1)			
Location	*Water Made Available equaled or exceeded 10% of Water Years (kAF)*	*Water Made Available equaled or exceeded 50% of Water Years (kAF)*	*Water Made Available equaled or exceeded 90% of Water Years (kAF)*
WCA 3	647	357	97
ENP	534	256	37
Florida Bay	418	137	-13

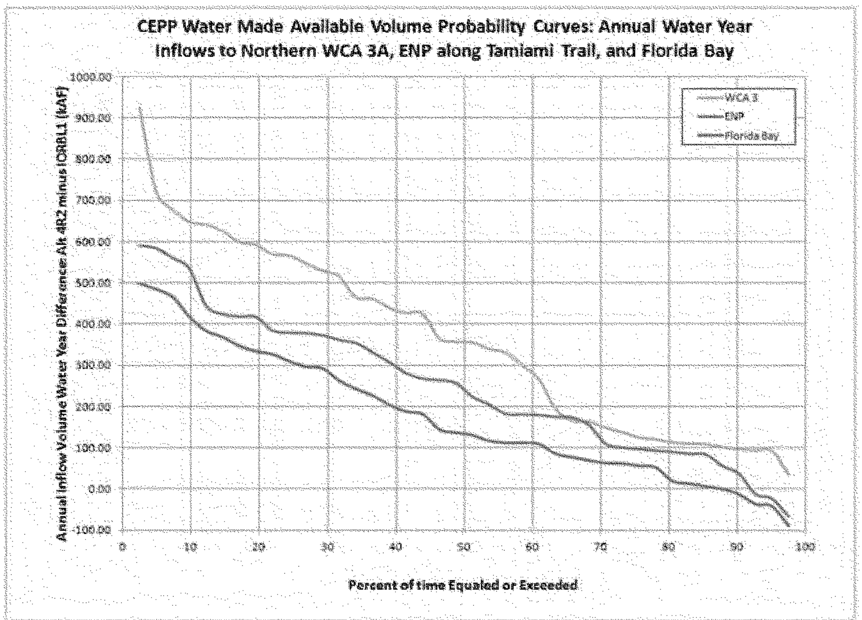

Figure B-57. CEPP Water Made Available Volume Probability Curves for WCA 3, ENP, and Florida Bay

B.4.3.1 Water to be Reserved or Allocated for the Natural System

As required by Section 601(h)(4)(A) of the of the WRDA 2000 and Section 385.35 of the Programmatic Regulations for the Implementation of CERP, the water made available by the project will be protected using the State of Florida's reservation or allocation authority under state law as in represented by **Table B-12**. The SFWMD has protected the pre-project water for the natural system in the Holeyland and Rotenberger Wildlife Management Areas; WCA 1, WCA 2A, WCA 2B, WCA 3A, and WCA 3B; and ENP through the Restricted Allocation Area Rule for the Everglades and North Palm Beach/Loxahatchee River Watershed water bodies. Refer to Section 3.2.1 of the SFWMD's Basis of Review for Water Use Permit Applications (2012) for additional information. The combination of protecting the pre-project water and protecting the water made available by the CEPP project features is necessary for the CEPP to achieve its intended benefits.

The SFWMD will protect the water made available by the CEPP project features using its reservation or allocation authority as required by 373.470, Florida Statutes (F.S.). Protection of water made available by CEPP project features is required in order for the SFWMD and the Department of the Army to enter into one or more Project Partnership Agreements to construct the CEPP project features.

B.4.4 Project Assurances – Identifying Water Made Available for Other Water Related Needs

The ability of the CEPP project features to provide water to meet other water related needs in the LOSA, LECSA 2, and LECSA 3 was analyzed for the recommended plan. Based on the analysis, the level of service for the LOSA water supply has not improved, nor has it been degraded by CEPP (refer to **Section B.2.3** and **Section B.3**) Therefore, no water was quantified for other water related needs in the LOSA. However, by virtue of additional water being stored in Lake Okeechobee, additional water may reach water users located in the LOSA.

Additional water available for allocation to consumptive use permit applicants is expected to be generated by CEPP in LECSA 2 and LECSA 3 for municipal, industrial, and agricultural users. The specific locations, volumes, and/or timing of where this water will be available for withdrawal in LECSA 2 and LECSA 3 will be developed when the following, project-related conditions are met: 1) completion of all CEPP project features and 2) upon a formal determination by the SFWMD's Governing Board that these project features are operational consistent with requirements of the appropriate CEPP PPA. The following steps must be complete prior to this determination: 1) CEPP project authorization by Congress; 2) appropriation of federal and state funding; 3) Project Partnership Agreement(s) for construction of CEPP features; 4) construction of CEPP features; and 5) operational testing and monitoring of CEPP features. Water will be allocated in accordance with the requirements of the SFWMD's consumptive use permitting rules in effect at that time. Other future state or federal initiatives may make additional water available for consumptive use in addition to this CERP increment. Potential consumptive use permit applicants may, at their discretion, evaluate whether or not this additionally available water is a suitable source to meet their needs.

B.4.5 Incremental Analysis during Plan Implementation

The Recommended Plan is composed of implementation phases that include the construction of a recommended plan feature or logical groupings of recommended plan features, agreed upon by the USACE and SFWMD, that maximize benefits to the extent practicable consistent with project dependencies and the Adaptive Management and Monitoring Plan. These implementation phases will achieve incremental hydrologic and environmental benefits. CEPP will be designed and constructed in phases, with each construction phase containing one or more implementation phases as described in **Section 6** of the PIR main report. The approach incorporates the adaptive management process, maximizing the opportunity to realize incremental restoration benefits by initially building features that utilize pre-project available water in the system which meets State water quality standards. The USACE and the SFWMD will select particular implementation phases and the sequence of project features to maximize benefits to the extent practicable and consistent with the Adaptive Management and Monitoring Plan (See Annex D). The Corps and the District will undertake updated project assurances and Savings Clause analyses for the implementation phases that are selected to be included in a Project Partnership Agreement (PPA) or amendment thereto prior to entering into the PPA or PPA amendment.

For the CEPP PIR, the analyses for CEPP associated with Section 601(h)(4) and 601 (h)(5) of WRDA 2000 and the Programmatic Regulations for the CERP (33 CFR Part 385) for Project-Specific Assurances and Savings Clause were conducted for the CEPP recommended plan. The USACE and the SFWMD will undertake updated project assurances and Savings Clause analyses, if necessary, for the implementation phases that are selected to be included in a PPA or amendment thereto prior to entering into the PPA or PPA amendment. The USACE District Engineer will ensure that Project-Specific Assurances and Savings Clause requirements are met per PPA, per applicable policies and laws. NEPA Documentation will be updated, if applicable, as revisions are made to Water Control Plans and/or Project Operating Manuals associated with each PPA. Compliance with the requirements of the Savings Clause will be maintained throughout the entirety of the CEPP implementation period.

B.4.6 Project Assurances Commitments for All CERP Projects

The overarching objective of the CERP (referred to as simply the "Plan" in WRDA 2000 and the Programmatic Regulations) is the restoration, preservation, and protection of the South Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection. The federal government and the State of Florida are committed to the protection of the appropriate quantity, quality, timing, and distribution of water to achieve and maintain the benefits to the natural system described in CERP. As envisioned in WRDA 2000 and the Programmatic Regulations, each PIR will identify this appropriate quantity, quality, timing, and distribution of water for the natural system.

The following language sets forth these commitments:

> *The overarching objective of the Plan is the restoration, preservation, and protection of the South Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection. The Federal Government and the non-Federal sponsor are committed to the protection of the appropriate quantity, quality, timing, and distribution of water to ensure the restoration, preservation, and protection of the natural system as defined in WRDA 2000, for so long as the project remains authorized. This quantity, quality, timing, and distribution of water shall meet applicable water quality standards and be consistent with the natural system restoration goals and purposes of CERP, as the Plan is defined in the programmatic regulations. The non-Federal sponsor will protect the water for the natural system by taking the following actions to achieve the overarching natural system objectives of the Plan:*
>
> *1. Ensure, through appropriate and legally enforceable means under Federal law, that the quantity, quality, timing, and distribution of existing water that the Federal Government and the non-Federal sponsor have determined in this Project Implementation Report is available to the natural system, will be available at the time the Project PartnershipAgreement for the project is executed and will remain available for so long as the Project remains authorized.*
>
> *2a. Prior to the execution of the Project Partnership Agreement, reserve or allocate for the natural system the necessary amount of water that will be made available by the project that the Federal Government and the non-Federal sponsor have determined in this Project Implementation Report.*
>
> *2b. After the Project Partnership Agreement is signed and the project becomes operational, make such revisions under Florida law to this reservation or allocation of water that the Federal Government and the non-Federal sponsor determines, as a result of changed circumstances or new information, is beneficial for the natural system.*
>
> *3. For so long as the Project remains authorized, notify and consult with the Secretary of the Army should any revision in the reservation of water or other legally*

enforceable means of protecting water be proposed by the non-Federal sponsor, so that the Federal Government can assure itself that the changed reservation or legally enforceable means of protecting water conform with the non-Federal sponsor's commitments under paragraphs 1 and 2. Any change to a reservation or allocation of water made available by the project shall require an amendment to the Project Partnership Agreement

B.5 State Compliance Report

CENTRAL AND SOUTHERN FLORIDA PROJECT
COMPREHENSIVE EVERGLADES RESTORATION PLAN

Central Everglades Planning Project

State Compliance Report
Section 373.1501, Florida Statutes

Annex B-87

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Figures

1 Overview of Section 373.1501, Florida Statutes Requirements

Section 373.1501, Florida Statues (F.S.) requires the Florida Department of Environmental Protection (FDEP) to ensure that the South Florida Water Management District, as local sponsor for the Comprehensive Everglades Restoration Plan (CERP), evaluate whether each CERP project has considered all state water resource issues and is technologically feasible and cost effective. The required evaluations include analysis of water resource issues, project feasibility, consistency with state and federal laws, project assurances, and utility and public infrastructure coordination. This report, along with the additional detail provided in the Project Implementation Report (PIR), provides the information necessary for FDEP to determine that the South Florida Water Management District (SFWMD) has conducted the necessary evaluations as set forth in Subsection 373.1501(5), F.S.

1.1 Introduction

The Central Everglades Planning Project (CEPP) is encompassed in CERP, which was approved by Congress as a framework for the restoration of the natural system under Section 601 of the Water Resources Development Act of 2000 (WRDA 2000). CERP, including CEPP, intends to achieve more natural flows by re-directing flows that are currently discharged to tide, to a more restored flow of water that is distributed throughout the system similar to pre-drainage conditions. A fundamental objective of CERP was to increase water management flexibility to meet water needs of the Everglades. The purpose of CEPP is to improve the quantity, quality, timing, and distribution of water flows to the central Everglades (Water Conservation Area 3 [WCA 3] and Everglades National Park [ENP]).

The CEPP study recommends six components of the CERP:

- Everglades Agricultural Storage Reservoirs (Component G)
- WCA 3 Decompartmentalization and Sheetflow Enhancement (Components AA and QQ)
- S-356 Pump Station Modifications (Component FF)
- L-31 N Improvements for Seepage Management (Component V)
- System-Wide Operational Changes – Everglades Rain-Driven Operations (Component H)
- Flow to Northwest and Central WCA 3A (Component II)

1.1.1 Study Area

The study area for the CEPP encompasses the Northern Estuaries (St. Lucie River and Indian River Lagoon and the Caloosahatchee River and Estuary), Lake Okeechobee, the Everglades Agricultural Area (EAA), the Water Conservation Areas (specifically WCAs 2 and 3); ENP, the Southern Estuaries (specifically focused on Florida Bay), and portions of the Lower East Coast (LEC). Adjacent areas were also evaluated. For purposes of this study, the term Greater Everglades is defined as the region encompassing WCA 3 and ENP. A map of the CEPP study area is provided in Figure 1-1 with a description of the study area regions provided in Table 1-1.

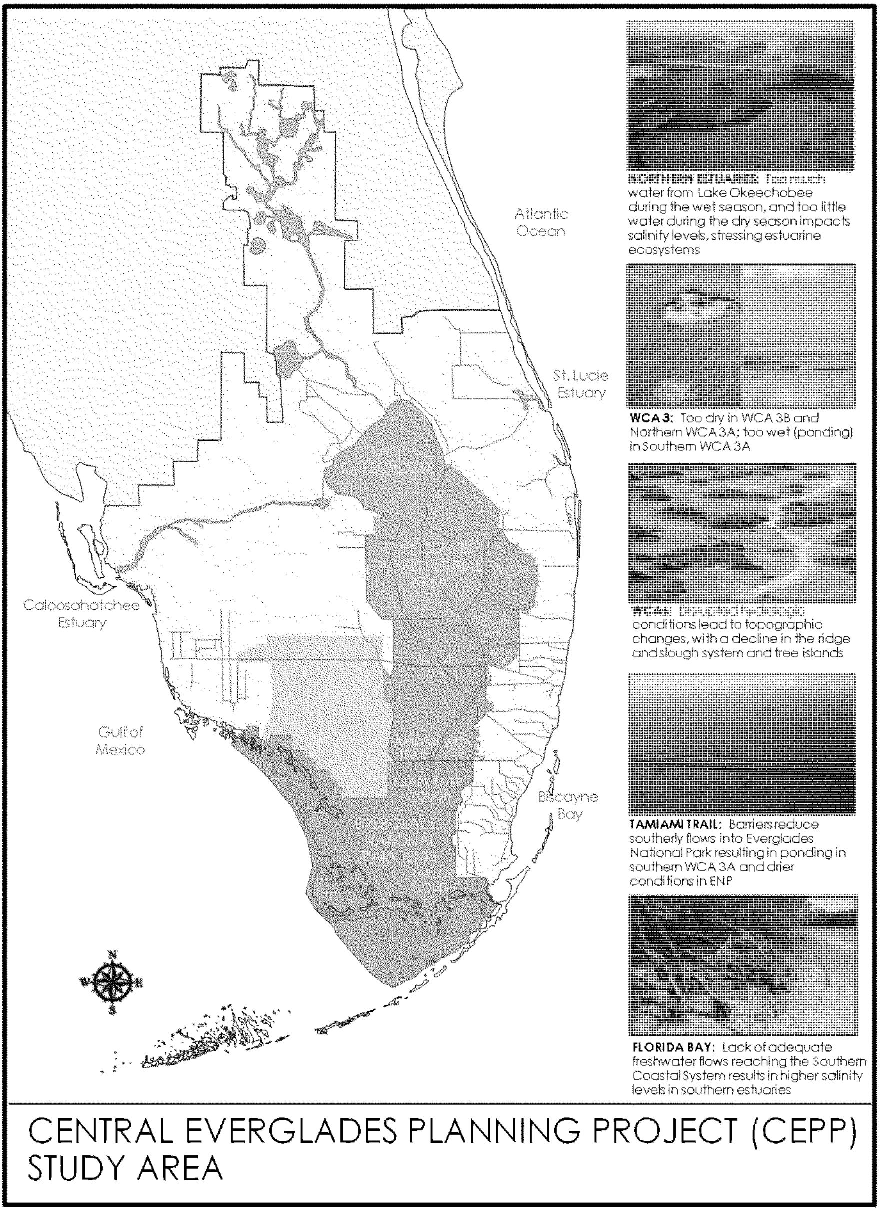

Figure 1-1 - Map of Study Area

Table 1-1 Description of the CEPP Study Area

CEPP Study Area Region	Description of the Study Area Region
Lake Okeechobee	Lake Okeechobee is a large, shallow lake (surface area 730 square miles) 30 miles west of the Atlantic coast and 60 miles east of the Gulf of Mexico. It is impounded by a system of levees, with 6 outlets: St. Lucie Canal eastward to the Atlantic Ocean, Caloosahatchee Canal/River westward to the Gulf of Mexico, and four agricultural canals (West Palm Beach, Hillsboro, North New River and Miami). The lake is surrounded by the 143 mile long Herbert Hoover Dike. The lake has many functions, including flood risk management, urban and agricultural water supply, navigation, recreation, fisheries, and wildlife habitat. It is critical for flood control during wet seasons and water supply during dry seasons. Agriculture in the Lake Okeechobee Service Area (LOSA), including the EAA, is the predominate user of lake water. The lake is an economic driver for both the surrounding areas' and south Florida's economy.
Northern Estuaries	Lake Okeechobee discharges into the 2 Northern Estuaries. The St. Lucie Canal flows eastward into the St. Lucie Estuary, which is part of the larger Indian River Lagoon Estuary. The Caloosahatchee Canal/River flows westward into the Caloosahatchee Estuary and San Carlos Bay, which are part of the larger Charlotte Harbor Estuary. The St. Lucie and Caloosahatchee estuaries are designated Estuaries of National Significance, and the larger Indian River Lagoon and Charlotte Harbor estuaries are part of the U.S. Environmental Protection Agency (USEPA)-sponsored National Estuary Program. The landscape includes pine-flatwoods, wetlands, mangrove forests, submerged aquatic vegetation, estuarine benthic areas (mud and sand) and near-shore reefs.
Everglades Agricultural Area	The EAA is approximately 630,000 acres in size and is immediately south of Lake Okeechobee. Much of this rich, fertile land is devoted to sugarcane production, and is crossed by a network of canals that are strictly maintained to manage water supply and flood protection. The landscape includes natural and man-made areas of open water such as canals, ditches, and ponds, wetlands, and lands associated with agricultural and urban use. Within the EAA there is approximately 45,000 acres of stormwater treatment areas (STAs) and the Holey Land and Rotenberg Wildlife Management Areas.
Water Conservation Areas	WCA 2 and, WCA 3 (the largest of the three) are situated southeast of the EAA and are approximately 1,328 square miles. The WCAs extend from EAA to ENP. They provide floodwater retention, water supply for urban and agricultural uses, and are the headwaters of ENP. The landscape includes open water sloughs, sawgrass marshes, and tree islands.
Everglades National Park	ENP was established in 1947, covering ~2,353 square miles (total elevation changes of only 6 feet from its northern boundary at Tamiami Trail south to include much of Florida Bay). The landscape includes sawgrass sloughs, tropical hardwood hammocks, mangrove forest, lakes, ponds, and bays.
Florida Bay	Florida Bay is a shallow estuarine system (average depth less than 3 feet) comprising a large portion of ENP. It is the main receiving water of the greater Everglades, heavily influenced by changes in timing, distribution, and quantity of freshwater flows into the Southern Estuaries. The landscape includes saline emergent wetlands, seagrass beds, and mangrove forests.
Lower East Coast	The LEC encompasses Palm Beach, Broward, Monroe and Miami-Dade Counties. Water levels in this area are highly controlled by the C&SF water management system to provide flood damage reduction and sufficient water supply to minimize the risk of detrimental saltwater intrusion. Biscayne Bay and the contiguous water bodies of Card, Little Card, and Barnes Sounds and Manatee Bay lie along the southeastern mainland boundary of the LEC and receive their freshwater supplies as inflows of surface and groundwater that are dependent on water table stages east of L-31 N. The CEPP is focused on the portions of the LEC adjacent to the natural areas that are susceptible to seepage.

1.1.2 Project Objectives

Section 601(h) of WRDA 2000 states "[t]*he overarching objective of the Plan is the restoration, preservation, and protection of the South Florida Ecosystem while providing for other water-related needs of the region, including water supply and flood protection*". These same objectives apply to the CEPP study efforts (Table 1-2).

Table 1-2 Goals and Objectives of CERP and CEPP

CERP Goal: Enhance Ecological Values	
CERP Objective	**CEPP Objective**
Increase the total spatial extent of natural areas	No corresponding CEPP objective; consider this objective in future increments
Improve habitat and functional quality	Restore seasonal hydroperiods and freshwater distribution to support a natural mosaic of wetland and upland habitat in the Everglades System
	Improve sheetflow patterns and surface water depths and durations in the Everglades system in order to reduce soil subsidence, the frequency of damaging peat fires, the decline of tree islands, and salt water intrusion
	Reduce high volume discharges from Lake Okeechobee to improve the quality of oyster and SAV habitat in the northern estuaries
Improve native plant and animal species abundance and diversity	Reduce water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization
	Restore more natural water level responses to rainfall to promote plant and animal diversity and habitat function
CERP Goal: Enhance Economic Values and Social Well Being	
Increase availability of fresh water (agricultural/municipal & industrial)	Increase availability of water supply
Reduce flood damages (agricultural/urban)	No corresponding CEPP objective; consider this objective in future increments
Provide recreational and navigation opportunities	Provide recreational opportunities
Protect cultural and archeological resources and values	Protect cultural and archeological resources and values

1.1.3 Project Features

The components of the Recommended Plan, Alternative 4R2, are organized into four geographic areas: North of the Redline, South of the Redline, the Green/Blue lines and along the Yellowline (**Figure 1-1**).

North of Redline

- A-2 Flow Equalization Basin (14,000 acres), including exterior and internal levees
  - Seepage Pump Station (500 cubic feet per second [cfs])
  - Water Control Structures (culverts, spillway)
  - Emergency Overflow Weir
  - Canals (inflow, seepage collection, internal collection, and discharge)

South of Redline
- L-6 Canal Flow Diversion
- L-5 Canal Conveyance Improvements
- S-8 Pump Station Complex Modifications
- L-4 Levee Degrade (approximately 2.9 miles) and Pump Station (360 cfs)
- Miami Canal Backfill (approximately 13.5 miles from 1.5 miles south of S-8 to Interstate 75)

Blueline/Greenline
- S-333 Spillway Modification (1,150 cfs gated spillway adjacent to S-333; 2,500 cfs total)
- L-29 Canal Gated Spillway (1,230 cfs)
- L-67A Conveyance Structures (three, 500 cfs)
- L-67C Levee Gap (6,000 feet)
- L-67C Levee Degrade (approximately 8 miles)
- Blue Shanty Levee, WCA-3B (approximately 8.5 miles)
- L-29 Levee Degrade (4.3 mi, within Blue Shanty Flow-way)
- L-67 Extension Levee Degrade and Canal Backfill (approximately 5.5 miles)
- Old Tamiami Trail Removal (~ 6 miles)

Yellowline
- S-356 Pump Station Modifications (increase to 1,000 cfs)
- Seepage Barrier, L-31N Levee (approximately 4.2 miles)
- System-wide Operations Refinements

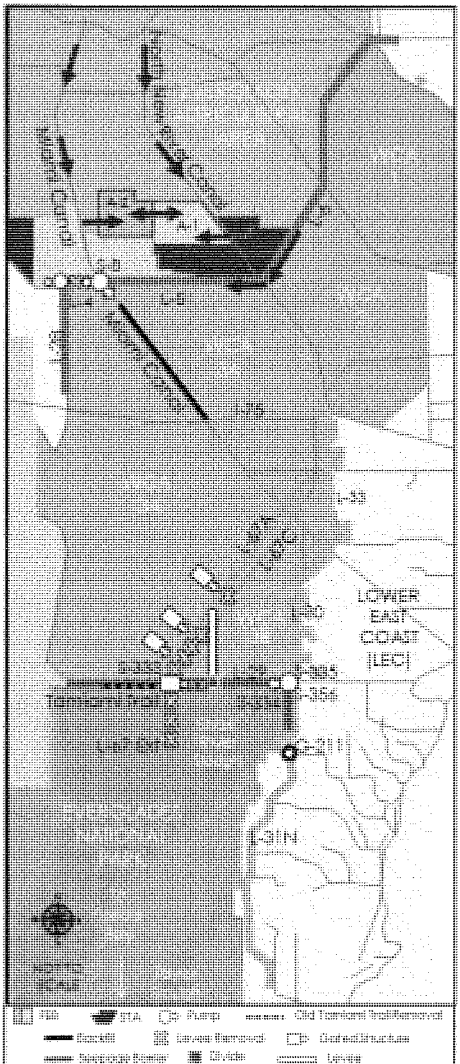

Figure 1-2 - CEPP Project Features

1.2 State Authority for CERP Projects

The Florida Legislature authorized the SFWMD to act as local sponsor for CERP projects. Section 373.1501, F.S. requires the SFWMD, for each CERP project, to analyze and evaluate whether all needs are being met in a comprehensive manner, to consider all applicable state water resource issues and to determine if it is technologically feasible and cost effective. Specifically, SFWMD must evaluate the following:

1. Water Resource Issues - water supply, water quality, flood protection, threatened and endangered species and other natural system and habitat needs (Paragraph 373.1501(5)(a), F.S.)
2. Project Feasibility - determine, with reasonable certainty, project feasibility based upon standard engineering practices, cost effectiveness, consistency with CERP purposes and implementation of other CERP projects, and operations (Paragraph 373.1501(5)(b), F.S.)
3. Consistency with state and federal laws - determine, with reasonable certainty, that each CERP project is consistent with applicable laws and can be permitted and operated as proposed (Paragraph 373.1501(5)(c), F.S.)
4. Project Assurances - Provide reasonable assurances that the quantity of water available to existing legal users shall not be diminished by a CERP project 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; and that water management practice will continue to adapt to me the needs of the restored natural environment (Paragraph 373.1501(5)(d), F.S.)
5. Utility and Public Infrastructure Coordination - Coordinate with existing utilities and public infrastructure or minimize impacts to the relocation of existing public infrastructure and utilities (Paragraph 373.1501(5)(e), F.S.)

The FDEP has oversight to ensure that SFWMD has conducted these required evaluations (Subsection 373.1501(4), F.S.) and these evaluations are necessary for FDEP to approve each CERP project in order for the project to receive state funds and be submitted to Congress for authorization, Paragraph 373.026(8)(b), F.S. The FDEP is required to approve each CERP project following the formal submittal of the project by the SFWMD to FDEP.

In addition, Paragraph 373.470(3)(c), F.S. requires the SFWMD, in cooperation with the U.S. Army Corps of Engineers (USACE), to complete a Project Implementation Report that identifies the increase in water supplies resulting from each CERP project, which shall be allocated or reserved by SFWMD. FDEP is also required to issue Comprehensive Everglades Restoration Plan Regulation Act permits for construction and operation of each CERP project, Section 373.1502, F.S.

1.3 Relationship to Other USACE/Non-Federal Sponsor Efforts, Studies, Documents and Reports

Listed below are brief descriptions of other key projects related to the Central Everglades Planning Project. Included in the description are the objectives and/or study area.

1.3.1 Restoration Strategies Regional Water Quality Final Plan

In 2012, the State of Florida and the U.S. Environmental Protection Agency reached a consensus on new strategies for improving water quality in America's Everglades. Under these strategies, the South Florida Water Management District is implementing a technical plan to complete several projects that will create more than 6,500 acres of new stormwater treatment areas (STAs) and 116,000 acre-feet of additional water storage through construction of flow equalization basins (FEBs). The *Restoration Strategies Regional Water Quality Final Plan* is required to meet a numeric discharge limit for phosphorus, called a Water Quality Based Effluent Limitation (WQBEL). The WQBEL is contained in the NPDES permit for existing flows and discharges from the stormwater treatment areas (STAs) into the Everglades Protection Area (EPA). The projects have been divided into three flow paths (Eastern, Central and Western), which are delineated by the source basins that are tributary to the existing Everglades STAs. The identified projects primarily consist of flow equalization basins (FEBs), STA expansions, and associated infrastructure and conveyance improvements. The primary purpose of the FEBs are to attenuate peak stormwater flows prior to delivery to STAs and provide dry season benefits, while the primary purpose of STAs is to utilize biological processes to reduce phosphorus concentrations in order to achieve the WQBEL. The Central Flow Path contains STA-2, and STA-3/4. The Central flowpath also includes an FEB with approximately 60 thousand acre-feet kAF of storage that will attenuate peak flows to STA-3/4, and STA-2. Based on the CEPP project objectives, only the Central Flow Path features are included in the CEPP modeling representation of the future without project conditions (FWO). The FEB located within the Central Flow Path will be located on the A-1 Talisman site.

1.3.2 Operations at Southern WCA 3A, ENP and the South Dade Conveyance System

The 2006 Interim Operational Plan for Protection of the Cape Sable seaside sparrow (IOP) was the governing regulation schedule for the project area at the start of the CEPP planning process. The current approved operational plan for southern WCA 3A, ENP, and the South Dade Conveyance System (SDCS) as of October 2012 is known as the Everglades Restoration Transition Plan (ERTP). It superseded the 2006 IOP and is intended to be a transitional plan to be used until completion of the final operational plan that was to be developed as part of the Modified Water Deliveries (MWD) and Canal 111 South Dade Projects. The final operational plan for these two projects has not yet been developed.

1.3.3 Modified Water Deliveries Project

The Modified Water Deliveries Project includes authorized improvements for structural modifications and additions to the existing C&SF Project required to enable water deliveries for the restoration of more natural hydrologic conditions in ENP. Together, these improvements would enable the re-establishment of the historic Shark River Slough flow-way from WCA 3A through WCA 3B to ENP.

1.3.4 Tamiami Trail Modifications: Next Steps Project

The Department of the Interior, through the National Park Service and Everglades National Park, completed a study to restore more natural water flow that would be in addition to the

MWD project. The Tamiami Trail Modifications Next Steps (TTMNS) approved plan called for 5.5 miles of bridging, which would be in addition to the 1-mile bridge authorized by MWD and completed in March 2013. The remaining unbridged roadway would be elevated to allow a design high water stage of 9.7 feet NGVD in the L-29 borrow canal. This road height would allow all predicted future stage increases envisioned by CERP without damage to the road.

1.3.5 Partial Seepage Barrier Near the L-31N Levee

As mitigation for a Section 404 permit, the Miami-Dade Limestone Products Association (Association) constructed a 1,000 foot long, 18 foot deep slurry wall to reduce seepage between ENP and rock mine properties to the east of ENP. In July 2012, the Association completed construction of a 2 mile long, 35 foot deep seepage wall in this same location south of Tamiami Trail. Although results appear promising, further analysis for CEPP is necessary to determine the extent to which the 2 mile long, 35 foot deep seepage wall will reduce seepage to the east, or whether the Association will construct an additional wall if tests determine the current wall is ineffective. The association also may construct an additional 5 miles of seepage wall south of the 2-mile seepage wall if permitted. Since the capability of the seepage wall to mitigate seepage losses is under ongoing analysis, CEPP will not include any length and depth of seepage wall in the FWO project condition. The CEPP alternative plans will have to identify and develop the total amount and types of seepage management needed for the volume and distribution of water that the plans would deliver from WCA 3B and/or ENP. It is unknown at this time whether the slurry wall will effectively reduce seepage to the east, or whether the Association will need to do additional work in the area to manage seepage.

1.3.6 Biscayne Bay Costal Wetlands Project

The CERP Biscayne Bay Coastal Wetlands Project provides the restoration, protection, and preservation of the water resources of central and south Biscayne Bay. The project consists of three integrated sub-components: Deering Estate, Cutler Flow-way, and L-31 East. The purpose of the Biscayne Bay Coastal Wetlands project is to restore the natural hydrology and ecosystem in an area that has been degraded by regional drainage and land development practices.

1.3.7 C-111 Spreader Canal Western Project

The CERP C-111 Spreader Canal Western Project is intended to improve the delivery of flow to Florida Bay via Taylor Slough, improve hydroperiods within the Southern Glades and Model Lands, and re-establish sheetflow and hydrologic connectivity between natural areas, resulting in improved hydropatterns. The project area is within the Central Everglades Planning Project area.

1.3.8 C-111 South Dade Project

The *C-111 South Dade County 1994 Integrated General Reevaluation Report and Environmental Impact Statement (EIS)* was published in May 1994). This report described a conceptual plan for five pump stations and levee-bounded retention/detention areas to be built west of the L-31N Canal, between the S-332B and S-332D pump stations, to control seepage out of ENP while providing flood mitigation to agricultural lands east of C-111 Canal. The original and current configuration of these structural features is further discussed in the description of IOP Alternative 7R, within the *2006 IOP Final Supplemental EIS*. Operational guidance for the new S-332DX1 structure was included in the *Everglades Restoration Transition Plan Final EIS*.

2 Water Resource Analysis and Evaluation

Under Subsection 373.1501(5)(a), F.S. the SFWMD shall "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."

The recommended plan beneficially affects more than 1.5 million acres in the St. Lucie and Caloosahatchee Estuaries, WCA 3A, WCA 3B, Everglades National Park, and Florida Bay. In addition to redistributing existing treated water in a more natural sheetflow pattern, the recommended plan provides an average of approximately 210,000 acre-feet per year of additional clean freshwater flowing into the central portion of the Everglades. This increase in freshwater flow to the Everglades is approximately two-thirds of the additional flow estimated to be provided by the CERP.

The same hydrologic models used for plan formulation are typically applied to additional analyses for this report. This ensures consistency when representing the project effects in the analyses subsequent to plan selection. The Regional Simulation Model (RSM) for Basins (RSM-BN) and the RSM Glades-LECSA (RSM-GL) hydrologic models were used to simulate and evaluate the environmental effects of the CEPP final array of alternatives through comparison with base conditions simulated with the same models. The RSM-BN is applied north of the L-4/L-5/L-6 levees (the CEPP formulation Redline) for Lake Okeechobee, the EAA, and the Northern Estuaries; the RSM-GL is applied within the WCAs, ENP, and the LECSAs. The RSM models use a 41-year period of hydrologic record (1965 through 2005) that includes sufficient climatological variability (including natural fluctuations of water) to represent the full range of hydrologic conditions experienced within the south Florida region over a long-term period. No one modeling tool or representation of model results can definitively predict with project hydrologic conditions across the entire CEPP project area given the large regional scope of the project, model tools limitations and assumptions, and future uncertainties regarding the effects of other projects. However, each snapshot of model results can form the basis for applying best professional judgment to determine whether the potential effects of CEPP would reduce the availability of existing source of water or reduce the level of service for flood protection and to quantify the water necessary to achieve the benefits of the plan.

2.1 Project Objectives and Assumptions Associated with RSM Simulations

The analyses for state requirements includes considerations of three different sets of assumptions at two different points in time (existing or future) and two different conditions (with and without the project [selected plan]) as depicted in **Table 2-1**. In addition, the existing condition is also described by Existing Condition Baseline (ECB), which is similar to scenario 2012EC except it includes the previous regulatory schedule for WCA 3A known as IOP. ECB was only used during plan formulation. The model assumption tables for all base conditions and alternatives analyzed in the PIR main report are provided in Reference 2 of the Hydrologic Modeling Annex (A-2) to the Engineering Appendix A.

Table 2-1 - Key Assumptions based on Summary Tables from EN Appendix and H&H Annex

Condition	Intent	Equivalent for CEPP	Model Scenario
Pre-CERP Baseline	Conditions on the date of enactment of WRDA 2000 (December 2000), to provide a baseline to compare effects of project	Includes conditions in 2010 and most closely represents the Pre-CERP Baseline for LECSA 3, WCA 3 and ENP. Significant changed assumptions from the Pre-CERP Baseline include the 2008 Lake Okeechobee Regulation Schedule (2008 LORS) and the Interim Operating Plan (IOP) for WCA 3A and the South Dade Conveyance System (SDCS) in the existing conditions baseline (ECB). A Pre-CERP Baseline is not available with the RSM.	**ECB**
Existing Conditions	Actual conditions at the time the Tentatively Selected Plan (TSP) is selected, including land use, operations, and demands. Demand can be either permitted or projected, whichever is greater.	The existing 2012 conditions with only the projects and operations approved and in effect. Includes 2008 LORS and the Everglades Restoration Transition Plan (ERTP) for WCA 3A and the SDCS. Permitted demands are included.	**2012EC**
Initial Operating Regime Baseline	Future conditions at the time the recommended plan is operational including land use, operations, and demands. It does not include the Recommended Plan. Demands can be either permitted or projected, whichever is greater.	The future condition when the project will be initially operated, including other Non-CERP projects, CERP projects (with completed PIRs), and associated operations, aka future without project condition. Includes LORS 2008 and ERTP. Permitted demands are included.	**IORBL1**

2.2 Volume Probability Curves and Stage Duration Curves

To identify the quantity, timing, and distribution of water for the natural system, a probabilistic approach was selected utilizing volume probability curves to depict the distribution of volumes of water that provide natural system benefits as a result of project features or to determine whether water is eliminated or transferred from natural systems. These volumes of water may include water that is available to meet natural system needs without project features and the water made available from CEPP project features to meet natural system needs through the entire range of historic climatologic conditions. For purposes of identifying the increase in the volume of water for the natural system, volume probability curves were produced depicting the range of the quantities of water delivered for natural system areas and coastal estuaries under all climatic conditions through the RSM period of simulation used to perform project evaluations.

The probability curve indicates the probability (percentage of time equaled or exceeded, on the x-axis) that a certain quantity of water (expressed as flow or volume on the y-axis) is made available as a function of historical rainfall distribution. The water quantities are aggregated for each water year within the RSM period of simulation, defined as starting in May of year 1 and continuing through April of year 2 (40 total water years in the 1965-2005 RSM period of simulation). Once sorted, the values are ranked from highest to lowest. Volume probability curves quantify the water, along with its timing and distribution to the natural system.

To identify whether the CEPP project reduces the level of service of flood protection, evaluations focus on changes to water stages and their frequency within canals and at selected representative monitoring gauge locations within the LECSAs. The RSM-GL has no capability to precisely measure flood control on individual fields or during relatively short events, but the RSM-GL can be used as a coarse-scale tool to indicate a potential change in flood risk. Like volume probability curves, stage duration curves indicate the probability (percentage of time equaled or exceeded, on the x-axis) that a certain stage (expressed in National Geodetic Vertical Datum [NGVD] on the y-axis) is achieved as a function of historical rainfall distribution. Stages are aggregated for each day in the RSM period of simulation. Once sorted, the values are ranked from highest to lowest. A more localized analysis, with higher resolution hydrologic and/or hydraulic models, will be performed if there is an indication of significant increase in flood risk from the regional analysis.

2.3 Water Supply

The purpose of the Central Everglades Planning Project is to restore or improve the Everglades ecosystem (including wetlands, uplands, and associated estuaries), water quality, water supply, and maintain or improve recreation while protecting cultural and archeological resources and values. The recommended plan would achieve these benefits by reducing the large pulses of regulatory flood control releases sent from Lake Okeechobee by redirecting approximately 210,000 acre-feet of additional water on an annual basis to the historical southerly flow path.

An existing legal use of water is defined in state law as a water use authorized under a SFWMD water use permit or existing and exempt from permit requirements. Existing legal users of water including agricultural and urban in the LOSA and LECSAs will continue to be met by their current sources, primarily Lake Okeechobee, the Everglades (including the WCAs), surface water in the regional canal network, and the surficial aquifer system. All existing legal users will continue to have their needs met during implementation and once the project is in operation.

2.3.1 Lake Okeechobee Service Area

Due to the reduction in irrigated land with the inclusion of the FEB on the EAA A-2 site, the demand for supplemental irrigation is reduced from an annual average of 339 kAF in the future without project condition (IORBL1) to 328 kAF in Alt 4R2. The volume of demand not met for the LOSA during the eight years with the largest water shortage cutbacks in the period of simulation is the same or slightly improved when comparing the with project condition, Alt 4R2, and the without project condition, IORBL1. In six of these years, the volume of demand not met is reduced (improved water supply performance) by approximately 1 to 7 percent. In the two remaining years where the volume of demand not met increases compared to the without project condition (1981 and 1982), the increase is 1 percent or less (**Figure 2-1**). Over the entire period of simulation, the average annual volume of demand not met during water shortages declines by 6 kAF (1%) in the with project condition compared to the without-project condition

(Alt 4R2 and IORBL1 average 29 kAF and 35 kAF of cutbacks for EAA and Other LOSA combined, respectively) (**Figure 2-2**).

An additional analysis compares the 2012EC and ECB to Alt 4R2. The water supply demands met improve slightly. Of the eight years with the largest water shortage cutbacks, seven years indicate reduced cutbacks ranging between less than 1 to 6 percent for the with project condition (Alt 4R2), compared to the existing condition (2012EC and ECB). In one year, 1989, the cutback percentage is increased by approximately 1 percent. Over the entire period of simulation, the average annual volume of demand not met during water shortages declines by 4 kAF (<1%) in the with project condition compared to the existing baselines (Alt 4R2 averages 29 kAF of cutbacks, and 2012EC/ECB average 33 kAF of cutbacks for EAA and Other LOSA combined).

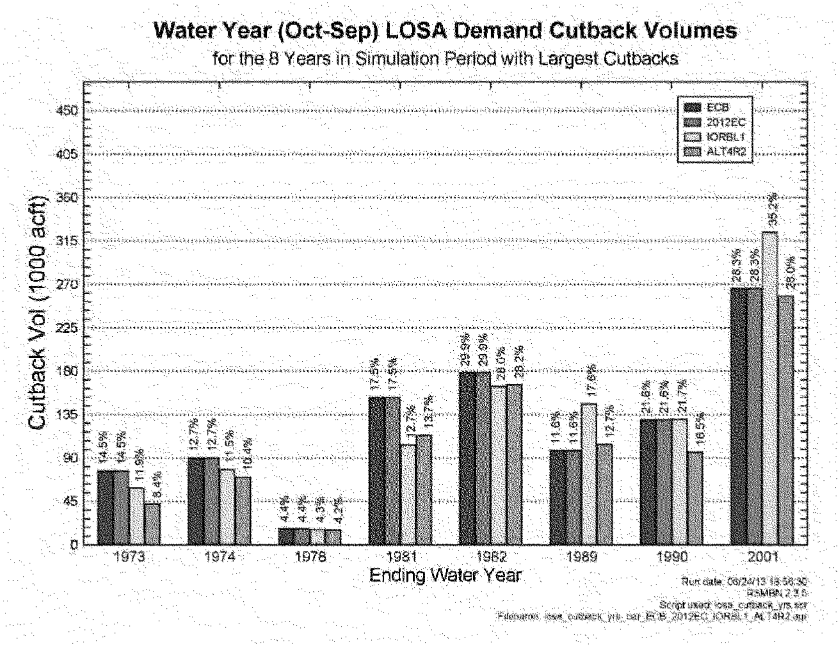

Figure 2-1 - LOSA Demand Cutback Volumes for the 8 Years with the Largest Cutbacks

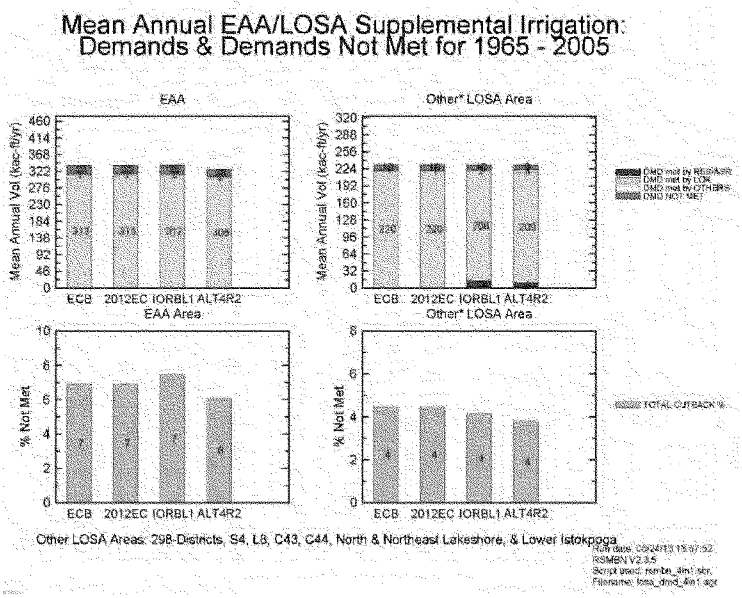

Figure 2-2 - Mean Annual EAA/LOSA Supplemental Irrigation: Demands and Demands Not Met for 1965–2005

Some of the water utilized by agricultural users in the LOSA from Lake Okeechobee will be transferred to WCA 3 and further south as a result of the implementation of the recommended plan. This transfer is anticipated to occur after the modification of the Lake Okeechobee Regulation Schedule that will allow full utilization of the CEPP A-2 FEB. The recommended plan has identified an additional source of water of comparable quantity and quality that will be available to replace the water sent south. Instead of discharging all water stored in the reservoir to tide via the S-80 or to meet C-44 Basin agricultural water supply demands, as assumed in the future without project IORBL1 baseline condition operations, the recommended plan retains a portion of the water stored in the CERP Indian River Lagoon-South (IRL-S) C-44 Reservoir/STA in the regional system for backflow to Lake Okeechobee via the C-44 Canal and raises the Lake Okeechobee stage criteria to allow increased C-44 Canal backflow. This added operation does not affect existing permitted allocations within the C-44 Basin. The additional C-44 Canal backflow operations to Lake Okeechobee included in the CEPP recommended plan improves the ability to meet existing permitted demands in the LOSA by retaining more water in the regional system and making it available to agricultural users. The operations do not benefit agricultural users in the C-23 Basin. The CEPP recommended plan backflow operations capture a portion of releases from the C-44 Reservoir/STA that would otherwise be directed to the Saint Lucie Estuary as excess water.

Specifically, the future without project condition (IORBL1) allows backflow to Lake Okeechobee from the C-44 Canal when S-308 (the Lake Okeechobee discharge structure to the C-44 Canal) is not open for regulatory discharges and when the stage in Lake Okeechobee is 0.25 feet below the base of the 2008 Lake Okeechobee Regulation Schedule (LORS) low sub-band (within the baseflow sub-band), which varies between 13.0 and 14.5 feet NGVD seasonally. This operational assumption is consistent with the existing operational protocols of Lake Okeechobee (2008 LORS) and the SFWMD Lake Okeechobee Water Shortage Management (LOWSM) operations. Discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are otherwise limited to environmental deliveries for the St. Lucie Estuary and C-44 Basin agricultural water supply demands during these backflow operations.

The CEPP recommended plan operations expand on the IORBL1 backflow to Lake Okeechobee through the following operational changes: (1) backflow to Lake Okeechobee from the C-44 Canal is allowed when S-308 is not open for regulatory discharge and the stage in Lake Okeechobee is below 14.5 feet NGVD (no seasonal variability); and (2) discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are made when the stage in Lake Okeechobee is below the baseflow zone of the 2008 LORS schedule (the bottom of this zone varies seasonally between 12.6 and 13.0 feet NGVD) to provide an additional source of backflow water to Lake Okeechobee. Water captured in the C-44 Reservoir/STA, includes excess water conveyed from the C-23 Canal and Basin (approximately 6 kAF on an average annual basis) that is not needed to meet the IRL-S North Fork water reservation target. The recommended plan operational changes result in an average annual increase in C-44 Canal backflow volume to Lake Okeechobee of 57.3 kAF (97.3 kAF in the recommended plan, compared to 40.0 kAF in the IORBL1) and an average annual increase in C-44 Reservoir discharges to the C-44 Canal of 21.3 kAF (37.6 kAF in the recommended plan, compared to 16.3 kAF in the IORBL1).

The transfer of water from Lake Okeechobee to WCA 3 will not be implemented until the CERP C-44 Reservoir/STA, the canal connecting the C-44 Reservoir to both the C-23 Basin and the C-23 Canal, and the CEPP FEB on the EAA A-2 site are operational. If the canal to the C-23 Basin and the C-23 Canal is not operational when the CEPP FEB on the EAA A-2 site is ready to store water, the operations, and ultimately the delivery of water from Lake Okeechobee to the CEPP FEB, may need to be modified to avoid elimination of this portion of the source of water for the LOSA. The water retained in Lake Okeechobee also maintains the level of service for water supply for existing legal users dependent on Lake Okeechobee and its connected conveyance system. Specifically, this includes the agricultural users in the LOSA and the Seminole Tribe of Florida.

2.3.2 Lower East Coast Service Area

Existing legal uses of water in the Lower East Coast Service Area include groundwater withdrawn by public utility wellfields, private wells, agricultural irrigation wells, and surface water withdrawals for agricultural uses in the LECSA 2 and LECSA 3. The Seminole Tribe of Florida also withdraws groundwater to meet water supply demands in LECSA 2. CEPP Alt 4R2 project features and operations are designed to maintain canal and groundwater stages, manage additional seepage quantities, and maintain overall flows to the LECSAs and Biscayne Bay. The water the CEPP project provides to WCA 3A will be conveyed south to ENP, with some portion reaching the LECSA through recharge of the surficial aquifer system.

In the LECSA, the water supply for existing legal uses continues to be met by the regional system including Lake Okeechobee, the WCAs, and the surficial aquifer system when CEPP is implemented. The ability to continue to meet urban and agricultural demands with CEPP implementation is evaluated by assessing relative changes in the frequency of water supply cutbacks in LECSA 2 and LECSA 3. Although the RSM-GL model predictions of the absolute number of water supply cutback events and the corresponding frequency of occurrence have a high degree of uncertainty, relative comparisons between the RSM-GL base conditions and the RSM-GL with project condition (Alt 4R2) provide a meaningful comparison to quantify potential effects of the CEPP project. Water supply cutbacks to the LECSAs can be triggered by Lake Okeechobee stages or by local groundwater levels. If the local groundwater levels trigger increased water shortage cutbacks, the trigger may either be the result of changed local groundwater conditions resulting directly from the CEPP project or more locally triggered cutback events becoming apparent as the lake triggered cutback events decline in frequency with the moderate to significant increase to Lake Okeechobee stages with Alt 4R2. In the case of the CEPP, increased LECSA water shortage cutbacks triggered by local groundwater stages are the result of the increased stages in Lake Okeechobee.

In the with project condition (Alt 4R2), the number of water years with lake triggered cutbacks during the period of simulation is 13 events and local groundwater triggered cutbacks is 19 events in LECSA 2. For the future without condition (IORBL1), the number of water years with lake triggered cutbacks is 16 events and groundwater triggered cutbacks is 16 events in LECSA 2. The total number of cutbacks events and the resulting frequency for LECSA 2 remains the same for the two conditions at 32 events (**Figure 2-3** and **Figure 2-4**), indicating no significant change for water supply performance within LECSA 2. For LECSA 3, there are no locally triggered groundwater cutbacks events indicated in the Alt 4R2 or IORBL1 modeling simulations. The number and frequency of water years with cutback events declines since the lake triggered cutback events decline from 16 with the IORBL1 to 13 with Alt 4R2 due to the rise in lake stages with the inclusion of the project (**Figure 2-5** and **Figure 2-6**), indicating a small water supply improvement within LECSA 3. CEPP implementation will provide increased stages and extended hydroperiods within WCA 3B and Northeast Shark River Slough, resulting in a net increase in average annual groundwater seepage flows from these natural areas to the adjacent LECSA 3. The increased seepage flows may slightly alter the water quality composition within the LECSA 3 surficial aquifer, through the relative increased contribution of groundwater seepage flows to the surficial aquifer recharge compared to the contribution from regional C&SF canal flows. These changes should result in either no significant change or a potential minor improvement to the water quality of withdrawals from the proximate public water supply wellfields within LECSA 3.

Comparisons to the existing condition base conditions (2012EC and ECB) indicate one additional water year cutback event with the existing condition compared to Alt 4R2 in LECSA2 (33 cutback events compared to 32 events). For LECSA 3, there are no locally triggered groundwater cutbacks events. The total number and frequency of lake triggered cutback events are the same for Alt 4R2 and the 2012EC/ECB, at 13 events (**Figure 2-7** through **Figure 2-10** and **Table 2-2**).

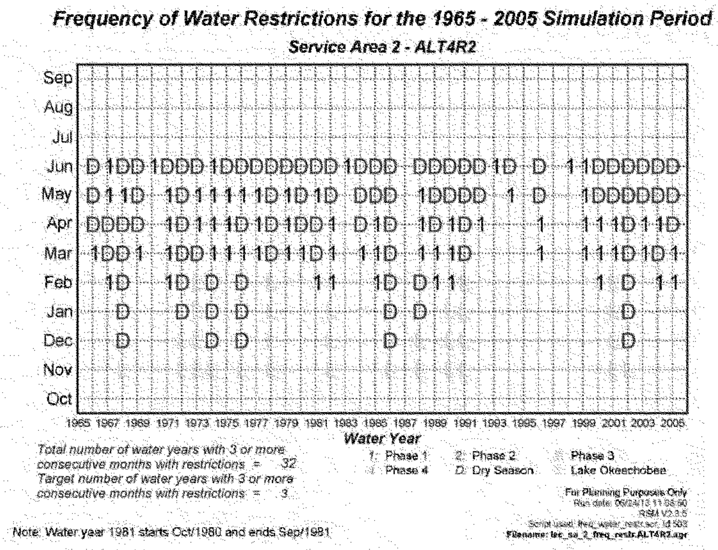

Figure 2-3 - Frequency of Water Restrictions for the 1965–2005 Simulation Period for the LECSA 2 Alt 4R2 Scenario

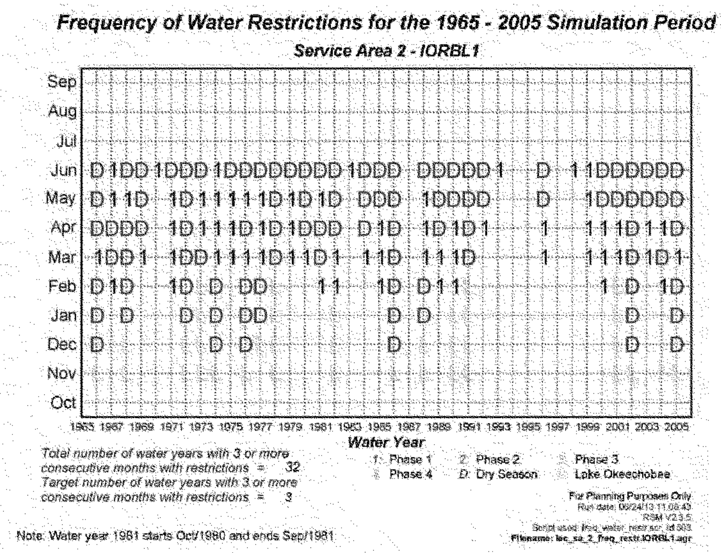

Figure 2-4 - Frequency of Water Restrictions for the 1965–2005 Simulation Period for the LECSA 2 IORBL1 Scenario

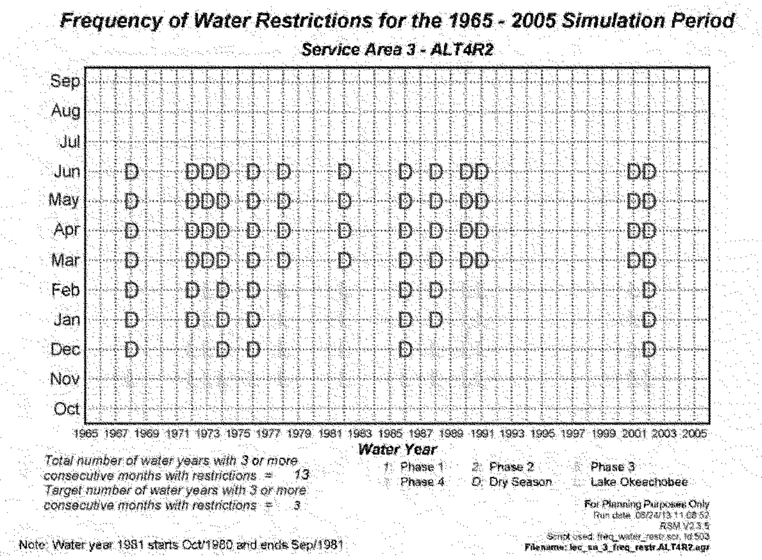

Figure 2-5 - Frequency of Water Restrictions for the 1965-2005 Simulation Period for the LECSA 3 Alt 4R2 Scenario

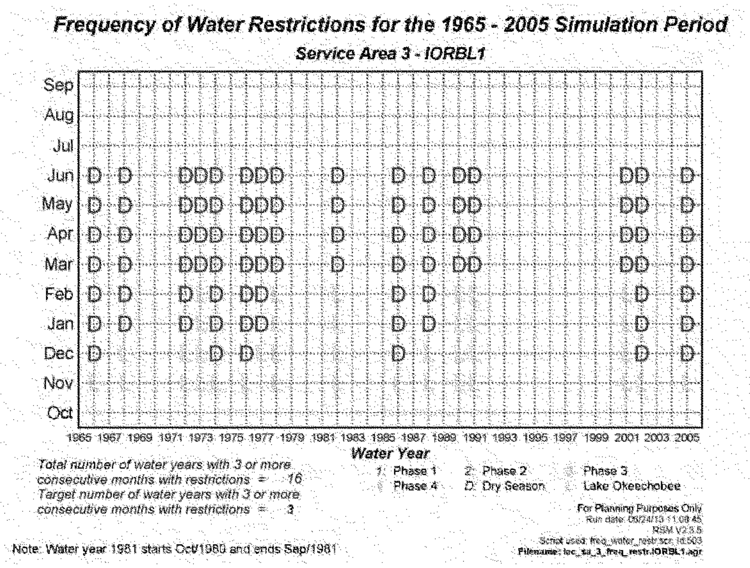

Figure 2-6 - Frequency of Water Restrictions for the 1965–2005 Simulation Period for LECSA 3 IORBL1 Scenario

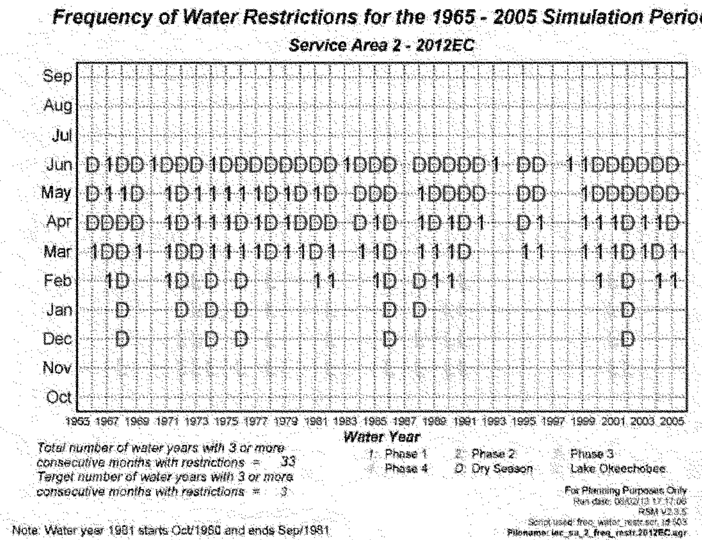

Figure 2-7 - Frequency of Water Restrictions for the 1965–2005 Simulation Period for LECSA 2 2012EC Scenario

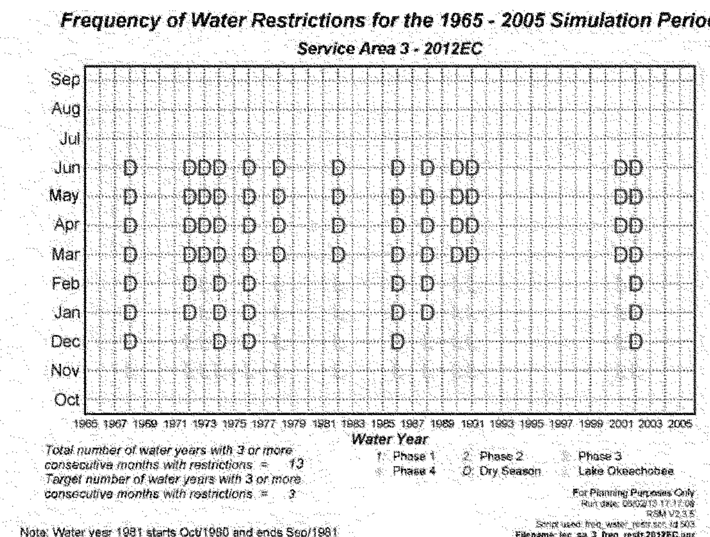

Figure 2-8 - Frequency of Water Restrictions for the 1965–2005 Simulation Period for LECSA 3 2012EC Scenario

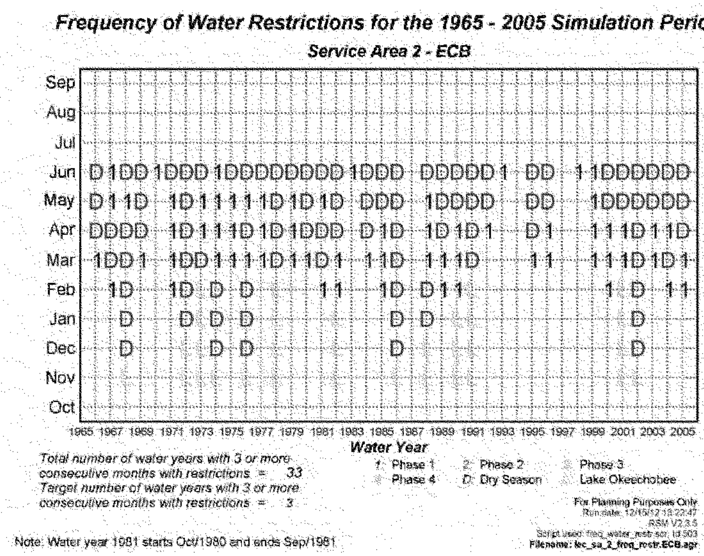

Figure 2-9 - Frequency of Water Restrictions for the 1965–2005 Simulation Period for LECSA 2 ECB Scenario

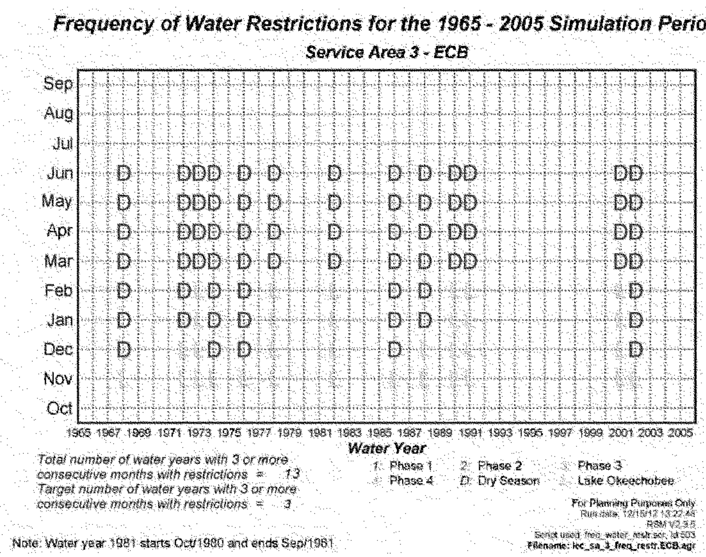

Figure 2-10 - Frequency of Water Restrictions for the 1965–2005 Simulation Period for LECSA 3 ECB Scenario

Table 2-2 - Number of Years with Water Restrictions in LECSA Triggered by Lake and Local Wells

Total Number of Years with Water Restrictions in the 41 year period of record			
	2012EC Lake/Local/Total	IORBL1 Lake/Local/Total	Alt4R Lake/Local/Total
Lower East Coast Service Area 2	13/20/33	16/16/32	13/19/32
Lower East Coast Service Area 3	13/0/13	16/0/16	13/0/13

The recommended plan meets the requirements of 373.1501(5)(a) by analyzing and evaluating water supply needs within the areas affected by the project.

Additional information on the requirements of the WRDA 2000's Savings Clause and its analysis can be found in Annex B of the Final PIR.

2.4 Water Quality

2.4.1 Compliance with State Water Quality Standards for Total Phosphorous

The Central Everglades Planning Project is projected to send approximately 210 kAF of additional water on an annual basis to the Everglades historical southerly flow path. This additional water must meet state water quality standards contained in Chapter 62-302, Florida Administrative Code (F.A.C.), notably for total phosphorous. Nutrients such as phosphorous and nitrogen compounds are a concern in the WCAs, ENP, and Lake Okeechobee since they result in an imbalance of flora and fauna. Excess nutrients come primarily from agricultural fertilizers; the decomposition of the peat soils in the area also contributes to excess phosphorus in the system. Phosphorus is the limiting nutrient for Lake Okeechobee, the WCAs, and ENP. CEPP depends on water quality treatment facilities owned and operated by the SFWMD (STA-2 and STA-3/4) and is integrated with the yet-to-be constructed A-1 Flow Equalization Basin included in SFWMD's "Restoration Strategies" project (*Restoration Strategies Regional Water Quality Plan* by SFWMD, April 27, 2012) to achieve state water quality standards. To achieve restoration objectives for WCA 3A, CEPP involves discharges from these STAs to previously unimpacted areas. Concerns were expressed about the effects of the new discharges on water quality and native flora and fauna in Everglades areas. Flows into WCA 3A must meet state water quality standards before discharges to the Everglades occurs. To ensure that the recommended plan meets state water quality standards, discharge permits with associated effluent limits will govern discharges from STA-2 and STA-3/4. The A-1 FEB is designed to assist STA-2 and STA-3/4 in achieving their effluent limits, but the effluent limits do not apply to the discharges from the FEB.

CEPP both increases flows and modifies the distribution of flows into Everglades National Park. Under existing conditions, water quality entering Everglades National Park is subject to an annual limitation of phosphorus contained in both Appendix A of the Settlement Agreement between the USA and SFWMD (Case No. 88-1886-Civ-Moreno) and Section 62-302.540, (F.A.C). Compliance with the annual limitations set forth in both Appendix A and state water quality standards are currently determined through a methodology which establishes an inverse relationship between flow and concentration. The existing limits for ENP are flow dependent and, generally, increased volume of water results in a lower allowable concentration of phosphorus to maintain the overall load of phosphorus entering the ENP. The state and federal parties are currently evaluating the compliance methodology with the recognition that additional federal and joint features which will substantially increase flow and distribution of flow to ENP are proposed to be implemented both in the near term and as part of CEPP implementation. In order to move forward with CEPP, the current compliance methodology found in Appendix A of the Settlement Agreement and in state water quality standards must be updated to reflect the proposed system operation and continue to be protective of ENP. Compliance with future water quality standards, which may include the need for additional joint water quality features, will be determined as part of the detailed design process and prior to operation of such features which may have an impact on water quality.

CEPP project features cannot proceed unless/until it is determined through the Comprehensive Everglades Restoration Plan Regulation Act (CERPRA) permitting process that construction and/or operation of the feature(1):

1. Will not cause or contribute to a violation of state water quality standards
2. Will not cause or contribute to a violation of any applicable water quality permit discharge limits or specific permit conditions
3. Reasonable assurances exist that demonstrate adverse impacts on flora and fauna in the area influenced by the Project features will not occur

The relationship between CEPP, Restoration Strategies, and the need to meet Consent Decree obligations is captured in language negotiated between the State of Florida and the federal government regarding compliance with state water quality standards and Consent Decree obligations for CEPP. The State's ability to support CEPP is contingent upon all parties following through with this agreed upon framework to address water quality issues that may occur as a result of the implementation of CEPP.

> *Restoration of the Everglades requires projects that address hydrologic restoration as well as water quality improvement. The National Academy of Sciences in its most recent biennial report on restoration progress in the Everglades has recognized this where it noted that near-term progress to address both water quality and water quantity improvements in the central Everglades is needed to prevent further declines of the ecosystem. The significant amount of water resulting from CEPP will significantly improve restoration of the Everglades. Both the federal and state parties recognize that*

[1] Note there are permitting criteria contained in 373.1502, F.S. that need to be addressed in addition to water quality requirements

water quantity and quality restoration should be pursued concurrently and have collaborated to develop and concur on a suite of restoration strategies being implemented by the state to improve water quality ("State Restoration Strategies"), as well as other state and federal restoration projects, both underway and planned, to best achieve Everglades hydrologic objectives. Specific examples of federally authorized projects include the Everglades Restoration Transition Plan, Modified Water Deliveries to Everglades National Park Project, and the Tamiami Trail Next Steps Project. One of the goals of these projects and their associated operating plans, as well as certain components of the CERP awaiting authorization or that are being planned as part of the Central Everglades Planning Project is to improve water quantity and quality in the Everglades through more natural water flow within the remnant Everglades which includes the water conservation areas and Everglades National Park ("ENP"). Variations in flows of the C&SF system may result from a variety of reasons. These reasons include natural phenomena (i.e. weather) and updates to the operating manuals to achieve the purposes of the C&SF project such as flood control and water supply.

One goal of the Consent Decree is to restore and maintain water quality within ENP. The Consent Decree established, among other things, long-term water quality limits for water entering ENP to achieve this goal. The existing limits for ENP are flow dependent and, generally, increased volume of water results in a lower allowable concentration of phosphorus to maintain the overall load of phosphorus entering the ENP. There will be redistribution of flows and increased water volume above existing flows associated with system restoration efforts beyond the current State Restoration Strategies projects. The Corps and its federal and state partners recognize that to achieve long-term hydrologic improvement, water quality may be impacted, particularly as measured by the current Consent Decree Appendix A compliance methodology. The Corps and the state partners agree that the monitoring locations/stations for inflows to ENP will require revision. The Technical Oversight Committee ("TOC") is currently conducting an evaluation of this and other aspects of the compliance methodology.

In an effort to address these potential impacts and determine updates to Appendix A to reflect increased inflows and new discharges into ENP since the Consent Decree was entered, the parties to the Consent Decree have established a process and scope for evaluating and identifying necessary revisions to the Appendix A compliance methodology utilizing the scientific expertise of the TOC. The TOC may consider all relevant data, including the 20 years of data collected since Appendix A was implemented. Ultimately, such evaluations and changes to the Appendix A compliance methodology would be recommended by the Consent Decree's TOC for potential agreement by all parties. Failure to develop a mutually agreed upon and scientifically supportable revised compliance methodology will impact the State's ability to implement or approve these projects.

The State's Restoration Strategies will be implemented under a Clean Water Act discharge permit that incorporates and requires implementation of corrective actions *required under a state law Consent Order, as well as a Framework Agreement between the U.S. Environmental Protection Agency and the state discharge permitting agency, the Florida Department of Environmental Protection, to ensure compliance with Clean Water Act and state water quality requirements for existing flows into the Everglades. The Clean Water Act permit for the state facilities, the associated Consent Order (including a detailed schedule for the planning, design, construction, and operation of the new project features), and technical support documents were reviewed by, and addressed all of, the U.S. Environmental Protection Agency's previous objections related to the draft National Pollutant Discharge Elimination System ("NPDES") permits, prior to issuance.*

All parties are committed to implementing the State Restoration Strategies, joint restoration projects, and associated operational plans, in an adaptive manner that is consistent with the objectives of the underlying C&SF Project. The Corps and the state will use all available relevant data and supporting information to inform operational planning and decision making, document decisions made, and evaluate the resulting information from those decisions to avoid adverse impacts to water quality where practicable and consistent with the purposes of the C&SF Project. Based upon current and best available technical information, the federal parties believe at this time that the State Restoration Strategies, implemented in accordance with the state issued Consent Order and other joint restoration projects, are sufficient and anticipated to achieve water quality requirements for existing flows to the Everglades. If there is an exceedance of the Appendix A compliance limits, which results from a change in operation of a Federal project, and it has been determined that an exceedance cannot be remedied without additional water quality measures, the federal and state partners agree to meet to determine the most appropriate course of action, including what joint measures should be undertaken as a matter of shared responsibility. These discussions will include whether it is appropriate to exercise any applicable cost share authority. If additional measures are required and mutually agreed upon, then they shall be implemented in accordance with an approved process, such as a GRR or LRR, and if necessary, supported through individual PPA's. Failure to develop mutually agreed upon measures and cost share for these measures may impact the State's ability to operate the Federal project features.

The State of Florida plans to proceed with the 1501 review process concurrent with the final review by USACE headquarters and prior to the PIR being transmitted to Congress. The SFWMD and Department are preceding the formal review and approval process required under State law with the understanding there will be no change to the aforementioned agreed upon language. Substantive changes that are not agreeable to the State may impact the SFWMD's ability to serve as local sponsor, and FDEP's ability to approve CEPP pursuant to 373.026(8)(b).

2.4.2 Other Water Quality Considerations

Implementation of the recommended plan, ALT4R2, is likely to improve water column TP concentrations within most areas of WCA 3 primarily due to the use of state-owned water quality treatment facilities, increased upstream storage capacity provided by the A-2 FEB, backfilling of the Miami Canal and redistributing flows into the northwestern corner of WCA 3A. These improvements should allow for uptake of TP within this marsh and over, the long-term, it is likely that the project will beneficially affect WCA 3. However, there may be temporally and spatially limited impacts to TP conditions within the marsh until more stabilized conditions are established. Sequencing of projects to ensure that water quality benefits are optimized is critical to moving CEPP forward as part of restoring the Everglades. There is risk that the changes in flow distributions proposed under CEPP will impact compliance with Appendix A of the 1991 Settlement Agreement; however, this risk will be managed through additional analysis in the detailed project planning and design phase and the permitting process.

The CEPP is not expected to significantly affect Lake Okeechobee water quality; however increased backflow into the lake at the S-308 structure will result in a relatively small increase in lake phosphorus load. Specifically, increased backflow into the lake at the S-308 structure will result in a relatively small increase in lake phosphorus load (currently estimated at less than 2 percent of the phosphorus TMDL target for Lake Okeechobee of 140 metric tons/yr). FDEP is in the process of developing a Basin Management Action Plan (BMAP) for Lake Okeechobee pursuant to Section 403.067, Florida Statutes. This BMAP will be an iterative effort to address water quality issues in Lake Okeechobee. Potential water quality issues associated with S-308 loads will be addressed as part of future phases of the BMAP.

The Northern Estuaries should see slight improvements to water quality that result from reduced high flow events associated with Lake Okeechobee operations. The construction and operation of the A-2 FEB will slightly decrease EAA basin phosphorus loads to WCA 3. The northern estuaries should see slight improvements to water quality that result from reduced high flow events associated with Lake Okeechobee operations. The construction and operation of the A-2 FEB will slightly decrease EAA basin phosphorus loads; however, the risk that the 2012 WQBEL for discharges from the EAA to the water conservation areas will not be met is low.

2.4.3 Salinity in the Northern Estuaries and Florida Bay

The CEPP is anticipated to improve the number of low and high salinity events for the Caloosahatchee Estuary as well as the number of high flow events for the St. Lucie Estuary. Improvement in nutrient and dissolved oxygen conditions should also result from the reduced high flow events from Lake Okeechobee. The CEPP is also anticipated to improve water quality conditions for Florida Bay with salinity moving closer to the salinity target for the bay, with a 2 practical salinity unit (psu) decrease in the bay's central zone and an average salinity decrease of 1.5 psu amongst all bay zones for wet and dry seasons.

2.4.4 Hazardous, Toxic and Radioactive Waste (HTRW)

The HTRW evaluation for the CEPP requires an analysis of the potential effects to human health and ecological risk. Human health risks are typically evaluated by comparing chemical concentrations in all media (e.g., soil, groundwater, surface water, sediment) to human health-based cleanup target levels (CTLs) promulgated by FDEP in Chapter 62-777, F.A.C.

Ecological risks are typically evaluated by comparing chemical concentrations to the Sediment Quality Assessment Guidelines (SQAGs) developed by FDEP for inland waters and to ecological restoration targets established by the USFWS. The A-2 FEB lands within the project boundary have been investigated in accordance with the *Protocol for Assessment, Remediation and Post-remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects* jointly developed by FDEP, SFWMD, and U.S. Fish and Wildlife Service (USFWS). The protocol, which is commonly referred to as the Ecological Risk Assessment (ERA) Protocol, is intended to provide guidance on conducting environmental site assessments on agricultural lands proposed for use in projects to be inundated with water, such as for conversion to STAs, wetlands, reservoirs, and other aquatic features.

The 14,521 acre A-2 site that is proposed for a FEB was surveyed for hazardous, toxic, and radioactive waste (HTRW) as well as residual agricultural chemicals in the cultivated soils. The FDEP and USFWS reviewed the results of the environmental audits and risk assessments and concluded that the required remediation actions have been completed and that the detected residual agricultural chemicals in cultivated soils are present at concentrations that do not present a risk to humans or environmental receptors. Since the A-2 site is currently under cultivation, close out environmental audits and sampling will be performed again prior to certification of the lands. The HTRW Appendix C.1.1.15 and Annex H of the PIR contain additional information on the HTRW materials identified.

2.5 Flood Protection

Under Subsection 373.1501(5)(a), F.S., the SFWMD shall "analyze and evaluate all needs to be met in a comprehensive manner and consider all applicable water resource issues, including ... flood protection..."

The recommended plan design features will maintain the existing levels of flood protection. A combination of modeling tools (Annex B of the Final PIR) was used to perform an analysis of flood protection impacts. Flood protection is evaluated by a combination of best professional judgment interpreting model results and engineering analyses. This varies from typical storm event analyses by using a long-period of record simulation and focusing on the wet events included within the 1965-2005 simulation period

As an example of an extreme wet event encompassed within the CEPP RSM-BN/RSM-GL simulation period and therefore included in the CEPP evaluations, Hurricane Irene in late 1999 (13-17 October) may be specifically considered. During this historical storm event, several monitoring sites in Broward, Miami-Dade, and Palm Beach counties, including WCAs 1, 2, and 3, received the 24-hour, 48-hour, and 72-hour maximum rainfall amounts that would be expected to occur once in 100 years, with cumulative rainfall in excess of 9 inches (SFWMD Technical Publication EMA #386, May 2000). Notably, however, as documented within the CEPP RSM model output hydrographs (a link to this data is provided in the CEPP Final PIR main report: http://www.evergladesplan.org/pm/projects/proj_51_cepp.aspx), peak stages within the simulation period of record for the CEPP project area typically occur outside of this 1999 event. The occurrence of the majority of peak stages for WCAs 1, 2, and 3 during 1994-1995 and the occurrence of peak stages for Lake Okeechobee during 1969-1970 indicates that for these specific areas, these other hydrologic combinations of storm events and wet antecedent conditions also observed within the simulation period may, in fact, correspond to a lower frequency of occurrence (return period greater than 100 years) than the 1999 event.

The four features or areas affected by the project that will be analyzed include (1) the potential risk to Herbert Hoover Dike (HHD) due to changes in the Lake Okeechobee stages, (2) the FEB located in the EAA, (3) the effects of changed water levels in WCA 3A and WCA 3B on the Everglades Protective levees (L-31N and L-31W), L-67, L-29, and L-30, and 4) the agricultural and urban areas located east of the Everglades Protective levees L-31N and L-31W.

2.5.1 Lake Okeechobee Herbert Hoover Dike

For the HHD, risk and uncertainty associated with increased lake stages were assessed consistent with the HHD formulation assumptions established for the CEPP future without condition. There are structural integrity concerns with the embankment and internal culvert structures that resulted in a Dam Safety Action Classification (DSAC) risk rating of Level 1. DSAC Level 1 represents the highest USACE dam risk of failure rating and requires remedial action. The USACE Major Rehabilitation Report (MRR) from 2000 divided the 143 mile dike into eight reaches with the initial focus on Reach 1. The current approved and planned remediation measures will address the highest points of potential failure in the system based on known areas of concern. These USACE efforts are intended to lower the DSAC rating from Level 1. The CEPP future without project condition assumes the planned remediation of HHD will lower the DSAC risk rating and be completed by 2022. These remediation measures will not resolve all issues with the HHD dam, nor will all current design criteria be met. To assess other issues and address future modifications with HHD, a comprehensive potential failure mode analysis and risk assessment is being performed and will be included in the ongoing USACE Dam Safety Modification Report (DSMR). This report is scheduled for completion/approval in 2015.

Prior to the 2008 LORS, Lake Okeechobee operated under the Water Supply and Environmental Regulation Schedule (WSE). The 2006-2008 LORS study was initiated because of adverse environmental impacts that WSE had on the lake ecology. Dam safety was later added as a performance criterion since lowering of the lake, as the LORS study was pursuing, is one of the basic Interim Risk Reduction Measures implemented for deficient dams until appropriate remediation is effectuated. The WSE held Lake Okeechobee stages approximately 1.0-1.5 feet higher than the 2008 LORS under wet conditions. Studies for the remediation of HHD are based on the 2008 LORS, which was used as the basis for the development of the Standard Project Flood (SPF) condition. The SPF is the design condition used for the risk assessment and remediation to address internal erosion failure modes.

CEPP benefits gained from sending new water south from Lake Okeechobee are derived in part from operational refinements that can take place within the existing, inherent flexibility of the 2008 LORS, and in part with refinements that are beyond the schedule's current flexibility. Modifications to 2008 LORS will be required to optimally utilize the added storage capacity of the A-2 FEB to send the full 210 kAF/yr of new water available in the CEPP south to the Everglades, while maintaining compliance with Savings Clause requirements for water supply and flood control performance levels.

The hydrologic modeling conducted for all the CEPP alternatives to optimize system-wide performance incorporated the current Regulation Schedule management bands of the 2008 LORS. The hydrologic modeling of the CEPP alternatives included proposed revisions to the 2008 LORS flow chart guidance of maximum allowable discharges, which are dependent on the following criteria:

- Class limits for Lake Okeechobee inflow and climate forecasts, including tributary hydrologic conditions, seasonal climate outlook, and multi-seasonal climate outlook
- Stage level, as delineated by the Regulation Schedule management bands
- Stage trends (whether water levels are receding or ascending)

Most of the 2008 LORS refinements applied in the CEPP modeling lie within the bounds of the operational limits and flexibility available in the current 2008 LORS, with the exception of the adjustments made to the class limits for the Lake Okeechobee inflow and climate forecasts. Under some hydrologic conditions, the class limit adjustments made to the Lake Okeechobee inflow and climate forecasts reduced the magnitude of allowable discharges from the lake, thereby resulting in storage of additional water in the lake to optimize system-wide performance and ensure compliance with Savings Clause requirements. However, these class limit changes represent a change in the flow chart guidance that extends beyond the inherent flexibility in the current 2008 LORS. As detailed in Section 6.7.2.1 of the main PIR report, the CEPP recommended plan operations also expand on the 2008 LORS backflow operations to Lake Okeechobee through the following operational changes: (1) backflow to Lake Okeechobee from the C-44 Canal is allowed when S-308 is not open for regulatory discharge and the stage in Lake Okeechobee is below 14.5 feet NGVD (no seasonal variability); and (2) discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are made when the stage in Lake Okeechobee is below the baseflow zone of the 2008 LORS schedule to provide an additional source of backflow water to Lake Okeechobee. Additional information and documentation of the CEPP Recommended Plan modeling assumptions for Lake Okeechobee operations are found in Section A.8.3.2.3.3 of Appendix A (Engineering) of the CEPP PIR.

Independent of the CEPP implementation, there is an expectation that revisions to the 2008 LORS will be needed following the implementation of other CERP projects and Herbert Hoover Dike infrastructure remediation. The USACE expects to operate under the 2008 LORS until there is a need for revisions due to the earlier of either of the following actions: (1) system-wide operating plan updates to accommodate CERP "Band 1" projects, as described in Section 6.1.3.2, or (2) completion of sufficient HHD remediation for reaches 1, 2 and 3 and associated culvert improvements, as described in Section 2.5.1. When HHD remediation is completed and the HHD DSAC Level 1 rating is lowered, higher maximum lake stages and increased frequency and duration of high lake stages may be possible to provide the additional storage capacity assumed with the CEPP Recommended Plan. The future Lake Okeechobee Regulation Schedule which may be developed in response to actions (1) and/or (2) is unknown at this time. It is anticipated that the need for modifications to the 2008 LORS will be initially triggered by non-CEPP actions and that these actions will occur earlier than implementation of the CEPP. Therefore, the CEPP PIR will not be the mechanism to propose or conduct the required NEPA evaluation of modifications to the Lake Okeechobee Regulation Schedule. However, depending on the ultimate outcome of these future Lake Okeechobee Regulation Schedule revisions, including the level of inherent operational flexibility provided with these revisions, the CEPP implementation may still require further Lake Okeechobee Regulation Schedule revisions to optimize system-wide performance and ensure compliance with Savings Clause requirements.

Lake Okeechobee stage duration curves for the RSM-BN model representation of the ECB/2012EC (2008 LORS; note that plot lines overlap), IORBL1 (2008 LORS, plus additional CERP and non-CERP projects), and Alternatives 4R2 (LORS 2008, additional CERP and non-CERP projects, and prescribed assumed operational flexibility) are included as **Figure 2-11** (note: upper 25% of the stage duration curve is displayed). Peak stages for the CEPP Savings Clause baselines and Alt 4R2 are summarized as follows: 17.54 feet NGVD for the 2012EC; 17.52 feet NGVD for the IORBL1; and 17.66 feet NGVD for Alt 4R2. The baselines and the Recommended Plan Alt 4R2 all show simulated stages above 17.25 feet NGVD: 18 days for the 2012EC; 9 days for the IORBL1; and 29 days for Alt 4R2 (note: 14,975 days in the RSM-BN 41-year period of simulation). The USACE 2008 LORS Environmental Impact Statement assessment recognized that minimizing the frequency of exceedance of the 17.25 feet elevation offers additional protection for public safety and the HHD, for the condition prior to completion of the current approved and planned HHD remediation measures, and this criterion was evaluated as a LORS project performance measure. The assumed modified Lake Okeechobee operations with the CEPP alternatives (including Alt 4R2) do not cause significant increases in the frequency, duration, and magnitude of Lake Okeechobee peak stages (compared to the IORBL1), despite the assumed completion of HHD remediation measures, because the adverse ecological effects associated with increased lake stages and the associated increases in high volume releases to the estuaries were effectively balanced during the CEPP preliminary screening (for additional discussion of screening metrics, refer to **Section 3** of the PIR main report). Following completion of the HHD remediation of Reaches 1, 2, and 3, the degree to which higher maximum lake stages and increased frequency and duration of high lake stages would be accepted, if at all, will be contingent on the conclusions identified in the 2015 DSMR (note: this process is independent and separate from the CEPP project).

Given recognition of the DSMR uncertainty and the continued utilization of the 2008 LORS Lake Okeechobee Regulation Schedule for CEPP, the USACE assessment of the Lake Okeechobee high water performance with CEPP indicated consistency with the HHD formulation assumptions established for the CEPP future without project condition (FWO/IORBL1), which included general consideration of potential risk and uncertainty associated with increased lake stages. Lake Okeechobee high water performance requirements will likely need to be revisited following completion of the 2015 DSMR, but the CEPP stage duration curve trends for increased high water conditions appear reasonable based on the USACE current best available information and current expectations for the HHD remediation.

Extreme high lake stages have also been documented to adversely impact the plant and animal communities, through processes which include the following: physical uprooting of emergent and submerged plants; reduced light levels in the water column due to increased suspended sediment; and littoral zone exposure to increased nutrient levels from the water column. The frequency of occurrence for lake stages above 16.0 feet, 16.5 feet, 17.0 feet, and 17.25 feet are summarized in **Figure 2-12**. Lake Okeechobee stages between 16.0 and 17.25 feet NGVD correspond to the seasonal range of the top zone of the 2008 LORS Regulation Schedule, and this performance metric was considered by the USACE during the LORS Regulation Schedule study. Refer to **Section 5** of the main PIR report and Appendices C.2.1 and C.2.2 for the environmental effects evaluations for Lake Okeechobee, which were determined to be approximately equivalent across the CEPP future with project alternatives. As documented in **Section 4** of the main PIR report, habitat units were not calculated for Lake Okeechobee since the performance of these areas were considered a constraint during formulation.

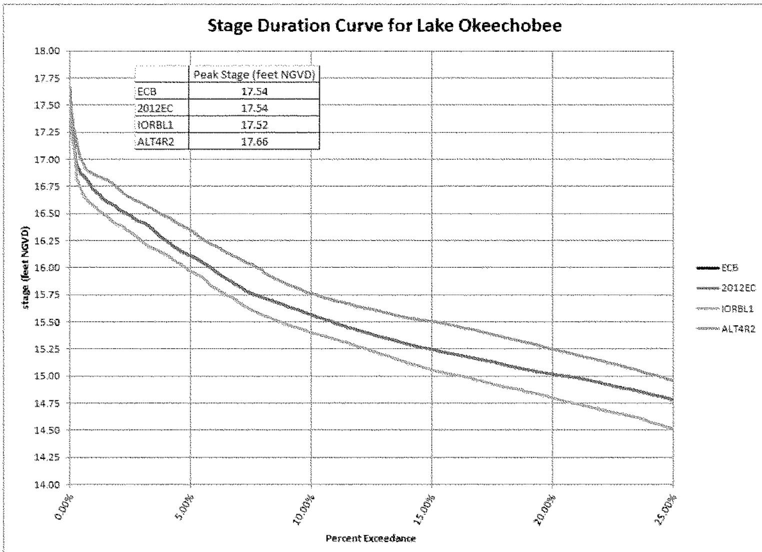

Figure 2-11 - Lake Okeechobee Stage Duration Curve

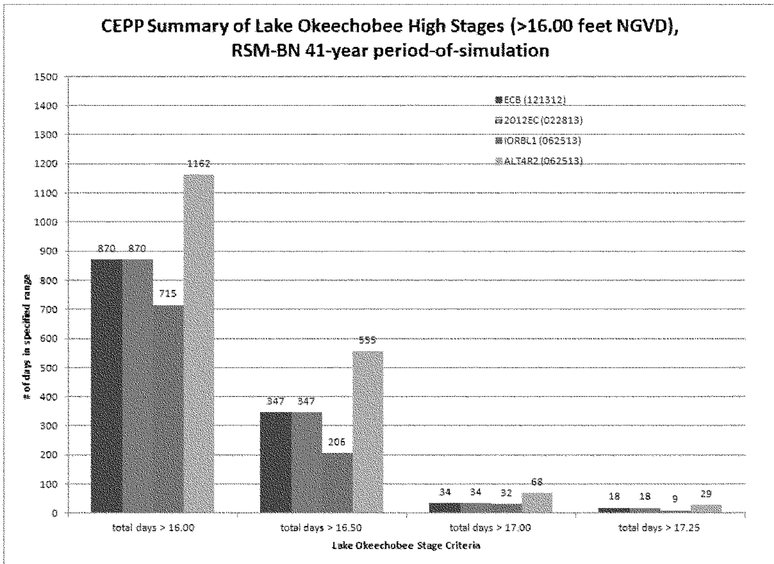

Figure 2-12 - Occurrence Frequency of Lake Okeechobee High Stages

2.5.2 FEB Located in the EAA

Consistent with the CEPP modeling assumptions for the action alternatives, operational stages for the EAA FEB storage feature were typically managed between 1 and 3 feet depth, with no additional structural inflows from Lake Okeechobee allowed when the FEB depth exceeded 3.8 feet. Structural inflows to the FEB would be discontinued when depths exceed 4 feet, although additional rainfall may further increase stages. Hydraulic design of the FEB perimeter levee system included consideration of the stage variability for FEB operations. Within the RSM-BN modeling conducted to support the CEPP preliminary screening and alternative evaluations, the SFWMD Restoration Strategies FEB located on the EAA A-1 parcel and the CEPP FEB on the EAA A-2 parcel are represented as a single storage feature. Consistent with the evaluation approach identified in Draft Guidance Memoranda 3, the FEB assessment for the level of service for flood protection was based on the performance of the flood control system when modeled against the period of record, and the assessment does not further consider specific design flood targets such as the 10-year or 100-yr flood event.

Detailed CEPP assessments within the EAA were not conducted because the RSM-BN does not simulate groundwater within the EAA. Although not anticipated, based on the CEPP plan formulation modeling, it could not be determined whether the A-2 FEB meets the Savings Clause requirements to maintain the pre-existing levels of flood protection. Further assessment of potential effects from the A-2 FEB will be deferred to the preconstruction engineering and design phase (PED), and the A-2 FEB will be designed to specifications that meet applicable flood protection requirements. Information regarding the FEB design considerations for flood protection is included in Section B.3.2.2.

Stage duration curves for the combined CEPP A-1 and A-2 FEB are shown in **Figure 2-13** for the IORBL1 (14,000 acres A-1 FEB only) and Alt 4R2. Ground surface elevations within the FEB were assumed at 9.63 feet NGVD for the RSM-BN modeling. Minor changes to groundwater levels are expected adjacent to the CEPP A-2 FEB (14,000 acres), compared to the future without project condition (IORBL1) which includes the SFWMD Restoration Strategies A-1 FEB.

The A-2 FEB design includes perimeter seepage collection canals and associated seepage pumps to limit potential impacts. The FEB at this time carries a low hazard potential classification (HPC) per CERP Design Criteria Memoranda (DCM) 1, which is extended to embankment design. Embankment top widths are 14 feet wide per DCM-4, with dam heights based on analysis of the following criteria: USACE Engineer Regulations (ER) 1110-8-2(FR), ER-1110-2-1156, DCM-2, and risk. The FEB perimeter levee elevation is established at 20.3 feet NGVD, 3 feet above the maximum surcharge pool elevation. As described in further detail in the Engineering Appendix accompanying the CEPP PIR (Appendix A), the maximum surcharge pool elevation is based on the greatest elevation resulting from the following storm routings: (1) The Inflow Design Flood (IDF), which is identified as the 100-yr 24-hr storm event for the CEPP FEB, per DCM-2; (2) the 50 percent 72-hr probably maximum precipitation per ER-1110-8-2(FR); and (3) wind setup and wave run-up analysis on critical fetch lengths with the impoundment at full pool. An orifice-type spillway will provide uncontrolled discharge from the A-2 FEB during extreme events, when FEB discharges are required to protect the embankment integrity. The spillway will include a 265 foot long weir with crest elevation set at 13.50 ft NGVD. The spillway will discharge into the adjacent seepage canal along the northern portions of the A-1 and A-2 FEBs. The spillway will be located in line with the northern extent of the eastern perimeter levee, adjacent to structure S-628.

Within the RSM-BN simulated period of record (1965-2005), the maximum simulated stage in the A-1/A-2 FEB is 13.54 feet NGVD for the CEPP Recommended Plan. Based on the assumed ground surface elevation of 9.63 feet NGVD used in the RSM-BN model, the peak depth is 3.91 feet over the period of record. The FEB emergency overflow spillway (S-627) was designed with a crest elevation of 13.50 feet NGVD, based on the average assumed ground surface elevation of 9.00 feet NGVD used for the preliminary (pre-PED survey) hydraulic design, as described in Appendix A of the PIR; based on this design, the FEB emergency overflow spillway would only discharge if the FEB depth exceeds 4.5 feet. As the FEB stages over the simulated period of record do not overtop the FEB emergency spillway (simulated peak depth condition of 3.91 feet), the FEB emergency spillway preliminary design details, including discharge location, did not warrant further analysis for the CEPP Savings Clause evaluation of Alt 4R2. During CEPP formulation, no detailed modeling was performed to determine the extent or frequency of emergency discharges under extreme event outside of the 1965-2005 period of record that was analyzed for the CEPP PIR.

Detailed CEPP assessments within the EAA were not conducted because the RSM-BN does not simulate groundwater within the EAA. Further assessment of potential effects from the A-2 FEB will be deferred to the PED phase of CEPP.

For flood protection in the EAA, the additional storage volume provided by the construction and operation of impoundments is expected to incidentally improve flood protection in the vicinity of the impoundments. For the FEB, available storage in the impoundments will be utilized to maximize flood control and reduce or eliminate discharges to the WCAs or released to tide associated with anticipated heavy rainfall from tropical storms or hurricanes. The control of seepage from project components will also help to assure that the existing level of service for flood protection is maintained and surrounding lands are not adversely impacted. An emergency overflow spillway for the A-2 FEB will provide protection for project embankments integrity during extreme storm events.

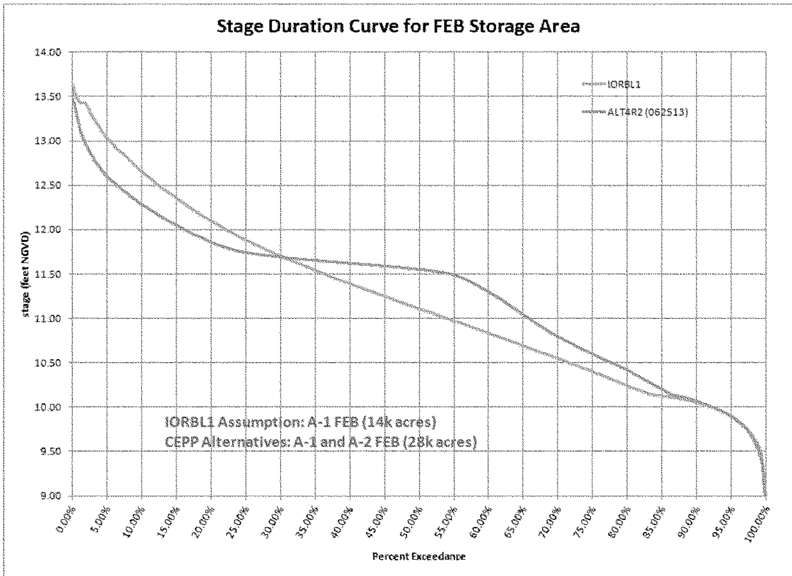

Figure 2-13 - FEB Stage Duration Curves

2.5.3 EAA/Northern WCA 3A – Backfilling of Miami Canal

The CEPP Alt 4R2 proposes to backfill the Miami Canal downstream starting 1-½ miles south of the S-8 pump station (refer to **Figure 1-2** for map) and extending to I-75. Without maintenance of the existing capacity for flood control within the EAA, flood control capability would be diminished. The CEPP plan formulation process assumed that the pre-project flood protection level of service for the EAA would be maintained under CEPP by providing the same total pumping capacity at the S-8 (4170 cfs) and S-7 (2490 cfs) pump stations, which provide drainage for the upstream EAA basin. No new structures are proposed under CEPP to further supplement the G-404 and S-8 pump stations for deliveries from the EAA to WCA 3A.

CEPP will maintain this existing design capacity for the S-8 complex through a combination of pump station design modifications, a new hydraulic connection from S-8 to the degraded L-4 Levee, utilization of the existing G-404 pump station (570 cfs design capacity), and leaving the 1-2 mile segment of the Miami Canal as available getaway conveyance capacity during peak flow events. S-8 modifications should be completed to permit the diversion of L-6 flows and must maintain flood control operation capability during implementation of S-8 modifications. The Alt 4R2 cost estimate includes placeholder funding for any required modifications of the S-8 outlet works, to address potential increased tailwater conditions with CEPP that may diminish the S-8 pump efficiency. Modifications of the S-8 pump station complex for CEPP operations will be further analyzed during the PED phase of CEPP, since the RSM-GL model applied for CEPP formulation is inadequate for detailed hydraulic design of the S-8 pump station complex; potential design modifications to be assessed/reassessed in further detail during PED will likely include the following: modifications to S-8 and/or G-404, to address pump efficiency concerns; the proposed S-8A culvert and associated canal connecting the Miami Canal to the L-4 Canal; and the required length of the unmodified Miami Canal to maintain hydraulic getaway conveyance capacity.

No design modifications to S-7 are proposed with Alt 4R2, and the S-621 gated spillway proposed on the STA-3/4 outlet canal has been initially designed at 2500 cfs to maintain the capability to deliver the S-7 design capacity flows from STA-3/4 to the S-7 pump station.

2.5.4 WCA 3A and WCA 3B

The USACE Final ERTP EIS and Record of Decision (ROD; signed on 19 October 2012) identified the 1960 WCA 3A 9.5 to 10.5 feet NGVD Regulation Schedule as an interim measure water management criterion for WCA 3A Zone A. This change to Zone A, compared to the previous IOP for WCA 3A regulation, was necessary to mitigate for the observed effects, including discharge limitations of the S-12 spillways. Based upon the interim water management criteria for WCA 3A as well as the current condition of endangered species within WCA 3A, the ERTP EIS concluded that IOP is no longer a viable option for water management within WCA 3A and SDCS. The preliminary USACE Water Resources Engineering Branch (EN-W) analysis of WCA 3A high water levels, which was integrated into the ERTP EIS, also recommended further consideration of additional opportunities to reduce the duration and frequency of Water Conservation Area 3A high water events (ERTP Final EIS, Appendix A-5).

The information on which the USACE relied on to require the ERTP WCA 3A Zone A as an interim risk reduction measure for WCA 3A high water levels did not change prior to CEPP formulation, and no new information was available compared to the July 2010 assessment included as Appendix A-5 of the ERTP Final EIS. Throughout CEPP formulation, the USACE advocated that CEPP formulation efforts attempt to maintain the frequency, duration, and peak stages of high water levels within WCA 3A consistent with the CEPP Future Without Project condition used during formulation, which includes ERTP, given recognition of the WCA 3A high water concerns identified with ERTP; prior to CEPP formulation, the USACE explicitly recognized that the ERTP constraint precluded raising of the top of the WCA 3A Regulation Schedule, while simultaneously recognizing that substantial benefits were still expected and that goals to further lower stages in WCA 3A were consistent with the constraint. The WCA 3A analysis provided in Section 3.2 provides comparisons between the final updated future without project baseline developed for CEPP (IORBL1) and the with-project condition (Alt 4R2); comparisons to the existing condition baseline (ECB and/or EC2012) are not provided since these comparisons were not utilized by USACE EN-W, as the ECB used during CEPP formulation included the IOP operations that were identified during ERTP as being no longer viable for water management within WCA 3A. EN-W also indicated that it would continue to rely on the WCA 3A three-gauge average stages for assessment of WCA 3A high water frequency, durations, and peak stages, consistent with the original WCA 3A design assumptions and the ERTP assessment (average of stages at the monitoring gauges of 3A-3, 3A-4, and 3A-27); increased weight would not be considered for a single gauge, such as 3A-28 (Site 65). It was further noted that if CEPP can provide operational assurances of additional WCA 3A outlet capacity under high water conditions, including adequate consideration of potential WCA 3B seepage management and/or ecological operational limitations, the EN-W may be able to further consider proportional relaxation of the WCA 3A future without project high water duration and frequency targets.

Compared to the CEPP FWO (final December 2012 release), the CEPP Alt 4R2 stages are lowered by approximately 0.1-0.3 feet in the upper 10 percent of the stage duration curve for the WCA 3A three-gauge average stage, as shown in **Figure 2-14** (upper 25 percent of the stage duration curve); the same performance is observed in the IORBL1. In order to consider potential differences during specific years, the EN-W assessment also considered the annual duration of exceedance of the ERTP WCA 3A Zone A stage levels for the complete period of simulation (**Figure 2-15**). The annual durations were also displayed and assessed as a frequency curve (**Figure 2-16**). The total number of days above Zone A is summarized as follows for the IORBL1 and CEPP alternatives (with percent of total period of simulation, 14975 days, in parentheses): CEPP IORBL1 – 2751 days (18.37%); and Alt 4R2 – 3323 days (22.19%).

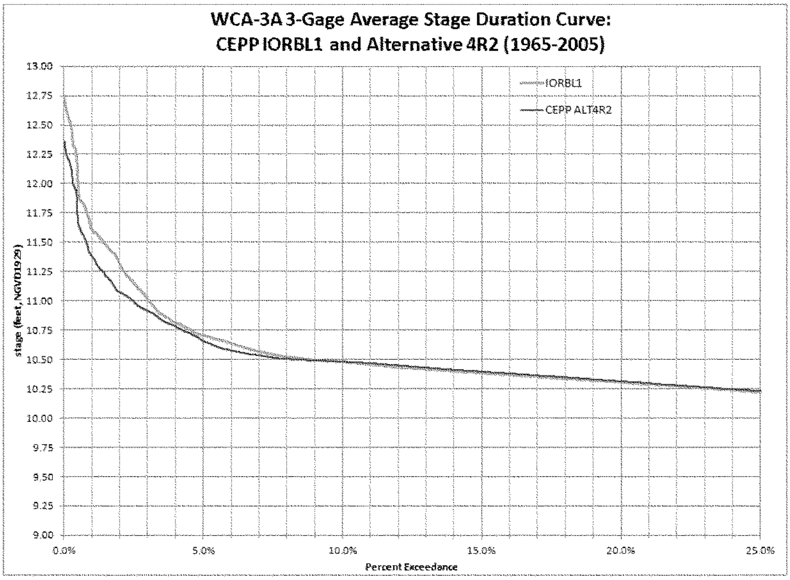

Figure 2-14 - WCA 3A Three-Gauge Average Stage Duration Curve

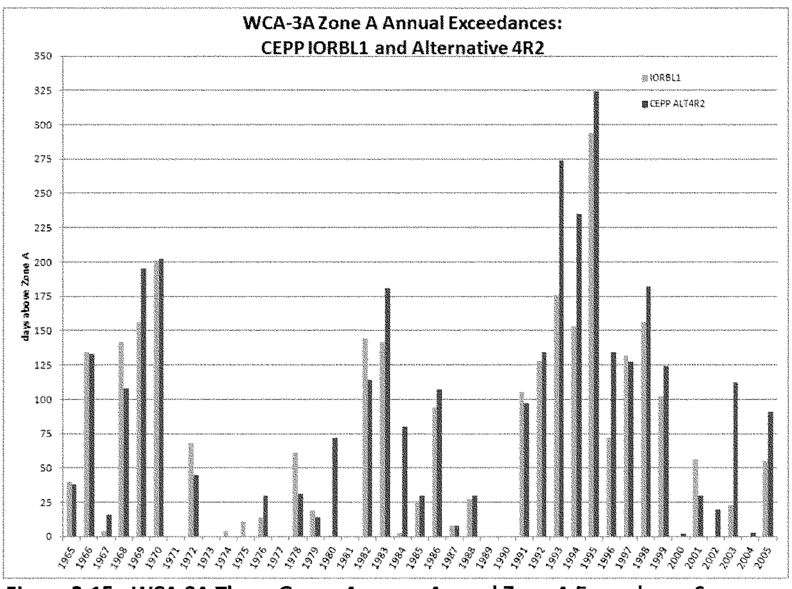

Figure 2-15 - WCA 3A Three-Gauge Average Annual Zone A Exceedance Summary

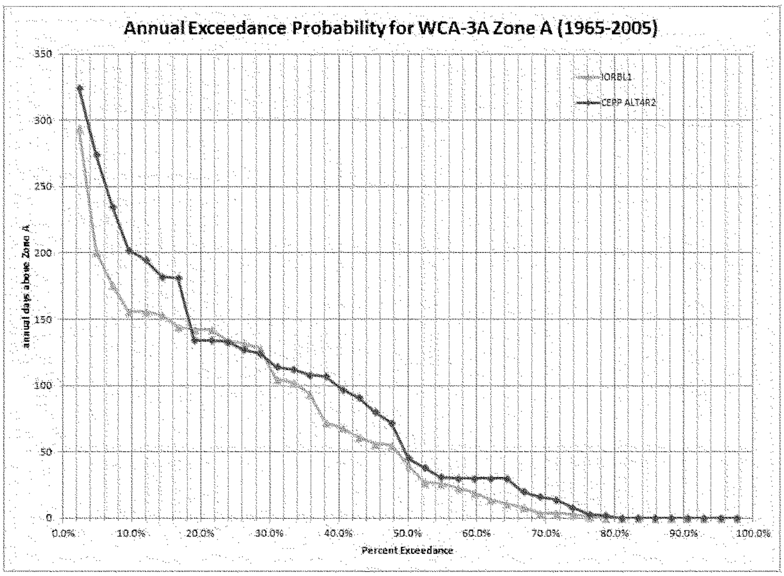

Figure 2-16 - WCA 3A Three-Gauge Average Probability Exceedance Curve for Annual Zone A Exceedance

The EN-W performance assessment for the final array of alternatives also included review of the WCA 3A stage hydrographs for individual years in which the number of days above Zone A increased by more than 20 percent between the CEPP FWO and any of the CEPP alternatives. Additional summary tables, annual hydrographs, and annual stage hydrograph statistical distribution plots are available in the CEPP PIR Engineering Appendix and the associated Hydrologic Modeling Annex A-2.

The detailed EN-W assessment of the frequency, duration, and peak stages of high water levels within WCA 3A concluded: (1) WCA 3A peak stages are lowered (these stages are most critical for WCA 3A design limitations); (2) the frequency and durations of Zone A exceedance are increased; (3) the increased frequency and durations occur during periods of the year when WCA 3A water levels are below peak critical levels; (4) CEPP infrastructure modifications (increased WCA 3A outlet capacity) and operations demonstrate that increased WCA 3A stages at the end of the dry season and start of the wet season can be effectively managed to avoid exacerbating high water conditions at the end of the wet season when Zone A levels off at 10.5 feet NGVD; and (5) CEPP infrastructure and operations utilized to achieve these performance levels need to be codified in the CEPP Project Operating Manual (POM). The requirements to maintain the frequency, duration, and peak stages of high water levels within WCA 3A consistent with the CEPP FWO (the IORBL1 performance is similar) were, therefore, successfully achieved based on EN-W assessment of the overall performance of the CEPP final array, including the Recommended Plan Alt 4R2.

Concurrent with CEPP alternative formulation and modeling efforts, EN-W conducted a review of WCA 3B high water levels compared to the WCA 3B design criteria and independent of any previous SPF stage considerations. WCA 3B is currently bounded by the L-29 Levee (Section 3) to the south, the L-67A Levee and the L-67C Levee to the west, and the L-30 Levee to the east. The design grades for these WCA 3B perimeter levees range between 13.0 feet NGVD for the L-29 Levee (note: typical sections range from 13.5-17.5 feet NGVD, due to subsequent stockpiling of spoil material from L-29 Canal improvements, and all L-29 Section 3 Levee sections meet or exceed the design grade) to 20.0 feet NGVD for the L-30 Levee (the design grades for the L-67A and L-67C Levees are 17.5 and 12.5 feet NGVD, respectively), such that the L-29 Levee design grade represents the limiting factor for peak WCA 3B stages for CEPP. Stage duration curves (upper 25%) for the CEPP ECB, CEPP FWO (the IORBL1 performance is similar), and Alt 4R2 are provided in the CEPP PIR Engineering Appendix for the two RSM-GL monitoring gauge locations within WCA 3B at Site 71 and Shark-1 (also alternatively referred to as SRS-1) that are produced with the model standard output information; corresponding RSM-GL model GSE elevations for these gauges are 6.64 and 6.61 feet NGVD, respectively. For CEPP Alt 4R2, peak stages within WCA 3B (outside of the Blue Shanty Flow-way in Alt 4R2) were 9.25 and 9.24 feet NGVD at Site 71 and Shark-1, respectively, or approximately 0.15-0.20 feet greater than the CEPP ECB/FWO baselines (9.05-9.06 feet NGVD) and the IORBL1 (9.08 feet NGVD); however, the WCA 3B peak stages for the CEPP Recommended Plan remains approximately 3.75 feet below the L-29 Section 3 design grade of 13.0 feet NGVD. The SPF rainfall for WCA 3B is approximately 1.5 feet (17.5 inches; based on the localized 3-day, 100-year maximum rainfall event of 14 inches). Based on EN-W assessment of these WCA 3B peak water depths less than 3 feet (2.61-2.63 feet peak depth for Alt 4R2 stages), maximum wind and wave run-up potentials would not be expected to exceed 1-2 feet.

For this preliminary EN-W assessment of WCA 3B (further analysis will be conducted during PED), a presumed worst-case scenario was defined for the CEPP Recommended Plan, with peak Alt 4R2 stages exacerbated by the additional SPF rainfall and maximum wind and wave run-up depths. Under this assumed worst-case scenario (9.25 feet NGVD stage + 1.5 feet SPF rainfall + 2.0 feet run-up potential), the L-29 Section 3 Levee would not be expected to be overtopped at the two lowest elevation points (with approximately 0.25 feet of remaining freeboard, compared to the minimum L29 Section 3 Levee elevation of 13.0 feet NGVD). Given no predicted L-29 Section 3 Levee overtopping for this conservative assumed combination of events and recognition that CEPP inflows to WCA 3B (both within the Blue Shanty flow-way and eastern WCA 3B) will utilize controllable structures that may be closed in anticipation of extreme rainfall events, the EN-W preliminary assessment of the WCA 3B design criteria concluded that the proposed CEPP water levels of Alt 4R2 would not adversely affect the flood control capability of the unmodified eastern segment of the L-29 Levee (or other perimeter levees, which have higher design elevations) bordering WCA 3B. Within the Blue Shanty flow-way, the peak stage with Alt 4R2 is 9.70 feet NGVD. The proposed L-67D Levee, which has a preliminary design elevation of 12.0 feet NGVD based on engineering design considerations (refer to Appendix A for additional details), would prevent the relatively higher stages within the Blue Shanty flow-way from further raising stages within eastern WCA 3B. The USACE currently anticipates revisiting the WCA 3B SPF stage during PED, pending final authorization of the CEPP and the establishment of operating criteria for WCA 3B water management structures for a System Operating Manual revision for CEPP implementation.

2.5.5 Agricultural and Urban Areas Located East of the East Coast Protective Levees

Flood protection in Miami-Dade County is of special concern due to the proximity of agricultural land uses, urban areas, and the Everglades. A complex network of canals, structures, culverts, impoundments, and pumps work in tandem to minimize seepage losses from the Everglades yet meet water supply and flood protection needs of agricultural and urban users. Selected gauges, groundwater difference maps, seepage from regional system and other model results were evaluated collectively to determine if the level of service for flood protection was affected.

For the agricultural and urban areas located east of the East Coast Protective Levees (L-31N and L-31W), the RSM-GL has no capability to precisely measure flood control on individual fields or during relatively short events, but the RSM-GL can be used as a coarse-scale tool to indicate a potential change in flood risk. Using the 1983 to 1993 stage duration curve data from the RSM-GL calibration and verification, the percentage of time the stage is above the root zone can be calculated and the information can be used to give an indication that additional flood control evaluation near a particular RSM-GL cell(s) may be needed. Six gauges or cells were evaluated consistent with Restoration Coordination and Verification (RECOVER) performance measure (**Figure 2-17**). In addition, a gauge near Tamiami Trail, G-3439, was also evaluated. It is located near the neighborhoods called Belen, Sweetwater, Serena Lakes and Country Walk which have experienced flood conditions historically (**Figure 2-18**). The most important part of the stage duration curve for flood protection assessment is the range of higher stages. Therefore, exceedances were evaluated for wet periods. Specifically, frequency and magnitude evaluations are made at the highest 1 to 20 percentiles of the curve, and relative magnitude of difference evaluations are made at the 10 percent frequency of stage duration. An alternative is of concern when the stages are noticeably higher than the 1983-1993 curve and when the higher stages occur for longer periods of time. Differences occurring deeper than 2 feet below land surface elevation are disregarded. It should be noted that usefulness of the 1983-1993 calibration data used in the official RECOVER performance measure was determined based on the South Florida Water Management Model (SFWMM). Confirmation that the RSM's calibration data bodes similar results (the RSM-GL calibration period is 1984-1995, and the verification periods are 1981-1983 and 1996-2000) or can be applied in the same manner as SFWMM has not been completed. A more appropriate comparison is the 2012EC and IORBL1 baselines in the SDCS, which include the same water control plan for this part of the system, ERTP.

The stage duration curves for the LEC canals adjacent to WCA 3B and ENP and selected monitoring gauges throughout the LEC were also assessed as part of the Savings Clause flood protection evaluation. The stage duration curves for these canals and gauges were assessed for increased stages within the upper 10 percentile, which were assumed as a representative indicator of potential increased flood protection risk.

Of the six RSM-GL cells compared to the 1983–1993 calibration data (**Figure 2-17**), the without project condition (IORBL1) and the existing condition baselines (2012EC and ECB), only one cell has stages that warrant detailed attention: cell 4328, located between the C-103 and C-113 Canals and immediately east of the C-111 Canal. For the other five indicator cells (**Figure 2-17**), stages in the with project condition (Alt 4R2) are either the same or below the 1983-1993 calibration data, IORBL1, and 2012EC, or groundwater stages are more than 2 feet below ground at levels that would not affect crops (**Figure 2-19** to **Figure 2-24**). The stage duration curve for indicator cell 4328 (**Figure 2-19**) for the with project condition (Alt 4R2) is essentially the same as the without project condition (IORBL1) during the wettest hydrologic conditions, up to the 20th percentile, with stages approximately 0.5 feet above the calibration values. Stages for cell 4328 are only slightly higher, by approximately 4 inches, between the 5th and 15th percentile when comparing the with project condition (Alt 4R2) to the existing condition baselines (2012EC and ECB). None of the simulated stages for the baselines or Alt 4R2 fall below the calibration data. Closer examination indicates that the stage is correlated to the adjacent C-111 Canal. In the RSM-GL model, final calibration of the Manning's coefficient (a roughness or resistance term) for the C-111 Canal resulted in selection of the maximum value (highest resistance) allowed under the calibration criteria. In general, selecting the extremes in the calibration range tends to lend less confidence in the results of the particular calibration parameter and, in this specific case, it is likely an indication that the C-111 Canal Manning's coefficient parameter was insensitive to conditions observed during the calibration period. Since the model performs well for the existing condition (2012EC) but shows high canal stages in the upstream reaches for the IORBL1 and Alt 4R2, the calibrated roughness coefficient is likely too high and the resulting upstream canal stages (and adjacent groundwater levels) are predicted higher by the RSM-GL than would be truly expected for the future with project conditions. This artifact of the model can only be addressed during model calibration and, in this specific case, should not be evaluated as representative of the predicted project performance.

G-3439, a monitored well located along the C4 Canal, was also evaluated (**Figure 2-25**). The with project condition (Alt 4R2) performs the same as the without project condition (IORBL1) during the highest 20 percent of the period of simulation. Comparison of the with project to the existing condition baselines (2012EC and ECB) shows the water stages slightly reduced with Alt 4R2.

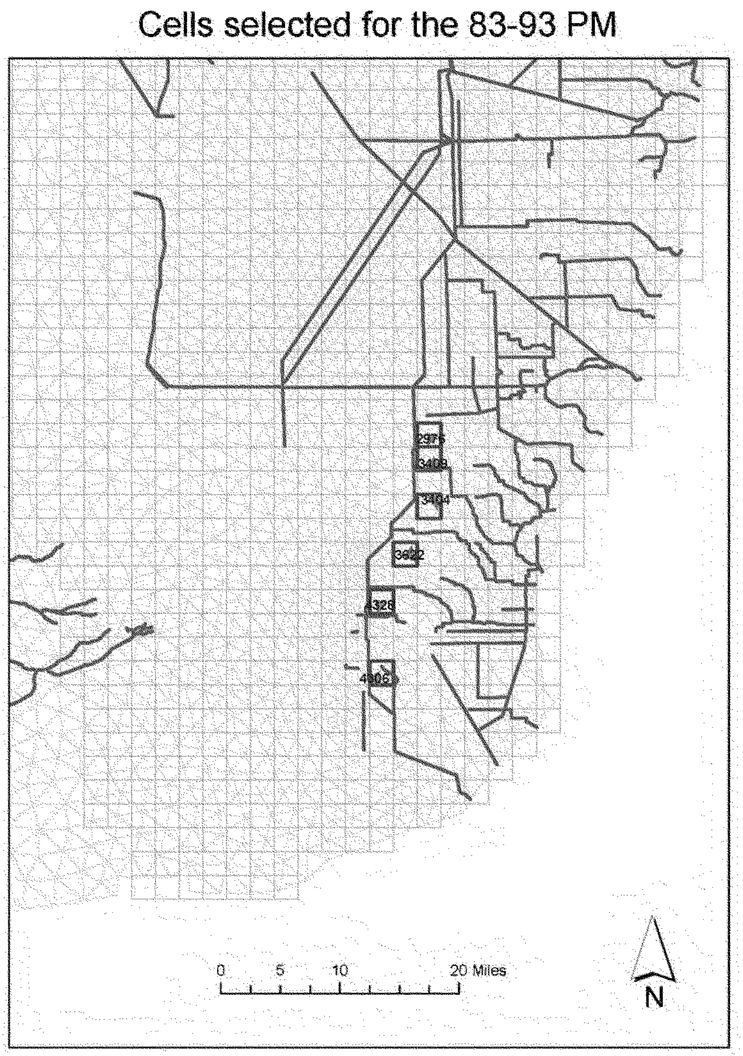

Figure 2-17 - Location of Cells Evaluation for Potential Effects to Agriculture in South Miami-Dade County

Figure 2-18 - Location of G-3439 (red dot) Relative to the Neighborhoods

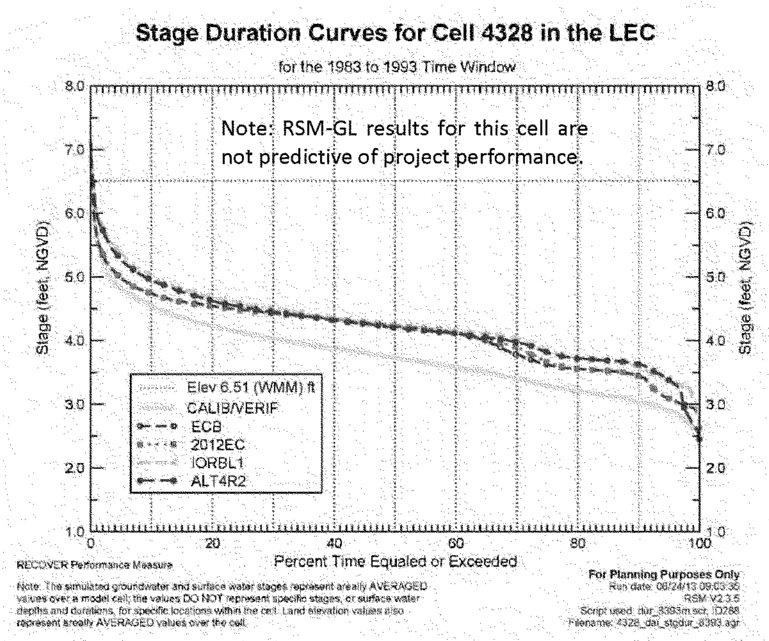

Figure 2-19 - Stage Duration Curves for Cell 4328 in the LEC Showing Anomalous Results

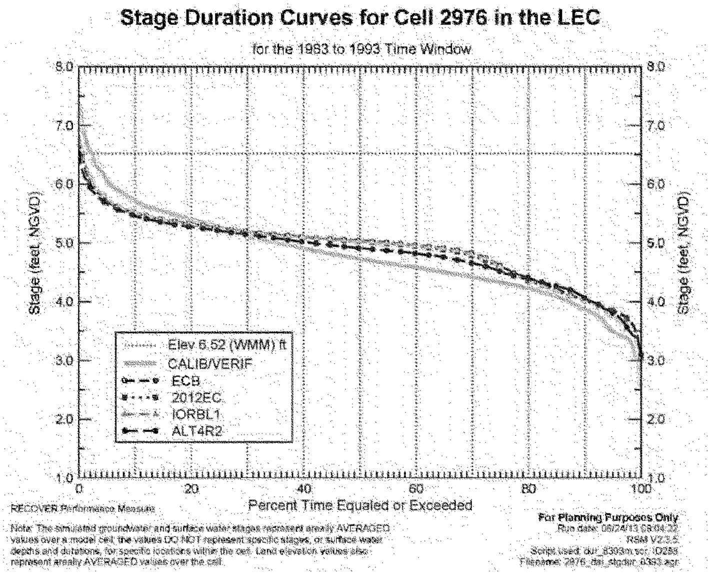

Figure 2-20 - Stage Duration Curves for Cell 2976 in the LEC Service Area

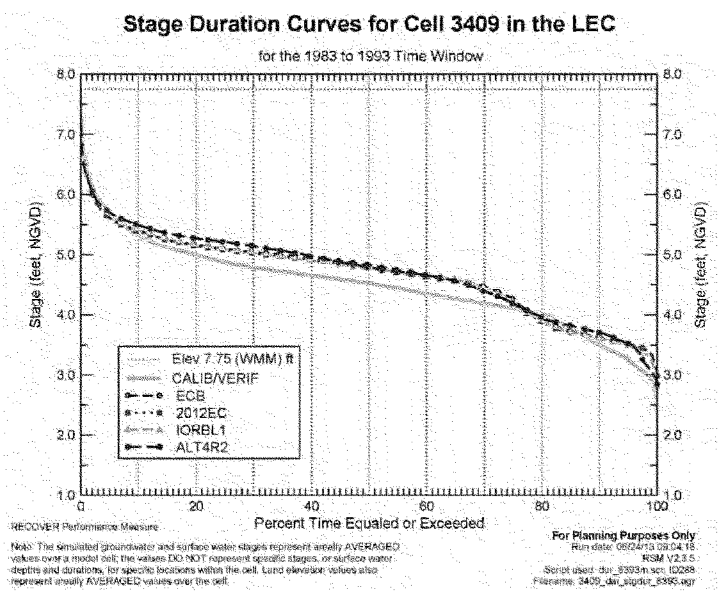

Figure 2-21 - Stage Duration Curves for Cell 3409 in the LEC Service Area

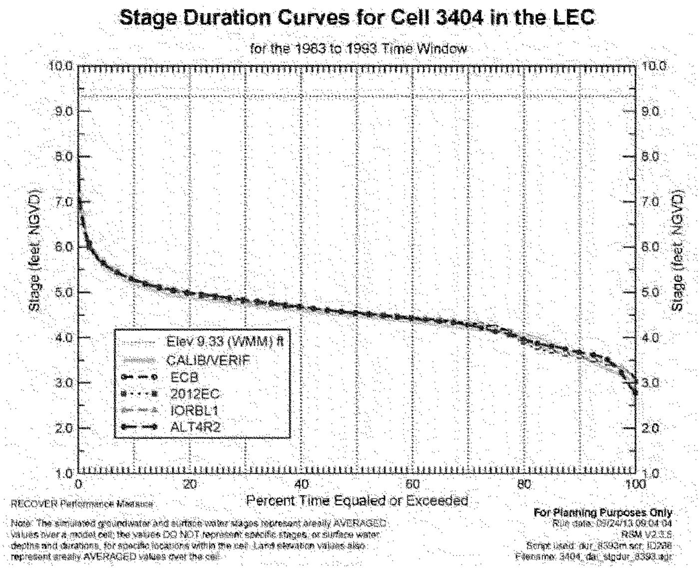

Figure 2-22 - Stage Duration Curves for Cell 3404 in the LEC Service Area

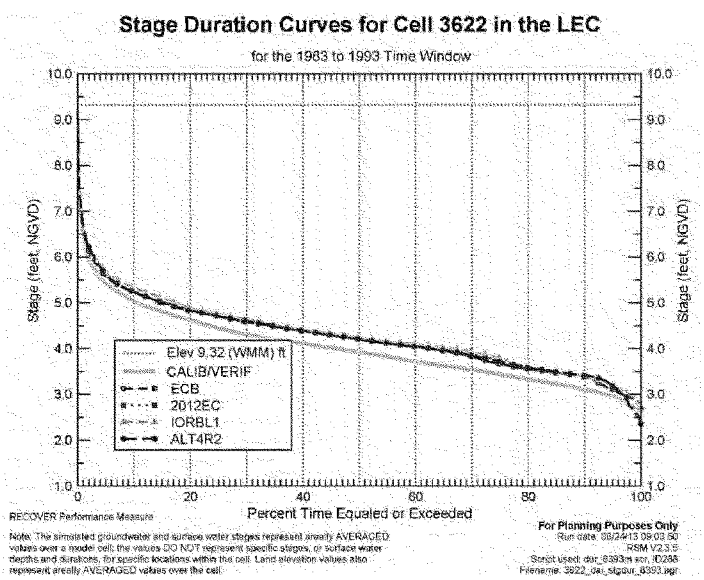

Figure 2-23 - Stage Duration Curves for Cell 3622 in the LEC Service Area

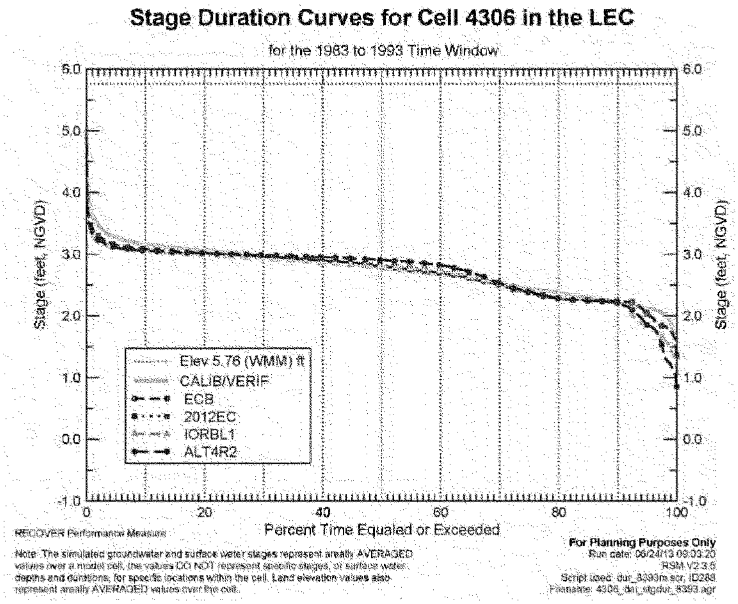

Figure 2-24 - Stage Duration Curves for Cell 4306 in the LEC Service Area

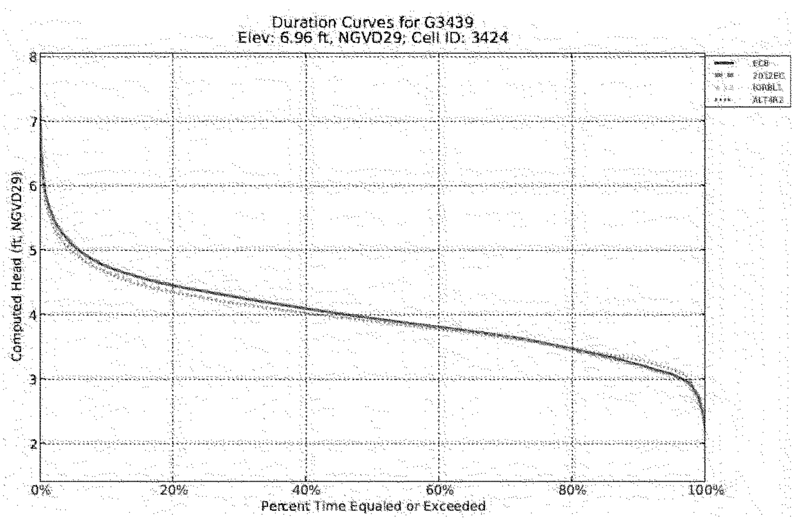

Figure 2-25 - Stage Duration Curves for Well G-3439

Additional information can be found in Annex B of the Final PIR

2.6 Threatened and Endangered Species

The project area of the CEPP is large and serves as refuge to a multitude of flora and fauna. The fauna of the area is dependent on wetlands as a source of food and refuge. Representatives from the U.S. Fish and Wildlife Service (USFWS) and Florida Fish and Wildlife Conservation Commission (FWC) have been active members of the project team and have provided guidance on potential impacts the CEPP may have on federally listed threatened and endangered species that live within the project area. The FWC completed an environmental resource analysis utilizing GIS with multiple data sets to produce an initial list of potentially occurring state listed species. This list was evaluated and reviewed with published literature and survey data by a team of FWC's habitat, wildlife, and fisheries experts to define and provide a final determination of potential effects on state listed species.

Forty federally listed threatened and endangered species are either known to exist or potentially exist within the project area and, subsequently, may be affected by the proposed project. Many of these species have been previously affected by habitat impacts resulting from wetland drainage, alteration of hydroperiod, wildfire, and water quality degradation. The USACE has coordinated the existence of federally listed species with USFWS and with National Marine Fisheries Service (NMFS), as appropriate. Specifically, coordination with NMFS includes listed fish, whales, and sea turtles at sea. Coordination with USFWS included other plants and animals.

Federally threatened, endangered, and candidate species that may occur within the study area include Florida panther (*Puma concolor coryi*), Florida population of West Indian Manatee (Florida manatee) (*Trichechus manatus*), Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), Everglade snail kite (*Rostrhamus sociablis plumbeus*), Northern crested caracara (*Caracara cheriway*), piping plover (*Charadrius melodus*), red-cockaded woodpecker (*Picoides borealis*), roseate tern (*Sterna dougallii dougallii*), wood stork (*Mycteria americana*), American alligator (*Alligator mississippiensis*), Florida bonneted bat (*Eumops floridanus*), American crocodile (*Crocodylus acutus*), Eastern indigo snake (*Drymarchon corais couperi*), Miami black-headed snake (*Tantilla oolitica*), Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*), Miami blue butterfly (*Cyclargus thomasi bethunebakeri*), Florida leafwing butterfly (*Anaea troglodyta floridalis*), Bartram's hairstreak butterfly (*Strymon acis bartrami*), Stock Island tree snail (*Orthalicus reses* [not incl. *nesodryas*]), crenulate lead-plant (*Amorpha crenulata*), Cape Sable thoroughwort (*Chromolaena frustrata*) deltoid spurge (*Chamaesyce deltoidea* ssp. *deltoidea*), Garber's spurge (*Chamaesyce garberii*), Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeenis*), Small's milkpea (*Galactia smallii*), tiny polygala (*Polygala smallii*), smalltooth sawfish (*Pristis pectinata*) and its critical habitat, Gulf sturgeon (*Acipenser oxyrinchus desotoi*) and its critical habitat, blue whale (*Balaenoptera musculus*), finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), leatherback sea turtle (*Dermochelys coriacea*), Kemp's ridley sea turtle (*Lepidochelys kempii*), loggerhead sea turtle (*Caretta caretta*), Johnson's seagrass (*Halophila johnsonii*) and its critical habitat, elkhorn coral (*Acropora palmata*) and its critical habitat, and staghorn coral (*Acropora cervicornis*) and its critical habitat.

To achieve restoration objectives, the recommended plan increases the amount of water delivered into areas inhabited by endangered species, including the critically-endangered Cape Sable seaside sparrow. The USFWS supports the recommended plan and is developing measures to improve the number and distribution of sparrows, but has expressed concerns about operations during nesting periods and effects on sparrow habitat. The USFWS has provided recommendations in their Programmatic Biological Opinion (BO), provided under the requirements of the Endangered Species Act, to avoid and minimize harmful effects on endangered species potentially affected by the project.

The CEPP project area contains habitat suitable for the presence, nesting, and/or foraging of 16 state-listed threatened and endangered species and 18 species of special concern. Threatened and endangered state-listed animal species include the Big Cypress fox squirrel (*Sciurus niger avicennia*), Florida mastiff bat (*Eumops glaucinus floridanus*), Florida black bear (*Ursus americanus floridanus*), Everglades mink (*Mustela vison evergladensis*), Florida sandhill crane (*Grus canadensis pratensis*), snowy plover (*Charadrius alexandrius*), Southeastern American kestrel (*Falco sparveriuspaulus*), least tern (*Sterna antillarum*), white-crowned pigeon (*Columba leucocephalus*), and Miami black-headed snake (*Tantilla oolitica*). Species of special concern include the Florida mouse (*Podomys floridanus*), Shermans fox squirrel (*Sciurus niger shermani*), American oystercatcher (*Haematopus palliates*), brown pelican (*Pelecanus occidentalis*), black skimmer (*Rynchops niger*), burrowing owl (*Athene cunicularia*), limpkin (*Aramus guarauna*), reddish egret (*Egretta rufescens*), snowy egret (*Egretta thula*), little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), white ibis (*Eudocimus albus*), roseate spoonbill (*Platalea ajaja*), osprey (*Pandion haliaetus*), mangrove rivulus (*Kryptolebias marmoratus*), mangrove gambusia (*Gambusia rhizophorae*), gopher tortoise (*Gopherus polyphemus*), and the Florida tree snail (*Liguus fasciatus*). While small foraging or nesting areas utilized by many of these animal species may be affected by this project, no adverse impacts are anticipated to state listed species as a result of this project.

State-listed threatened and endangered plant species include the pine-pink orchid, which frequents the edges of the farm roads just above wetland elevation; the lattice-vein fern, which is found occasionally in the forested wetlands; Eaton's spikemoss, and Wright's flowering fern, both found in the Frog Pond natural area; along with the Mexican vanilla plant and Schizaea tropical fern located on tree islands in the upper Southern Glades region.

The FWC supports CEPP as part of the global greater south Florida ecosystem restoration effort. However, the FWC have raised concerns that guidelines currently being considered for management of water in and through this ecosystem would result in high and low water conditions that negatively impact fish and wildlife populations, habitat, and diversity, particularly certain state and federally listed species. In particular, they are concerned that water levels and durations may affect terrestrial species and endangered species such as the panther, wood stork and Cape Sable seaside sparrow. It is the position of the FWC that water levels in the Central Everglades should be managed in a manner that sustains and restores native fish and wildlife populations, habitat, and diversity. The FWC intends to actively participate in the implementation phase and adaptive management process for the Central Everglades Planning Project to help ensure maximum benefits to fish and wildlife resources.

The recommended plan provides roughly 210 kAF of additional flow south from Lake Okeechobee and improves the current distribution of water into WCA 3A and throughout the Greater Everglades into Northeast Shark River Slough (SRS). The improved distribution of water deliveries through SRS is anticipated to increase foraging opportunities for wading birds and snail kites as well as improve conditions for alligators and other wetland species inhabiting the partially restored landscapes of northern WCA 3A, WCA 3B, and Northeast SRS. Also expected are improved conditions in southern WCA 3A, by reducing the frequency and duration of high water events, which erode the ridge and slough landscape and result in tree island flooding. Vegetation shifts are expected in marshes and on tree islands throughout northern WCA 3A, WCA 3B and SRS. The CEPP will also provide restoration benefits to ENP and Florida Bay. For example, re-establishing sheetflow and hydropattern will restore ridge and slough habitat beneficial to all natural resources within ENP. In Florida Bay, the CEPP will lower salinities resulting in measureable improvements in habitat for juvenile American crocodiles, juvenile spotted seatrout, pink shrimp, and seagrasses. Additional information can be found in Annex A and Appendix C.2.2 of the Final PIR.

2.7 Other Natural System Habitat Needs

The recommended plan provides significant benefits within the project area; beneficially affecting more than 1.5 million acres in the Caloosahatchee and St. Lucie Estuaries, the Greater Everglades, and Florida Bay. Based on the methodology that was used to quantify ecosystem benefits (i.e. Habitat Units [HU]), the recommended plan would provide 969,271 HUs, an improvement of 285,689 HUs in comparison to the future without project condition. The recommended plan would decrease high volume freshwater discharges from Lake Okeechobee that are currently sent to the Northern Estuaries. Additional water from Lake Okeechobee would be sent southward through canals of the EAA to the A-2 FEB. The A-2 FEB would provide storage capacity, attenuation of high flows, and limited pre-treatment prior to delivery of the redirected water to existing STAs, which would reduce phosphorus concentrations in the water to meet required water quality standards. The treated water would be distributed across the northwestern boundary of WCA 3A to flow through and help restore more natural quantity, timing and distribution of water to WCA 3A, WCA 3B, ENP, and Florida Bay. Several existing levees, canals, culverts, and pump stations would be constructed, modified, or removed to improve the flow of water through the system and provide for other water related needs.

The recommended plan addresses the need to restore ecosystem function in the Caloosahatchee and St. Lucie Estuaries by reducing the number and severity of events where harmful amounts of freshwater from Lake Okeechobee are discharged into the estuaries. Currently, many oyster and seagrass beds are stressed and have been reduced or eliminated from their former areas by extreme salinity fluctuations, increased turbidity and sedimentation, dredging, damage from boats, and nutrient enrichment, which causes algal blooms that in turn restrict light penetration. A reduction in the number of high volume freshwater discharges to the estuaries would help to reduce turbidity, sedimentation, and moderate unnatural changes in salinity that are extremely detrimental to estuarine communities. Reductions in turbidity and sedimentation would allow greater light penetration, promoting the growth of seagrass beds and would help lessen the problem of flushing oyster spat into outer areas of the estuaries that currently experience high salinity levels during the dry season resulting in increased predation and disease in the oyster population.

The recommended plan provides a significant increase in the quantity of fresh water (approximately 210 kAF/yr, annual average) flowing into the Everglades. This additional freshwater flow to the Central Everglades is essential to Everglades restoration. In the pre-drainage system, the inundation pattern supported an expansive system of freshwater marshes including longer hydroperiods sawgrass "ridges" interspersed with open-water "sloughs", higher elevation marl prairies on either side of Shark River Slough, and forested wetlands in the Big Cypress Marsh. The original C&SF Project has compartmentalized and fragmented the Everglades landscape, reduced flows through the sloughs, and altered hydroperiod and depths. The result has been substantially altered plant community structures, reduced abundance and diversity of animals, and spread of nuisance and exotic vegetation. The recommended plan would provide for resumption of sheetflow and related patterns of hydroperiods and water depth that would significantly help to restore and sustain the microtopography, directionality, and spatial extent of ridges and sloughs, and improve the health of tree islands within the landscape. Additional water flowing into the Everglades would also result in beneficial shifts in habitat for desired wildlife species. Implementation of the recommended plan features and additional flow would provide greater project benefits to those areas located in northern WCA 3A and ENP. **Figure 2-26** and **Figure 2-27** depict the differences in hydroperiod between the TSP and the FWO project condition in WCA 3 and ENP as modeled by the RSM-GL (version 2.3.2). The years 1989 and 1995 are depicted, which are representative of a dry and wet year in the 41-year period of simulation (1965-2005).

In northern WCA 3A, the Miami Canal functions as a major, unnatural drainage for WCA 3A. In combination with the northern levees of WCA 3A (L-4 and L-5), the Miami Canal has substantially impacted historical sheetflow and natural wetland hydroperiods. As a result, the natural capability of northern WCA 3A to store water is lost and the Miami Canal effectively over-drains the area. These hydrologic changes have increased the frequency of severe peat fires and have also resulted in the loss of ridge and slough topography that was once characteristic of the area. Most of WCA 3A north of Interstate 75 has experienced some form of fire and in more recent years those fires have moved farther south into the western portion of WCA 3A. Today, the northern WCA 3A is largely dominated by sawgrass, cattail, and scattered shrubs and lacks the structural diversity of plant communities seen in central and western WCA 3A. The recommended plan is expected to rehydrate much of northern WCA 3A by providing a means for redistributing treated STA discharges from the L-4 and L-5 Canals in a manner that promotes sheetflow and by removing the drainage effects associated with the Miami Canal. This would promote the reversal of soil loss and would help in the restoration of organic soil accretion.

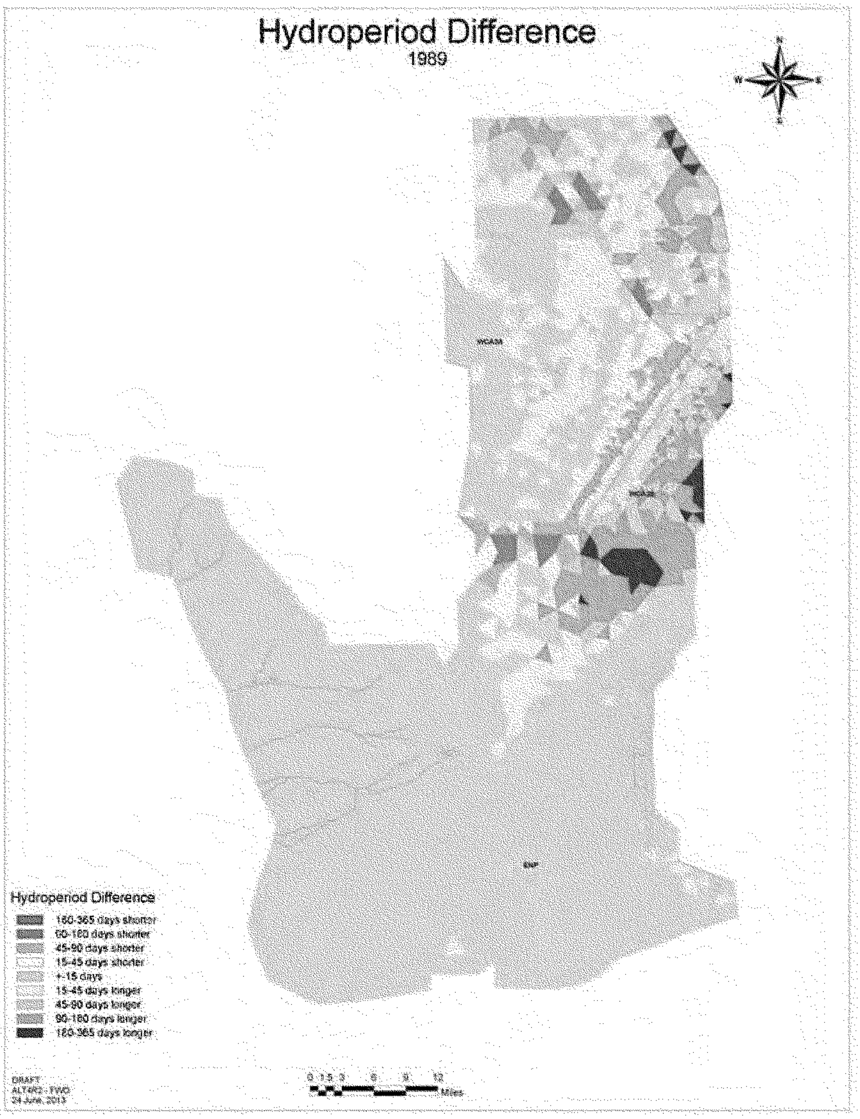

Figure 2-26 - Differences in Hydroperiod Distribution within WCA 3 and ENP between the FWO Project Condition and the TSP for a Representative Dry (1989) Year in the Period of Record (1965-2005)

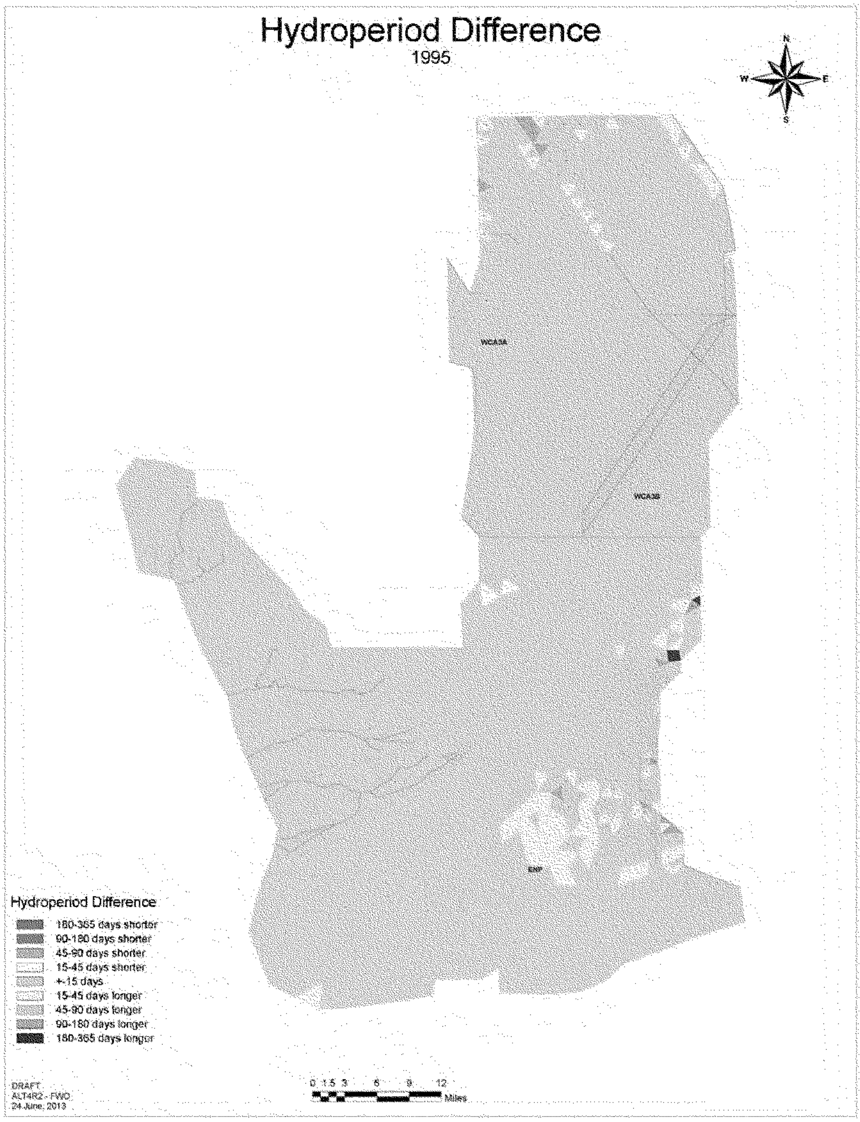

Figure 2-27 - Differences in Hydroperiod Distribution within WCA 3 and ENP between the FWO Project Condition and the TSP for a Representative Wet (1995) Year in the Period of Record (1965-2005)

Central WCA 3A is considered to be fairly well conserved ridge and slough habitat. Vegetation and patterning in the central portion of WCA 3A resembles the pre-drainage conditions most closely and represents some of the best examples of Everglades habitat left in south Florida. This region of the Everglades appears to have changed little since the 1950s (which was already post-drainage) and contains a mosaic of tree islands, wet prairies, sawgrass stands, sawgrass ridges, and aquatic sloughs. Increases in depth within central WCA 3A were not as significant as increases in observed depths in northern WCA 3A; however, maintenance of existing conditions within this region of the project area is desirable as ridge and slough habitat is well conserved.

The southern portion of WCA 3A is primarily affected by long durations of high water and a lack of seasonal variability in water depths created by impoundment structures (i.e., L-67 and L-29 Levees). The increased duration of high water events within southern WCA 3A has negatively impacted tree islands and caused fragmentation of the sawgrass ridges, again resulting in the loss of historic landscape patterning. Southern WCA 3A would remain largely unaffected by the recommended plan. The recommended plan would not result in significant benefits to southern WCA 3A through reduction in high water levels or durations.

Within WCA 3B, the ridge and slough landscape has been severely compromised by the virtual elimination of overland sheetflow since the construction of the L-67A/C Canal and Levee system. WCA 3B has become primarily a rain-fed compartment, experiencing very little overland flow and has largely turned into a sawgrass monoculture where relatively few sloughs or tree islands remain. Loss of sheetflow to WCA 3B has also accelerated soil loss reducing elevations of the remaining tree islands in WCA 3B, making them vulnerable to high water stages. The recommended plan would begin to re-establish hydrologic connectivity of WCA 3A, WCA 3B, and ENP. Increases in stages and hydroperiods would promote wetland vegetation transition, through contraction of sawgrass marshes and expansion of wet prairies and sloughs.

Flows through SRS under current water management practices, including the existing WCA 3A Regulation Schedule and the current limited capacity to redirect Lake Okeechobee water south to the Everglades, are much reduced when compared with pre-drainage conditions. The result has been lower wet season depths and more frequent and severe dry outs in the sloughs and reduction in the extent of the important shallow water "edges". Where infrequent dryouts allow marsh fishes and other aquatic animals to reach a relative abundance necessary to support upper trophic level reproduction, drydowns that are too frequent and severe hinder the ability of aquatic animal populations to rebound. Over-drainage in the peripheral wetlands along the eastern flank of Northeast SRS has resulted in shifts in community composition, invasion by exotic woody species, and increased susceptibility to fire. The recommended plan is expected to rehydrate much of Northeast SRS by providing a means for redistributing flows from WCA 3A through WCA 3B to ENP. Restoration of flow volumes will significantly improve hydroperiods and water depths while reducing the frequency and severity of drydowns.

Changes in hydrology of the freshwater systems have led to effects on the estuarine and marine environments of Florida Bay. Florida Bay is the main receiving water body of the Greater Everglades system and is heavily influenced by changes in the timing, distribution, and quantity of freshwater flows. Alterations in seasonal inflow deliveries to Florida Bay have resulted in extreme salinity fluctuations. Water management actions that result from the recommended plan have the potential to reduce the intensity, frequency, duration and spatial extent of hypersaline events in Florida Bay and establish a persistent and resilient estuarine zone that extends further into the bay than currently exists. CEPP does not reconnect Shark River Slough to Taylor Slough or Florida Bay as it was historically, but it does allow additional surface water to flow southeastward around Mahogany Hammock towards West Lake, the Lungs, and Garfield Bight helping to negate the harmful buildup of hypersalinity. This is expected to help restore the bay to more natural conditions and increase biomass and diversity of bay flora and fauna including ecologically and economically important pink shrimp and spotted sea trout, and desired seagrass species.

Further information pertaining to the evaluation of the recommended plan is described in Section 5 of the Final PIR and Appendix C.2.2.

3 Determination of Project Component Feasibility

Section 373.1501(5)(b), F.S., states that the SFWMD shall "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."

3.1 Standard Engineering Practices and Technologies

3.1.1 Summary of Project Features

The CEPP will be implemented in accordance with selected plan – Alternative 4R2. The components are:

3.1.1.1 Storage and Treatment - North of Redline (Figure 3-1)

The project features of the Storage and Treatment component include:

- Construction of A-2 FEB and integration with A-1 FEB operations
- Lake Okeechobee operational refinements

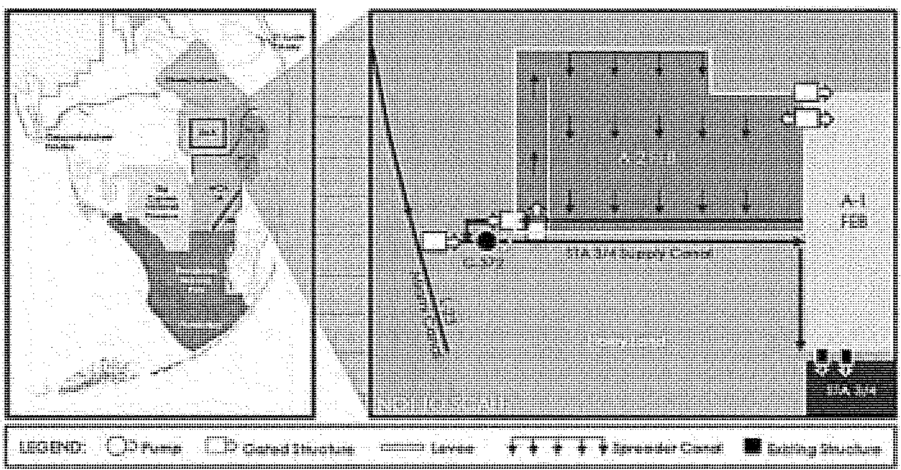

Figure 3-1 - Recommended Plan Treatment and Storage Features and Location

3.1.1.2 Distribution and Conveyance – South of Redline (Figure 3-2 & Figure 3-3)

The project features of the Distribution and Conveyance component include:

- Diversion of L-6 flows, infrastructure, and L-5 canal improvements
- Remove western ~2.9 miles of L-4 levee west of S-8 (3,000 cfs capacity)
- Construct 360 cfs pump station at western terminus of L-4 levee removal

- Backfill Miami Canal and Spoil Mound Removal from ~1.5 miles south of S-8 to I-75

3.1.1.3 Distribution and Conveyance – Greenline/Blueline (Figure 3-2 & Figure 3-3)

The project features of the Distribution and Conveyance component also include:

- Increase S-333 capacity to 2,500 cfs
- One 500 cfs gated structure north of Blue Shanty levee and 6,000-ft gap in L-67C levee
- Two 500 cfs gated structures in L-67A; 0.5 mile spoil removal west of L-67A canal north and south of structures
- Remove ~8 miles of L-67C levee in Blue Shanty flowway (no canal back fill)
- Construct ~8.5 mile levee (Blue Shanty levee) in WCA 3B, connecting L-67A to L-29
- Remove ~4.3 miles of L-29 levee in Blue Shanty flowway; divide structure east of Blue Shanty levee at terminus of Tamiami Trail Next Steps western bridge
- Remove entire 5.5 miles L-67 Extension levee; backfill L-67 Extension canal
- Remove ~6 miles of Old Tamiami Trail road (south of L-29 western levee, fromL-67 Ext to ENP Tram Rd)

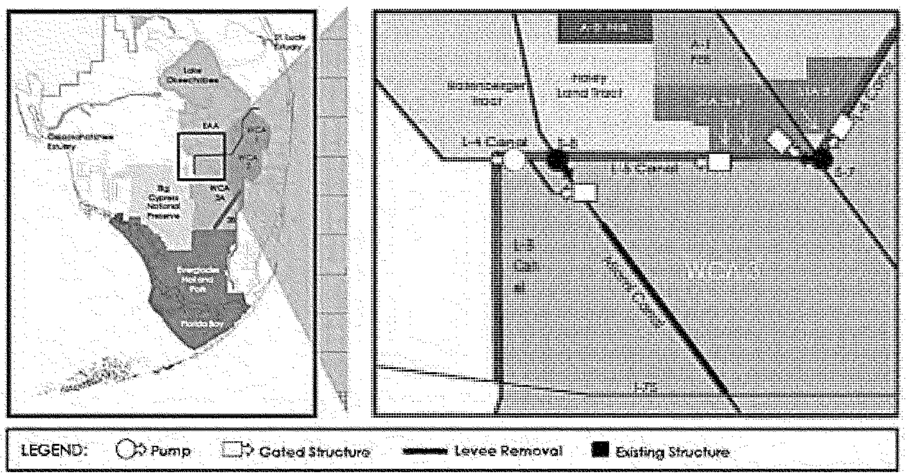

Figure 3-2 - Recommended Plan Northern Conveyance and Distribution Features and Location

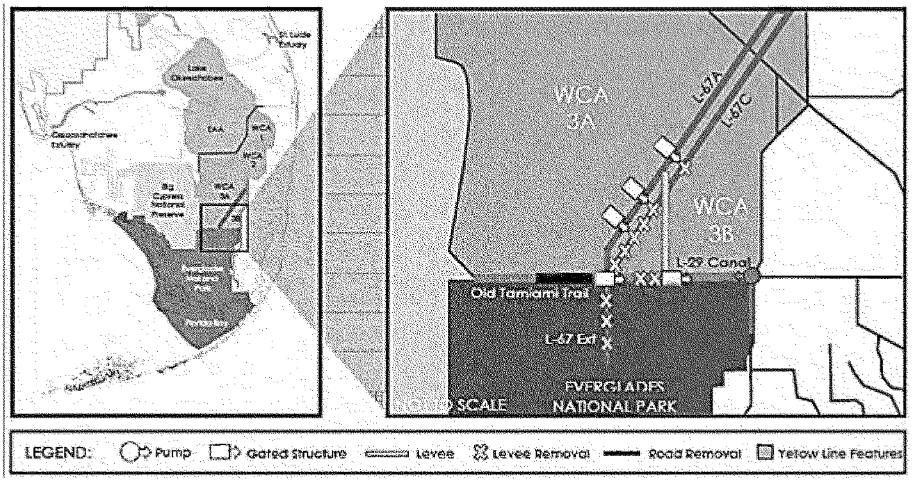

Figure 3-3 - Recommended Plan Southern Conveyance and Distribution Features and Location

3.1.1.4 Seepage Management - Yellowline (Figure 3-4)

The project features of the Seepage Management component include:

- New S-356 pump station with ~1,000 cfs capacity
- Construct 4.2 mile partial depth seepage barrier south of Tamiami Trail (along L-31N)
- G-211 operational refinements; use coastal canals to convey seepage

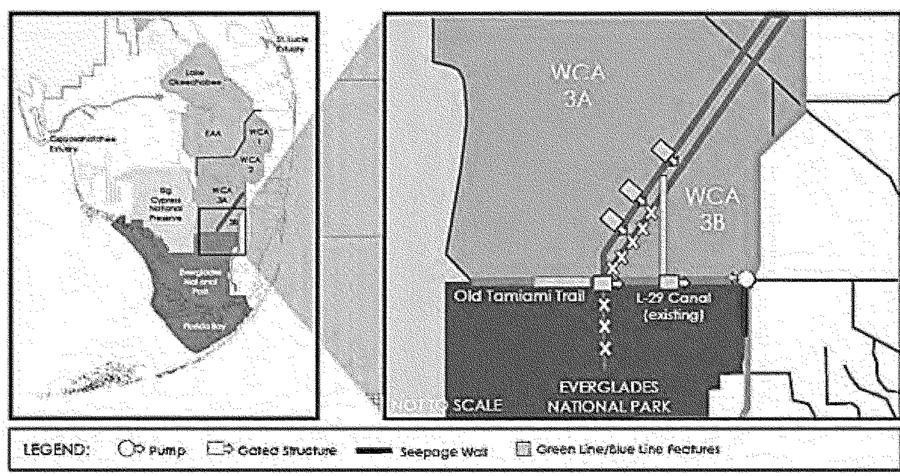

Figure 3-4 - Recommended Plan Seepage Management Features and Location

3.1.2 Engineering and Design

Due to an expedited schedule, absence of site-specific data and limited data, design for alternative development employed best professional judgment and prior knowledge of existing CERP components. **Appendix A** of the CEPP PIR provides a limited level of design, and includes documentation of all engineering assumptions and conceptual designs. Preconstruction Engineering and Design (PED) for recommended plan features could begin after Congressional authorization and upon SFWMD's concurrence consistent with the implementation phases and cost sharing. USACE will prepare an Engineering Design Report updating the conceptual design and prepare initial, intermediate, and final plans and specifications for each phase of construction. All work will be coordinated and reviewed between the USACE and the SFWMD, and approved by the USACE and SFWMD prior to construction, to ensure that the work meets USACE standards and regulations and incorporates SFWMD design guidance, as applicable. PED will include site-specific surveys and geotechnical investigations. During the design phase, detailed analyses, subsurface and site investigations will be conducted to prepare construction documents. During PED, project assurances, Savings Clause analysis, and operating manuals will be updated consistent with the implementation phases, if necessary. After completion of 60 percent final plans and specifications for a given project feature, the lead construction agency (USACE or SFWMD) will prepare and submit a CERPRA permit application (Section 373.1502, F.S.) to the FDEP. The FDEP will review the application material to determine if reasonable assurance that the feature will be consistent with state water quality standards in compliance with rules in effect at the time of application. See **Appendix A** and **Annex C-2** of **Appendix A of the PIR** for limited design details and conceptual design plates.

3.2 Efficiency and Cost Effectiveness

The CEPP recommended plan is justified by the environmental benefits derived by the south Florida ecosystem; however, a comparison of the benefits and costs of alternative plans is also conducted to ensure that a selected alternative is efficiently producing the environmental benefits. The measurement of efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment. Cost-effectiveness/incremental cost analysis (CE/ICA) is used to evaluate and compare the production efficiency of alternatives. This identifies the plans that reasonably maximize ecosystem restoration, a key criterion to select the national ecosystem restoration (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 lesser cost than other alternative plans. Alternative plans identified through this comparison are the cost effective alternative plans. Cost effective plans are then 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?", that is, are the additional outputs worth the costs incurred to achieve them?

The CE/ICA analysis is consistent with the PIR and follows guidance from the USACE, ER 1105-2-100. Costs are based initially on a planning level estimate and benefits are based on the habitat unit evaluation. 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 2072).

3.2.1 Costs of Final Array of Alternative Plans

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 2014 price levels. Costs of a plan represent the value of goods and services required to implement and operate/maintain the plan. The cost estimate for the alternatives includes construction, lands, easements, right-of-ways, relocation (LERR), preconstruction engineering and design (PED), construction management, and operations, maintenance, repair, rehabilitation and replacement (OMRR&R), and was developed through engineering design and cost estimation, and real estate appraisal efforts.

3.2.1.1 Overview of Real Estate Costs

A detailed analysis of the real estate requirements of the final array was completed. Each parcel required for construction or restoration activities was identified, characterized, and a value estimate was calculated. The real estate was valued in fee, however, lesser estates and interests in land could be considered. All of the alternatives had the same land requirements for the storage and treatment features. 14,521 acres in the A-2 Compartment were valued at SFWMD actual acquisition costs since these lands were purchased with both federal Farm Bill funds and SFWMD funds. 145.5 acres (90.93 acres owned by the State of Florida and 54.57 acres owned by SFWMD) were required for the new feeder canal leading from the Miami Canal on the west running east to the A-2 Compartment. These lands were valued at an estimated fair market value.

Alternative 1 included a feature at the L28 triangle which required additional lands, and accounts for the real estate difference between Alt 1 and the other alternatives. Lands were required for construction of pump stations, and other structures within Water Conservation Areas 3A and 3B. These lands were not assigned a value as they were provided for the prior Central and Southern Florida Flood Control Project.

3.2.1.2 Average Annual Costs

The timing of a plan's costs is important. Construction and other initial implementation costs cannot simply be added to periodically recurring costs for project operation, maintenance and monitoring if meaningful and direct comparisons of the costs of the different alternatives are to be made. A common practice of equating sums of money across time with their equivalent at an earlier 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 (set at 3.5% at the time of the evaluation), the cost time streams for the alternative plans were mathematically translated into an equivalent time basis value. There is some uncertainty as to how any of the alternatives 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 and would be implemented with no fiscal appropriation constraints.

ER 1105-2-100 requires that interest during construction (IDC) be computed, which represents the opportunity cost of capital incurred during the construction period. IDC was computed for PED 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, and assumed a 5 year unconstrained construction timeline. IDC was computed for both real estate and construction costs. IDC was computed for the total real estate cost starting from the month prior to construction commencing. The total first cost is the sum of construction and other capital cost, such as real estate and pre-construction. The total project investment is the first cost plus IDC. **Table 3-1** summarizes the total investment cost and average annual costs of each alternative plan.

Table 3-1 - Planning Level Construction and Investment Cost of Alternative Plans

	SUMMARY OF COSTS FOR CEPP ALTERNATIVE PLANS*			
	Alt 1	Alt 2	Alt 3	Alt 4
Cost Component				
Construction Features	**$1,855,000,000**	**$2,174,000,000**	**$2,282,000,000**	**$2,147,000,000**
Lands	**$41,000,000**	**$39,000,000**	**$39,000,000**	**$39,000,000**
Total First Cost	**$1,896,000,000**	**$2,213,000,000**	**$2,321,000,000**	**$2,186,000,000**
Interest During Construction				
Construction	$141,000,000	$165,000,000	$174,000,000	$163,000,000
Lands	$4,000,000	$4,000,000	$4,000,000	$4,000,000
Total Interest During Construction	**$145,000,000**	**$169,000,000**	**$178,000,000**	**$167,000,000**
Total Project Investment	**$2,041,000,000**	**$2,382,000,000**	**$2,499,000,000**	**$2,353,000,000**
Average Annual Cost				
Interest & Amortization	$87,000,000	$101,600,000	$106,500,000	$100,300,000
Operation, Maintenance, Repair, Rehabilitation, and Replacement	$5,500,000	$6,400,000	$6,900,000	$6,500,000
Average Annual Cost	**$92,500,000**	**$108,000,000**	**$113,400,000**	**$106,800,000**

*NER Annual costs are based on a 50-year period of analysis. Costs do not include costs of recreation features.

*Costs are planning level costs and do not coincide exactly with the detailed costs of the recommended plan presented in other sections of the report.

* Computation of the detailed estimate for the recommended plan is based on additional engineering and design.

* Contingency used in planning level costs was 82% due to the high level of uncertainty in the design of alternatives

3.2.2 Ecological Evaluation (Habitat Units)

The CEPP devised a project-specific tool, referred to as the CEPP planning model to evaluate alternatives within the CEPP project area. The primary areas evaluated included the St. Lucie River and Indian River Lagoon and the Caloosahatchee River and Estuary, WCAs 3A and 3B, ENP, and Florida Bay. Habitat units were not calculated for Lake Okeechobee or Biscayne Bay, since the performance of these areas were considered a constraint during formulation. The CEPP planning model is a Microsoft Excel spreadsheet that utilizes project performance measures to derive a Habitat Unit (HU) score that represents the ecological performance achieved by each alternative. The complete description of the model and further information pertaining to the alternative evaluation is described in **Appendix G**.

The CEPP planning model was used to aggregate the results of project performance measures. Each of the performance measures for the CEPP planning effort was derived from those approved for use in CERP by RECOVER. Eight performance measures were identified (**Table 3-2**). Performance measures were developed from the Northern Estuaries, Greater Everglades Ridge and Slough, and Florida Bay Conceptual Ecological Models (CEMs) (Barnes 2005, Ogden 2005a, Rudnick et al. 2005, Sime 2005). CEMs, as used in the Everglades restoration program, are non-quantitative planning tools that identify the major anthropogenic drivers and stressors on natural systems, the ecological effects of these stressors, and the best biological attributes or indicators of these ecological responses (Ogden et al. 2005b). These CEMs have been extensively peer reviewed and provide the framework for the planning and assessment of the CERP.

Table 3-2 - Performance Measures Used to Quantify National Ecosystem Restoration Plan Benefits

Region	Performance Measure	Description
Northern Estuaries	**Caloosahatchee Estuary** • PM 6.1 Low Flow Targets • PM 6.2 High Flow Targets **St. Lucie Estuary** • PM 7.1 Low Flow Targets • PM 7.2 High flow Targets	Measure of the frequency of flows correlated to downstream estuarine salinities favorable to marine fish, shellfish, oyster and SAV.
Greater Everglades (WCA 3 and ENP)	**Hydrologic Surrogate for Soil Oxidation** • PM 3.1 Drought Intensity Index	Measure of cumulative drought intensity as an indicator of peat oxidation and risk of fire.
	Inundation Duration: Ridge and Slough Landscape • PM 1.1 Percent Period of Record of Inundation	Measure of the frequency and duration of marsh inundation.
	Number and Duration of Dry Events: Shark River Slough • PM 4.1 Number of Dry Events • PM 4.2 Duration of Dry Events • PM 4.3 Percent Period of Record of Dry Events	Measure of the number of times and mean duration of periods when water levels drop below ground.
	Sheet flow in the Ridge and Slough Landscape • PM 2.1 Timing of Sheetflow • PM 2.2 Continuity of Sheetflow • PM 2.3 Distribution of Sheetflow	Measure of the agreement of seasonal timing of flows with pre-drainage timing and of the spatial uniformity of sheet flow across the landscape.
	Slough Vegetation Suitability • PM 5.1 Hydroperiod • PM 5.2 Dry down • PM 5.3 Dry Season Depth • PM 5.4 Wet Season Depth	Measure of hydrologic conditions favorable to two species (white water lily and spikerush) indicative of Everglades sloughs.
Florida Bay	**Salinity in Florida Bay** • PM 8.1 Dry Season Regime Overlap • PM 8.2 Wet Season Regime Overlap • PM 8.3 Dry Season High Salinity • PM 8.4 Wet Season High Salinity	Measure of temporal-seasonal agreement between predicted salinity regimes in Florida Bay and pre-drainage salinity targets.

Each performance measure has a predictive metric and targets based on hydrologic requirements necessary to meet empirical or theoretical ecological thresholds. Detailed estimates of hydrology across the 41-year period of record (January 1965-December 2005) generated by the RSM-BN (for the Northern Estuaries) and the RSM-GL (for the Greater Everglades [WCA 3 and ENP] and Florida Bay) were used to calculate performance measure scores.

Performance measure scores are displayed as a function of restoration potential or achievement of the target with the minimum value of zero representing a fully degraded ecosystem and a maximum value of 100 representing the restoration target. Habitat suitability indices associated with each performance measure are then summed and applied to the total spatial extent (acres) for each of the 17 zones (**Figure 3-5** through **Figure 3-8**) to produce habitat units.

Habitat unit results for the existing conditions baseline (ECB), the future without project condition (FWO) and the alternatives are displayed in **Table 3-6.**

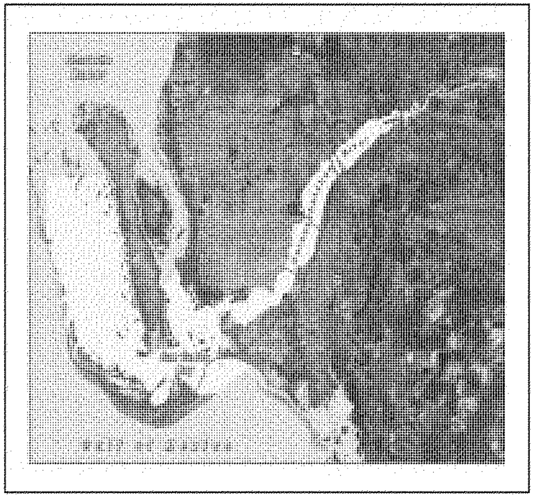

Figure 3-5 - Zones for Habitat Suitability within the Caloosahatchee Estuary

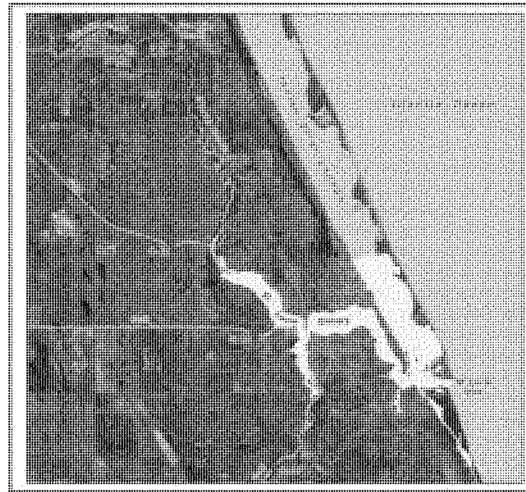

Figure 3-6 - Zones for Habitat Suitability within the St. Lucie Estuary

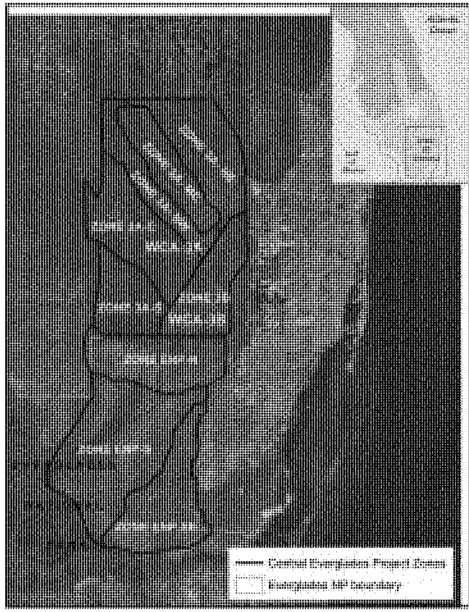

Figure 3-7 - Zones for Habitat Suitability within WCA 3 and ENP

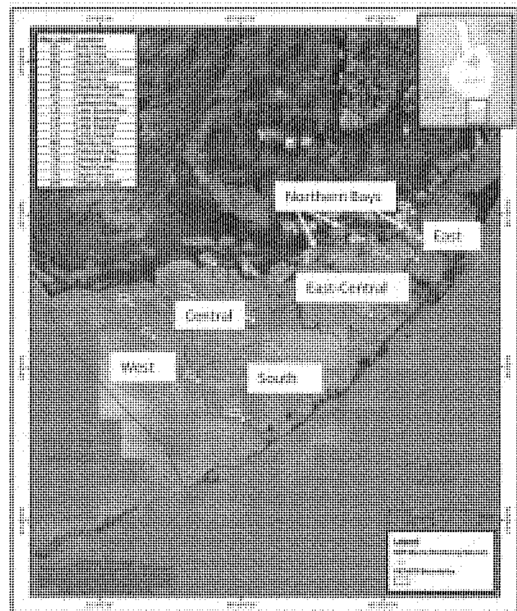

Figure 3-8 - Zones for Habitat Suitability within Florida Bay

Table 3-3 - Total Habitat Units for each Alternative Condition

Project Region (Zone)	ECB*	FWO**	Alt 1**	Alt 2**	Alt 3**	Alt 4**
Caloosahatchee Estuary (CE-1)	2,839	34,070	39,038	39,038	39,038	39,038
St Lucie Estuary (SE-1)	2,099	2,399	4,798	4,798	4,798	4,798
Total Northern Estuaries	4,938	36,469	43,836	43,836	43,836	43,836
Northeast WCA 3A (3A-NE)	44,451	29,634	96,311	96,311	96,311	96,311
WCA 3A Miami Canal (3A-MC)	32,847	27,373	57,874	57,092	56,310	57,092
Northwest WCA 3A (3A-NW)	30,970	30,266	54,902	53,494	53,494	53,494
Central WCA 3A (3A-C)	108,414	105,669	109,786	109,786	109,786	109,786
Southern WCA 3A (3A-S)	69,247	68,423	68,423	67,598	67,598	68,423
WCA 3B (3B)	55,697	48,842	58,268	59,125	57,411	54,840
Northern ENP (ENP-N)	57,557	55,054	102,601	101,350	103,852	102,601
Southern ENP (ENP-S)	124,068	126,454	169,400	169,400	176,558	188,488
Southeast ENP (ENP-SE)	79,711	81,062	82,413	82,413	82,413	83,764
Total Greater Everglades (WCA 3 and ENP)	602,962	572,777	799,978	796,569	803,733	814,799
Florida Bay West (FB-W)	23,693	20,534	42,647	42,647	47,386	52,124
Florida Bay Central (FB-C)	9,025	8,205	15,589	14,769	17,230	17,230
Florida Bay South (FB-S)	16,614	14,659	30,296	29,318	33,228	35,182
Florida Bay East Central (FB-EC)	21,984	20,225	36,933	36,933	42,209	46,606
Florida Bay North Bay (FB-NB)	2,154	2,028	2,661	2,661	2,788	2,915
Florida Bay East (FB-E)	9,440	8,685	10,573	10,573	10,950	10,950
Total Florida Bay	82,910	74,336	138,699	136,901	153,791	165,007
Total All Regions	690,810	683,582	982,513	977,306	1,001,360	1,023,642

* HU values for the ECB represent those calculated in the year 2010.

** HU values for the FWO and Alts 1 through 4 represent those calculated in the year 2072.

There are substantial benefits within the Blue Shanty Flow-way in WCA 3B that are not captured in the HU calculations. The CEPP planning model uses an indicator region that falls outside the Blue Shanty Flow-way; however, the hydrology within the flow-way would more closely resemble southern WCA 3A, potentially leading to an underrepresentation of benefits for Alt 4.

3.2.2.1 Average Annual Habitat Units

The average annual outputs were calculated as the difference between the with-plan and without plan conditions over the period of analysis (through year 2072). The base year for the period of economic analysis for CEPP is the year 2022. The average annual habitat unit lift is calculated as subtracting the future without project habitat units from the future with project habitat units for each year and averaging over the 50-year period of analysis. The anticipated time it will take to realize the benefits is necessary to calculate the average annual lift associated with each alternative.

Natural ecosystems are complex, dynamic systems and the exact functional form of the relationship among variables is rarely if ever known. South Florida ecosystems have been subject to extensive research and monitoring, and credible estimates of response times can be predicted based on how key ecosystem components have responded to varying hydrologic conditions. The rate at which CEPP benefits accrue over various time intervals, depending on the region, were estimated using these inferences. Linear interpolation was used as a simple method for inferring the rate at which benefits would accrue between those time intervals for each of the three regions of the project area for both the future without and future with project conditions.

3.2.2.2 Greater Everglades (WCA 3 and ENP)

An ecological response time for the Greater Everglades was estimated based on the ability of CEPP to improve conditions for aquatic and herbaceous vegetation communities, periphyton, piscivorous fish, aquatic prey base organisms, and hydroecological reshaping of ridges and tree islands. The ecological response time was estimated to be approximately 75-100 years until full impact would be realized, with a large percentage of benefits accruing earlier as identified in **Table 3-4**.

Table 3-4 - Ecological Response Time for Greater Everglades (WCA 3 and ENP)

Percentage of Benefit Achieved Over Time for the Greater Everglades				
0-2 Years*	**2-5 Years**	**5-10 Years**	**25-50 Years**	**75-100 Years**
50%	70%	80%	90%	100%

*Base year is 2022

Figure 3-9 graphically displays the ecological response time in the greater Everglades for each alternative condition. As previously discussed the period of analysis for CEPP extends 50 years out from the base year (2022) and consequently a greater degree of the full impact of the CEPP alternatives is captured by extending the period of analysis past the traditional CERP 2050 end year.

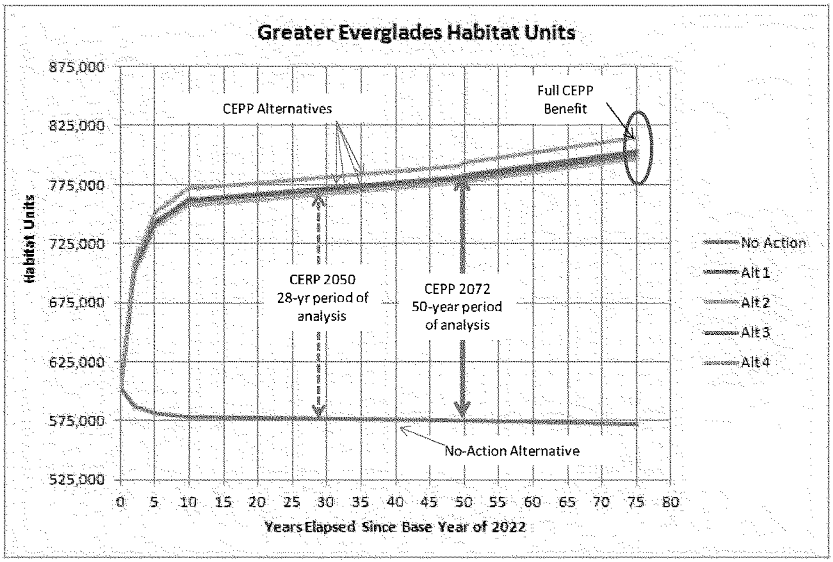

Figure 3-9 - Habitat Units through Time for Alternative Conditions in Reaction to Ecological Response Times

3.2.2.3 Florida Bay

An ecological response time for Florida Bay was estimated based on the ability of CEPP to improve conditions for phytoplankton, zooplankton, seagrass, and large and small invertebrates. The ecological response time was estimated to be approximately 15-25 years until full impact would be realized, with a large percentage of benefits accruing earlier as identified in **Table 3-5**.

Table 3-5 - Ecological Response Time for Florida Bay

Percentage of Benefits Achieved Over Time for Florida Bay				
0-2 years	**2-5 years**	**5-10 years**	**10-15 years**	**15-25 years**
40%	80%	90%	95%	100%

*Base year is 2022.

3.2.2.4 Northern Estuaries

An ecological response time for the Northern Estuaries was estimated based on the expected response time of oysters and submerged aquatic vegetation to improved salinities. The ecological response time was estimated to be approximately 6 years until full impact would be realized. **Table 3-6** includes the average annual lift when taking into account the ecological response times of each of the three regions described above.

Table 3-6 - Average Annual Habitat Unit Lift

	No Action	Alt 1	Alt 2	Alt 3	Alt 4
St Lucie					
Average Annual Habitat Units	2,378	4,612	4,612	4,612	4,612
Average Annual Habitat Unit Lift		2,234	2,234	2,234	2,234
Caloosahatchee					
Average Annual Habitat Units	31,918	36,543	36,543	36,543	36,543
Average Annual Habitat Unit Lift		4,625	4,625	4,625	4,625
Greater Everglades (WCA 3 and ENP)					
Average Annual Habitat Units	578,991	759,417	756,087	761,503	769,866
Average Annual Habitat Unit Lift		180,426	177,096	182,512	190,875
Florida Bay					
Average Annual Habitat Units	75,047	133,510	131,877	147,218	157,406
Average Annual Habitat Unit Lift		58,463	56,830	72,171	82,359
Total Average Annual Habitat Unit Lift		245,748	240,785	261,542	280,093

3.2.3 Cost Effective Analysis/Incremental Cost Analysis

Sometimes it is difficult to summarize the results of CE/ICA when the analyses are performed separately on HUs for distinct species, communities, or geographic areas. This phenomenon often occurs simply because different management measures or alternative plans have different functions, provide different types of output, and provide benefits to different biological communities. This is the case for the CEPP plans, in which certain features or alternatives provide greater benefits to Florida Bay and Everglades National Park, while other alternatives provide greater benefits for Northern WCA 3A and WCA 3B.

Costs and benefits for each geographic area (Northern Estuaries, Greater Everglades [WCA 3A and ENP] and Florida Bay) were examined both independently and combined. However, a combined HU score summing all geographic areas of the study area, while not appropriately representing the significance of each geographic area, provides a valuable cumulative analysis for determining the plan that best meets the needs of the entire watershed; for this reason, the combined HU were used to ensure a cost effective solution is identified.

For the incremental cost analysis, only the cost effective plans are arrayed by increasing output to show changes in cost (marginal cost) and changes in output (marginal output) of each cost effective alternative plan compared to the without plan condition. The plan with the lowest incremental costs per unit of output of all plans is the first best buy plan. All larger cost effective plans are compared to the first best buy plan in terms of increases in cost and increases in 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. In summary, CE/ICA was performed using the following four spatial metrics to represent various ecosystem outputs of the CEPP alternatives:

1. System-Wide HU Score
2. Northern Estuaries alone
3. Greater Everglades (WCA 3A and ENP) alone
4. Florida Bay alone

3.2.3.1 CE/ICA Analysis – Total System-Wide Outputs

As can be seen in **Table 3-7**, both Alts 1 and 4 are identified as being cost effective for the aggregated system-wide habitat units. Alts 2 and 3 are both more costly than Alt 4 and provide fewer overall habitat units, and these alternatives are not cost effective for the production of system-wide habitat units.

Table 3-8 shows that there are two best buy plans for the combined system-wide HU production, Alts 1 and 4. Alt 1 has the lowest cost per unit of output of any of the alternatives ($376 per combined habitat unit produced). The next best alternative in terms of average cost per combined habitat unit is Alt 4 ($381). Alt 4 provides an increment of 34,346 additional average annual habitat units produced over Alt 1 at an incremental cost of over $14,300,000 (incremental cost of $416 per habitat unit). Alt 4 provides approximately 14 percent greater benefits for a cost increase of 15 percent.

Table 3-7 - Results of Cost Effectiveness Analysis for Total System-Wide Performance

	Alt 1	Alt 2	Alt 3	Alt 4
Average Annual Cost (AAC)	**$92,500,000**	**$108,000,000**	**$113,400,000**	**$106,800,000**
Northern Estuaries	6,859	6,859	6,859	6,859
Greater Everglades (WCA 3 and ENP)	180,426	177,096	182,512	190,875
Florida Bay	58,463	56,830	72,171	82,359
Average Annual System Wide HUs (AAHU)	245,748	240,785	261,542	280,094
AAC/AAHU	$376	$449	$434	$381
Cost Effective	YES			YES

Notes: Values for alternatives are differences between "Without" plan and "With" plan on an average annual basis. Alternatives are arranged by increasing costs.

Table 3-8 - Results of Incremental Cost Analysis

	Average Annual Cost	Average Annual Habitat Units	Cost Per AAHU	Incremental Average Annual Cost Increase	Incremental AAHU Increase	Incremental AAC/AAHU
Alt 1	$92,500,000	245,748	$376	$92,500,000	245,748	$376
Alt 4	$106,800,000	280,093	$381	$14,300,000	34,345	$416

3.3 Consistency with Restudy Purpose

The plan formulation process for the Central Everglades Planning Project used a Project Delivery Team (PDT) consisting of those individuals designated by the USACE and the SFWMD, the implementing agencies, and representatives designated by other governmental agencies. Interagency participation is encouraged to take advantage of technical skills and knowledge of other agencies. Several federal, tribal, and state agencies are active members of the PDT.

The purpose of the CERP is to modify structural and operational components of the C&SF Project to achieve restoration of the Everglades and the south Florida ecosystem, while providing for other water-related needs such as urban and agricultural water supply and flood protection. The 68 components identified in the Yellow Book will work together to benefit the ecological structure and function of more than 2.4 million acres of the south Florida ecosystem by improving and/or restoring the proper quantity, quality, timing and distribution of water in the natural system. CERP will also address other concerns such as urban and agricultural water supply and maintain existing levels of service for flood protection in those areas served by the project. The CERP components were originally planned for implementation over an approximate 40 year period. The CERP is designed to achieve more natural flows by re-directing current flows that are currently discharged to the Atlantic Ocean and Gulf of Mexico, to a more restored flow of water that is distributed throughout the system similar to pre-drainage conditions.

The purpose of the CEPP is consistent with CERP to improve the quantity, quality, timing and distribution of water flows to the Northern Estuaries, central Everglades (Water Conservation Area 3 [WCA 3] and Everglades National Park [ENP]), and Florida Bay while increasing water supply for municipal, industrial and agricultural users. Too much water from Lake Okeechobee during the wet season, and too little water during the dry season impacts salinity levels within the Northern Estuaries, stressing estuarine ecosystems. Construction and operation of the WCAs compartmentalized a significant extent of the historical Everglades landscape and in turn degraded the structure and function of the remaining system. As a result, the Everglades are approximately half their original size, water tables are lowered, wetlands altered, freshwater flows diverted, water quality degraded, and habitats invaded by non-native plants and animals. All of these impacts are caused directly or indirectly by changes in hydrology. Changes in hydrology have led to the degradation of the historic slough, tree island and sawgrass mosaic that previously characterized much of the study area, as well as the marl prairies that exist in the southern portion of the area in ENP. The changes in the landscape pattern have had adverse effects on wildlife while changes in hydrology of the freshwater systems have led to effects on the estuarine and marine environments of Florida Bay. Alterations in seasonal inflow deliveries to Florida Bay have resulted in extreme salinity fluctuations. The already degraded state of the Everglades will continue to worsen in the absence of increased water deliveries, improved water timing and restored distribution. Redirecting a portion of the approximately 1.7 billion gallons of water per day on average that is discharged to the Atlantic Ocean and the Gulf of Mexico is essential to meeting the quantity, quality, timing and distribution of water required to realize a portion of the benefits envisioned in CERP.

Since CERP, twelve years of updated science, new information, improved hydrologic modeling tools and varying water treatment assumptions have led to the differences in CERP components and the CEPP recommended plan. There are six CERP (Yellowbook) components which have features or increments included within the components in the CEPP recommended plan: (1) Everglades Agricultural Area Reservoirs; (2) Flow to Northwest and Central WCA 3A; (3) WCA 3 Decompartmentalization and Sheetflow Enhancement; (4) S-356 Pump Station Modifications; (5) L-31 Levee Seepage Management; and (6) System-wide Operational Changes-Everglades Rain Driven Operations. These six CERP components were built upon (additional components of CERP added) as CEPP progressed through the scoping period. Some of the components considered during scoping and detailed analysis were not retained in the recommended plan. A comparison of the CERP/CEPP feature functions, elements and costs was completed for inclusion in the CEPP PIR and can be found in Section 6 of the Final PIR.

3.4 Implementation of Project Components

Implementation of CEPP will occur over many years and include many actions by USACE and SFWMD. This subsection discusses the major implementation phases that are expected to occur after Congressional authorization and appropriation of funding for project construction. Multiple Project Partnership Agreements (PPAs) will be executed prior to construction. Each PPA will cover a separable element that groups inter-related project features to provide hydrologic and ecological benefits. These PPAs include the construction of logical groupings of plan elements, agreed upon by the USACE and SFWMD, that maximize benefits to the extent practicable consistent with project dependencies (**Table 3-9**) and the Adaptive Management and Monitoring Plans (see **Annex D** of CEPP PIR).

A multiple PPA approach incorporates the adaptive management process, per the guidance of the Programmatic Regulations for the Comprehensive Everglades Restoration Plan (2003) and the Water Resources Development Act of 2007. Sequencing of the PPAs will allow earlier restoration benefits by initially building project components that take advantage of existing water in the system that meets state water quality standards, while providing assurances of sound financial investments.

Upon identification of a recommended plan for CEPP, the next step is to consider how CEPP features will be implemented (sequencing scenarios) when considering internal and external project dependencies. Development of sequencing for CEPP features considers that a number of CERP and non-CERP projects (**Table 3-9**) must be in place before implementing most CEPP features to avoid unintended consequences. Additionally, several basic principles considered in development of an implementation plan for CEPP features include the following:

1. All features of the state's Restoration Strategies must be completed and meet state water quality standards prior to initiating construction of most CEPP project features.
2. Construction of CEPP features cannot proceed until it is determined that construction and operation of the feature:
   a. Will not cause or contribute to a violation of state water quality standards; and
   b. Will not cause or contribute to a violation of any applicable water quality permit discharge limits or specific permit conditions; and

c. Reasonable assurances exist that demonstrate adverse impacts on flora and fauna in the area influenced by the Project features will not occur.

3. Appendix A water quality compliance must be addressed for new project water entering ENP.

4. The operation of State facilities is required to ensure that new water made available by CEPP meets water quality standards and to ensure achievement of CEPP project benefits. If after construction and operation of CEPP project features State water quality standards are not being met, the Federal and State partners agree per paragraph 8.3 of Section 8 of this PIR/EIS to meet to determine the most appropriate course of action in accordance with existing law and policy. In such an event, an evaluation of CEPP benefits, including the possibility of reduced benefits, will be included in the assessment of any suggested resolution. It is recognized that the operation of the State facilities has a primary permitted purpose of achieving water quality compliance for existing flows.

5. Sequencing takes into account the earliest opportunity to realize benefits, including the features that can provide benefits that utilize existing water meeting state water quality standards.

6. Additional outlet capacity from the south end of WCA 3A must be provided before new project water from Lake Okeechobee is released into WCA 2A and WCA 3A.

7. The sources of material needed for Miami Canal backfilling and the Blue Shanty Levee were considered to minimize costs associated with double handling and stockpiling of materials.

8. Where possible sequencing should include steps and timing to test concepts, as described in the CEPP Adaptive Management Plan.

9. Recreation features will be constructed in conjunction with corresponding CEPP project plan features.

Specific project features cannot be constructed until other CERP and non-CERP projects are constructed and operational. **Table 3-9** provides a complete list of which CEPP features are dependent on other projects and their operation in order to operate CEPP and obtain the full benefits envisioned.

In addition to the project feature dependency considerations listed in **Table 3-9**, other factors influencing implementation include funding availability, maintaining cost-share balance between the federal and non-federal sponsor, and the integration of projects that are to be constructed by other agencies. The USACE and SFWMD will undertake integration of the CEPP recommended plan and the other CERP projects awaiting authorization into the CERP programs' Integrated Delivery Schedule (IDS), which contains the Master Implementation Sequencing Plan (MISP), through a robust public process.

Project features were grouped into three separate PPAs based upon the spatial distribution of the recommended plan features and the locations within the CEPP study area where separable hydrologic and environmental benefits would accrue (**Table 3-10**). These groupings include a PPA of project features in northern WCA 3A (PPA North), a PPA of project features in southern

WCA 3A, 3B and ENP (PPA South), and a final PPA that provides the new water and required seepage management that benefits the entirety of the study area (PPA New Water).

Table 3-9 - Project Dependencies

Project	CEPP Feature Dependencies
A-1 FEB State Restoration Strategies	Required prior to implementation of northern WCA 3A distribution features (L-4 degrade, new pump station, S-8 Modifications, L-5 and L-6 improvements, Miami Canal Backfilling) to ensure adequate water quality treatment of inflows
8.5 Square Mile Area (SMA) and Existing S-356	Construction of the C-358 seepage collector canal and structure S-357N within the 8.5 SMA must be completed to allow full utilization of the 8.5 SMA features to provide seepage mitigation for increasing flows into Northeast Shark River Slough; operation of the existing S-356 pump station (500 cfs) is required prior to significantly increasing flows to Northeast SRS, to provide seepage management
C-111 South Dade	Extension of the detention area levees to connect with 8.5 SMA required prior to significantly increasing flows to Northeast SRS to enable operation of S-357 pump station to provide seepage management to 8.5 SMA
MWD 1-Mile Bridge & Road Raising	The MWD project will be complete and operational prior to implementation of WCA 3B inflow structures along the L-67A&C levees or increasing flows through existing S-333 to Northeast SRS to ensure adequate road protection to allow for increased stages in L-29 canal
BCWPA C-11 Impoundment	Required prior to increasing flow through S-333 or implementation of WCA 3B inflow structures along the L-67A&C levees to ensure adequate water quality of inflows to WCA 3B and Northeast SRS
Tamiami Trail Next Steps Bridging and Road Raising	Required prior to increasing capacities of S-333 and S-356 and implementation of WCA 3B inflow structures along the L-67A levee, gaps in L-67C levee and Blue Shanty flow-way (L-67C removal, L-29 levee removal)
C-44 Reservoir (IRL-S) and connection to C-23 Canal	Required prior to re-directing the maximum amount of water from Lake Okeechobee south to the FEB to meet environmental performance, to avoid reduction in low flows to the St. Lucie Estuary and low Lake Okeechobee water levels that affect the LOSA.
Modification of the Lake Okeechobee Regulation Schedule	Anticipated prior to full utilization of the A-2 FEB in order to achieve the complete ecological benefits envisioned through re-directing the full 210 kAF/yr south and to avoid low lake levels that would affect the LOSA

Table 3-10 - Project Features by PPA.

PPA North	
Project Features	**Construction Contract**
L-6 Diversion	Contract 1
S-8 Pump Modifications	Contract 1
L-4 Levee Degrade and Pump Station	Contract 1
L-5 Canal Improvements	Contract 2
Miami Canal Backfill	Contract 2
PPA South	
Project Features	**Construction Contract**
L-67 A Structure North	Contract 3
One L-67 C Gap (6,000 ft)	Contract 3
Increase S-356 to 1,000 cfs	Contract 4
Increase S-333	Contract 4a
L-29 Gated Spillway	Contract 4b
L-67 A Structures 2 and 3 South	Contract 5
L-67 A Spoil Mound Removal	Contracts 3 & 5
Remove L-67 C Levee Segment	Contract 6
Remove L-67 Extension Levee (No Backfill)	Contract 6
8.5 Mile Blue Shanty Levee	Contract 6
Remove L-29 Levee Segment	Contract 7
Backfill L-67 Canal Extension	Contract 7
Remove Old Tamiami Trail*	Contract X*
PPA New Water	
Project Features	**Construction Contract**
Seepage Barrier L-31 N	Contract 8
A-2 FEB	Contract 9

*Contract X - Old Tamiami Trail can be completed at any time during implementation, but must precede backfilling of L-67 Extension Canal.

A phased benefits analysis was done (see section 6.7.1.3 of PIR) to help demonstrate that PPA North and PPA South can be executed regardless of the status of the other two PPAs. While not providing full benefits to the region, each would provide a reasonable level of benefits commensurate with its cost, as demonstrated during the screening of options that made up the complete alternatives. PPA New Water is not cost effective as an independent separable element, and additional outlet capacity from WCA 3A (a PPA South component) must be provided before new project water from Lake Okeechobee is released into the system. As a construction element following construction of PPA North and PPA South, PPA New Water is a cost effective element.

Two potential implementation sequencing scenarios are possible with the three PPAs identified:

- **Scenario 1** – PPA North --> PPA South --> PPA New Water
- **Scenario 2** – PPA South --> PPA North --> PPA New Water

Additional information in **Table G-39** of **Appendix G of the PIR** shows four sets of cost and benefit information, one for each of the proposed three PPAs as stand-alone elements, and one with the costs and benefits gained from implementation of PPA New Water subsequent to the completion of features included in PPA North and PPA South. The information should not be used to justify the exclusion of individual PPAs from the recommended plan, since only regional benefits will be realized if the connectivity and timing of water deliveries through the system is not restored. A cost effective comparison between PPAs is inappropriate due to aforementioned project dependencies and the difference in ecosystem regions. Instead, each PPA is justified on the significance of the resource being restored, and the cost effectiveness of the features within an individual PPA has been conducted to ensure that features within PPAs are cost effective regardless of the status of the other PPAs.

Additional information in **Table G-39** of **Appendix G of the PIR** presents multiple estimates of performance associated with implementation of each PPA. Performance expectations for each PPA are described consistent with each of the Conceptual Ecological Models (Northern Estuaries, Greater Everglades Ridge and Slough, and Florida Bay) for the CEPP study area by stressors, ecological effects, and attributes. Project zones (See **Appendix G of the PIR**) and associated acreages estimated to benefit from implementation of each PPA were identified. Acreages shown do not reflect the magnitude or degree to which each acre is improved. The entire acreage associated with each project zone was assumed to benefit since detailed modeling for each PPA was not conducted. Features of the recommended plan identified in each PPA were not separately modeled using the RSM-GL and RSM-BN regional models; as such, a quantification of Habitat Units with the CEPP Planning Model was also not performed for individual PPAs. Modeling of each PPA would require development of an optimized operations plan to meet project constraints while providing benefits.

4 Determination of Project Consistency with Applicable Laws and Regulations

4.1 Pre-Application Conferences

In accordance with Section 373.1501(5)(c), F.S., a pre-application conference was held on September 5, 2013, at the SFWMD B-1 2-B Bridge Conference Room in West Palm Beach, Florida and via webinar. Representatives from the following agencies attended the conference:

- SFWMD
- FDEP
- USACE
- Miami-Dade County
- Broward County
- FDACS
- SHPO
- FDOT
- FWC
- USEPA

The meeting summary can be found at the end of this report. Information gained at the pre-application conference was considered by the SFWMD in preparing the Final PIR/EIS.

5 Reasonable Assurances

Under Section 373.1501(5)(d), F.S. the SFWMD shall "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."

The same hydrologic models used for plan formulation are typically applied to the reasonable assurances analysis. This ensures consistency when representing the project effects in the analyses subsequent to plan selection. The Regional Simulation Model (RSM) for Basins (RSM-BN) and the RSM Glades-LECSA (RSM-GL) hydrologic models were used to simulate and evaluate the environmental effects of the CEPP final array of alternatives through comparison with base conditions simulated with the same models. The RSM-BN is applied north of the L-4/L-5/L-6 levees (the CEPP formulation Redline) for Lake Okeechobee, the EAA, and the Northern Estuaries; the RSM-GL is applied within the WCAs, ENP, and the LECSAs. The RSM model uses a 41-year period of hydrologic record (1965 through 2005) which includes sufficient climatological variability (including natural fluctuations of water) to represent the full range of hydrologic conditions experienced within the South Florida region over a long-term period.

No one modeling tool or representation of model results can definitively predict with project hydrologic conditions across the entire CEPP project area given the large regional scope of the project, model tools limitations and assumptions, and future uncertainties regarding the effects of other projects. However, each snapshot of model results can form the basis for applying best professional judgment to determine whether the potential effects of CEPP would reduce the availability of water to existing legal users or reduce the level of service for flood protection.

Following identification of the recommended plan in June 2013, the CEPP base condition assumptions established for plan formulation were subsequently revisited and updated to represent the most current information for the analysis of 373.1501, 373.470 and WRDA 2000 requirements. Specifically, the Existing Condition Baseline (ECB) was updated to 2012EC and the future without project baseline (FWO) was updated utilizing new information for the Initial Operating Regime Baseline (IORBL1). In **Annex B of the Final PIR**, the potential effects of CEPP are analyzed through comparison of the with project condition (Alt 4R2) to the without project condition (IORBL1). This comparison segregates the effects of the intervening non-CERP and intervening CERP projects.

5.1 Water Supply Assurance

An existing legal use of water is defined as a water use authorized under a SFWMD water use permit or existing and exempt from permit requirements. Existing legal users of water including agricultural and urban in the LOSA and LECSAs will continue to be met by their current sources, primarily Lake Okeechobee, the Everglades (including the WCAs), surface water in the regional canal network, and the surficial aquifer system. On an average annual basis, less than 1 percent of the LOSA demands will be met by backflowing water from the C-44 Reservoir to Lake Okeechobee upon completion of the project. Therefore, all existing legal users will continue to have their needs met during implementation and once the project is operation.

Some of the water utilized by agricultural users in the LOSA from Lake Okeechobee will be transferred to WCA 3 and further south as a result of the implementation of the recommended plan. This transfer is anticipated to occur after the modification of the Lake Okeechobee Regulation Schedule that will allow full utilization of the A-2 FEB. The recommended plan has identified an additional source of water of comparable quantity and quality that will be available to replace the water sent south. Instead of discharging all water stored in the reservoir to tide via the S-80 or to meet C-44 Basin agricultural water supply demands, as assumed in the future without project IORBL1 baseline condition operations, the recommended plan retains a portion of the water stored in the CERP IRL-S C-44 Reservoir/STA in the regional system for backflow to Lake Okeechobee via the C-44 Canal and raises the Lake Okeechobee stage criteria to allow increased C-44 Canal backflow. This added operation does not affect existing permitted allocations within the C-44 Basin. The additional C-44 Canal backflow operations to Lake Okeechobee included in the CEPP recommended plan improves the ability to meet existing permitted demands in the LOSA by retaining more water in the regional system and making it available to agricultural users. The operations do not benefit agricultural users in the C-23 Basin. The CEPP recommended plan backflow operations capture a portion of releases from the C-44 Reservoir/STA that would otherwise be directed to the Saint Lucie Estuary as excess water.

Specifically, the future without project condition (IORBL1) allows backflow to Lake Okeechobee from the C-44 Canal when S-308 (the Lake Okeechobee discharge structure to the C-44 Canal) is not open for regulatory discharges and when the stage in Lake Okeechobee is 0.25 feet below the base of the 2008 LORS low sub-band (within the baseflow sub-band), which varies between 13.0 and 14.5 feet NGVD seasonally. This operational assumption is consistent with the existing operational protocols of Lake Okeechobee (2008 LORS) and the SFWMD Lake Okeechobee Water Shortage Management (LOWSM) operations. Discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are otherwise limited to environmental deliveries for the St. Lucie Estuary and C-44 Basin agricultural water supply demands during these backflow operations.

The CEPP recommended plan operations expand on the IORBL1 backflow to Lake Okeechobee through the following operational changes: (1) backflow to Lake Okeechobee from the C-44 Canal is allowed when S-308 is not open for regulatory discharge and the stage in Lake Okeechobee is below 14.5 feet NGVD (no seasonal variability); and (2) discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are made when the stage in Lake Okeechobee is below the baseflow zone of the 2008 LORS schedule (the bottom of this zone varies seasonally between 12.6 and 13.0 feet NGVD) to provide an additional source of backflow water to Lake Okeechobee. Water captured in the C-44 Reservoir/STA, includes excess water conveyed from the C-23 Canal and Basin (approximately 6 kAF on an average annual basis) that is not needed to meet the IRL-S North Fork water reservation target. The recommended plan operational changes result in an average annual increase in C-44 Canal backflow volume to Lake Okeechobee of 57.3 kAF (97.3 kAF in the recommended plan, compared to 40.0 kAF in the

IORBL1) and an average annual increase in C-44 Reservoir discharges to the C-44 Canal of 21.3 kAF (37.6 kAF in the recommended plan, compared to 16.3 kAF in the IORBL1).

The transfer of water from Lake Okeechobee to WCA 3 would not be implemented until the CERP C-44 Reservoir/STA, the canal connecting the C-44 Reservoir to both the C-23 Basin and the C-23 Canal, and the CEPP FEB on the EAA A-2 site are operational. If the canal to the C-23 Basin and the C-23 Canal is not operational when the CEPP FEB on the EAA A-2 site is ready to store water, the operations, and ultimately the delivery of water from Lake Okeechobee to the CEPP FEB, may need to be modified to avoid elimination of this portion of the source of water for the LOSA. The water retained in Lake Okeechobee also maintains the level of service for water supply for existing legal users dependent on Lake Okeechobee and its connected conveyance system. Specifically, this includes the agricultural users in the LOSA and the Seminole Tribe of Florida.

Sources of water to meet agricultural and urban demand in the LOSA and LECSAs will continue to be met by their current sources, primarily Lake Okeechobee, the Everglades (including the WCAs), surface water in the regional canal network, and the surficial aquifer system. Sources of water for the Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida are also influenced by the regional water management system (C&SF Project, including Lake Okeechobee); however, these sources will not be affected by the CEPP project. In addition, water supplies to ENP with implementation of the recommended plan exceed future without project and existing condition baseline volumes. Water sources for fish and wildlife located in the Northern Estuaries, WCA 2, WCA 3, Biscayne Bay, and Florida Bay will not be diminished. Therefore, there will be no elimination or transfer as a result of the recommended plan on existing legal sources of water supply.

5.2 Flood Protection Assurance

Under Section 373.1501(5)(d), F.S. the SFWMD shall "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."

The recommended plan also ensures that CERP implementation does not reduce the level of service for flood protection consistent with the WRDA 2000 Savings Clause. Comparison of canal stages and groundwater levels at key locations indicates the project will not reduce the flood protection within the areas affected by the project, including the EAA, LECSA 2, and LECSA 3. This includes the Seminole Tribe of Florida's Big Cypress Reservation and the Miccosukee Tribe of Indians of Florida's reservation areas and resort.

5.3 Adaptive Management to Meet the Needs of the Natural Environment

The CEPP Adaptive Management (AM) and Monitoring Plans (**Annex D of final PIR**) identifies the monitoring information needed to inform CEPP implementation and to document restoration progress to agencies, the public, and Congress. The overall objective of the AM and

Monitoring Plan is to focus resources on refinement of CEPP to fine-tune performance due to inevitable uncertainties, based on existing knowledge and knowledge that will be gained through monitoring and assessment.

The CEPP AM and Monitoring Plans contain descriptions of monitoring that should address specific uncertainties identified during CEPP planning, required parameters such as water quality and water levels, and ecological features that track CEPP's progress toward success. The monitoring data will indicate CEPP's progress toward the objectives of CEPP, and CEPP's conformance to applicable legal requirements. The monitoring descriptions are found in detail in the CEPP PIR **Annex D Part 1 Sections D.1.3 – D.1.4** (pages 13 – 91) and in **Annex D Parts 2, 3, 4**. For each region of south Florida in the CEPP study area, the monitoring parameters, their value to CEPP, timeframe needed to see changes, measurement frequencies, decision criteria for triggering adaptive management options, and suggested adaptive management options are provided in the AM Plan text; the information is also summarized per region in **Tables D.1.3** through **D.1.9**. Monitoring durations, which are specified in Annex D, are dependent on the intended use of the monitoring: regulatory monitoring will be continued as long as required by applicable regulations, and the adaptive management and ecological success monitoring will continue up to 10 years, per WRDA 2007 Section 2039, in coordination with the phases of CEPP construction. See CEPP PIR **Annex D Part 1 Section 1.5**, "Implementation of CEPP Adaptive Management" for a description of the rolling implementation of the monitoring and the feedback that the data will provide to inform management decisions. The implementation is summarized in **Annex D Part 1 Section D.1.5**, in **Figures D.1.11** through **D.1.17**, and in **Tables D.1.10** through **D.1.15**.

In addition to the AM Plan, **Annex D** or the CEPP PIR contains the Water Quality Monitoring Plan (Part 2), Hydrometeorological Monitoring Plan (Part 3), and the Ecological Monitoring Plan (Part 4). These include regulatory monitoring associated with water quality and the USFWS Programmatic Biological Opinion, as well as hydrometeorological monitoring to inform system operations, and ecological success monitoring directly related to project objectives. The CEPP AM Plan and Monitoring Plans have been designed to inform each other as much as possible and the Plans will support achievement of CERP and CEPP goals and objectives and remain within constraints by providing the data necessary to detect changes expected due to CEPP.

The methods, locations, timing, and funding requirements for conducting adaptive management and monitoring are also included in **Annex D**. The CEPP monitoring plan was designed to provide the monitoring required addressing CEPP-specific needs while being integrated with other Everglades monitoring to take advantage of existing monitoring efforts, knowledge, and information. The CEPP Adaptive Management and Monitoring Plan leverage several existing programs to avoid redundancies and insure cost-effectiveness. Since CEPP relies on existing physical instrumentation, stations, locations, servicing, and analysis efforts funded by RECOVER, CERP sponsors, and partner agencies, the monitoring requirements described in the CEPP plan are limited to the additional increase in monitoring resources and analysis efforts needed to address CEPP-specific questions.

The CEPP monitoring plan assumes these other monitoring efforts will continue into the future at least for the period required by CEPP.

5.4 Phased Implementation

It is recognized that prior to implementation of each phase, additional detailed information pertaining to that phase of implementation will be developed. In recognition of this, the SFWMD agrees to provide additional information gained through detailed project planning and work collaboratively with the Florida Department of Agriculture and Consumer Services (FDACS) and the FDEP to resolve any outstanding issue(s) prior to the implementation of each phase. Subsequent to this coordination, FDEP will consider input from both SFWMD and FDACS when determining consistency with state law. If additional information is necessary to determine that reasonable assurances exist with regard to the maintenance of existing flood protection and water supply, this information will be provided to FDEP prior to the execution of a project partnership agreement.

6 Coordination with Existing Utilities and Public Infrastructure

Paragraph 373.1501(5)(e) F.S., requires the SFWMD to "Ensure that implementation of project components is coordinated with existing utilities and public infrastructure and that impacts to and relocation of existing utility and public infrastructure are minimized."

6.1 Summary of Utilities and Coordination with Utilities and Public Infrastructure

During the planning process for the CEPP, there have been extensive coordination efforts with utilities and other entities responsible for public infrastructure in the CEPP project area in order to avoid and minimize impact to utilities and roads in the project area.

The expedited planning process for the CEPP study required extensive coordination with the public and federal, Tribal, state, and local resource management and regulatory agencies. An interagency project team was formed and met regularly throughout the study, providing federal, tribal, state, and local agencies opportunities to comment on planning assumptions, evaluation tools and methods, and alternative plans. The South Florida Ecosystem Task Force's Working Group sponsored 18 public workshops throughout the study (November 2011 through February 2013) providing opportunities for the public to provide input to the Task Force, which in turn informed the study team. Formal consultation with the Task Force also occurred throughout the study, including presentations of the final array of alternatives (December 2012) and the recommended plan (July 2013). The SFWMD's Governing Board and Water Resources Advisory Commission also met monthly throughout the study, providing opportunities for information to be provided to elected and appointed officials and the public. The CEPP study project team also hosted public meetings (November-December 2012) summarizing alternative plans and effects.

Annex D (Real Estate) of the Final PIR describes the utilities that are included within the CEPP project footprint as well as some of the actions that may need to be taken to implement the project. Some of the utilities affected include Florida Power and Light (FPL) and Quest Communications both of whom have transmission, power, or communication lines along Old Tamiami Trail.

In addition, the SFWMD closely coordinated with the Florida Department of Transportation (FDOT) during the project formulation and planning processes to ensure that changes made to the Miami Canal would not affect FDOT roadways, in particular, I-75. Due to the large project area and its proximity to the urban boundary, coordination with water utilities has been extensive. As part of the Project Delivery Team (PDT), Miami-Dade, Broward, and Palm Beach Counties have been active participants in the planning process and have ensured that the needs of local municipalities, flood control and water supply will be met in this project.

The SFWMD will undertake specific outreach efforts to coordinate implementation of the project components with existing utilities and public infrastructure as well as minimize impacts to and relocation of existing utilities and public infrastructure. A comprehensive list of agencies, utilities, or other public infrastructure entities that provide services within Palm Beach, Broward, and Miami-Dade counties is being developed by SFWMD. Each party will be contacted with a letter or telephone call, or when appropriate, a meeting will be arranged.

The purpose of this advance coordination is to (1) review the network of existing and proposed utility facilities and roads in the area; (2) identify which utility facilities can be removed (or relocated) and the process and timeframes for implementing their removal (or relocation) consistent with the project schedule; (3) identify those facilities that need to remain that may be impacted by the proposed project; (4) discuss options for minimizing and/or avoiding impacts to the facilities that need to remain and, if necessary, relocation options; and (5) identify any other potential utility and public infrastructure issues that need to be addressed during the planning, design, and/or construction process.

This effort will help strengthen working partnerships with local agencies and utility companies affected by the projects, and to identify new local issues to consider as detailed design progresses. Most importantly, the process allows the USACE and SFWMD to conclude that no insurmountable obstacles exist that would prevent or significantly alter the design and construction of the projects. Through these coordination efforts, the SFWMD will ensure that the implementation of the project components minimizes impacts to and relocation of existing utilities or public infrastructure.

7 Increased Water Supply Available from Project

Paragraph 373.470(3)(c), F.S. requires the SFWMD, in cooperation with the USACE, to complete a Project Implementation Report that identifies the increase in water supplies resulting from each CERP project, which shall be allocated or reserved by SFWMD.

Viewed from a programmatic perspective, the identification of water for the natural system associated with the CERP involves an analysis of four different aspects of ecological responses to hydrologic changes: (1) responses to the change in the quantity of water received by the natural system; (2) responses to the timing of those deliveries; (3) responses to the distribution of water delivered to the natural system; and (4) responses to the quality of the water received by the natural system. In a project specific sense, however, the relative importance of each of these aspects (quantity, timing, distribution, and quality) will vary from project to project depending upon the specific objectives established for the project.

7.1 Identifying Water for the Natural System

The recommended plan provides a significant increase in the quantity of fresh water (approximately 210 kAF/yr, annual average) flowing into the Everglades. This additional freshwater flow to the Central Everglades is essential to Everglades Restoration. In the pre-drainage system, the inundation pattern supported an expansive system of freshwater marshes including longer hydroperiods sawgrass "ridges" interspersed with open-water "sloughs", higher elevation marl prairies on either side of Shark River Slough, and forested wetlands in the Big Cypress Marsh. The original C&SF Project has compartmentalized and fragmented the Everglades landscape, reduced flows through the sloughs, and altered hydroperiod and depths. The result has been substantially altered plant community structures, reduced abundance and diversity of animals, and spread of nuisance and exotic vegetation. The recommended plan would provide for resumption of sheetflow and related patterns of hydroperiods and water depth that would significantly help to restore and sustain the microtopography, directionality, and spatial extent of ridges and sloughs, and improve the health of tree islands within the landscape. Additional water flowing into the Everglades would also result in beneficial shifts in habitat for desired wildlife species.

Implementation of the recommended plan features and additional flow would provide greater project benefits to those areas located in northern WCA 3A and ENP. **Figure 7-1** and **Figure 7-2** depict the differences in hydroperiods and stage between the TSP and the FWO project condition in WCA 3 and ENP as modeled by the Regional Simulation Model for the Glades and Lower East Coast Service Areas (RSM-GL) (version 2.3.2). The years 1989 and 1995 are depicted which are representative of a dry and wet year in the 41 year period of simulation (1965-2005). However, quantifying flows distributed spatially, and temporally can be difficult especially for a project covering most of south Florida.

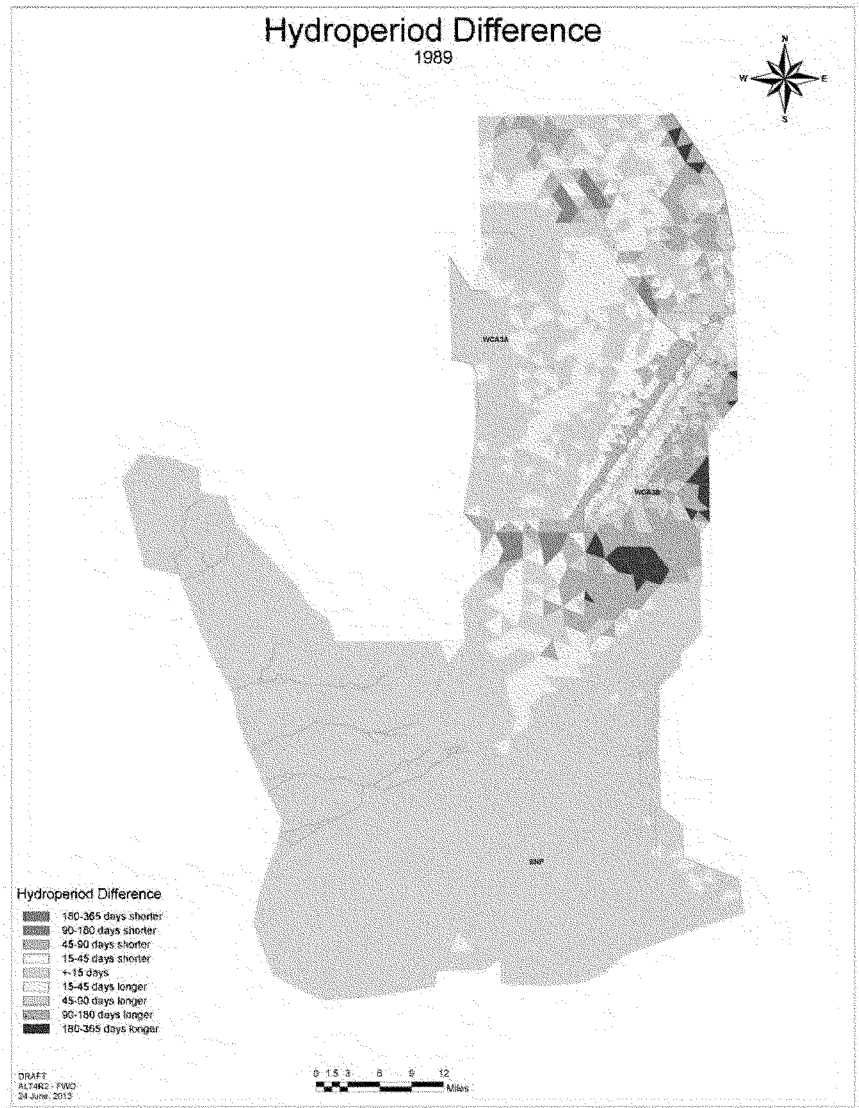

Figure 7-1 - Differences in Hydroperiod Distribution within WCA 3 and ENP between the FWO Project Condition and the TSP for a Representative Dry (1989) Year in the Period of Record (1965-2005)

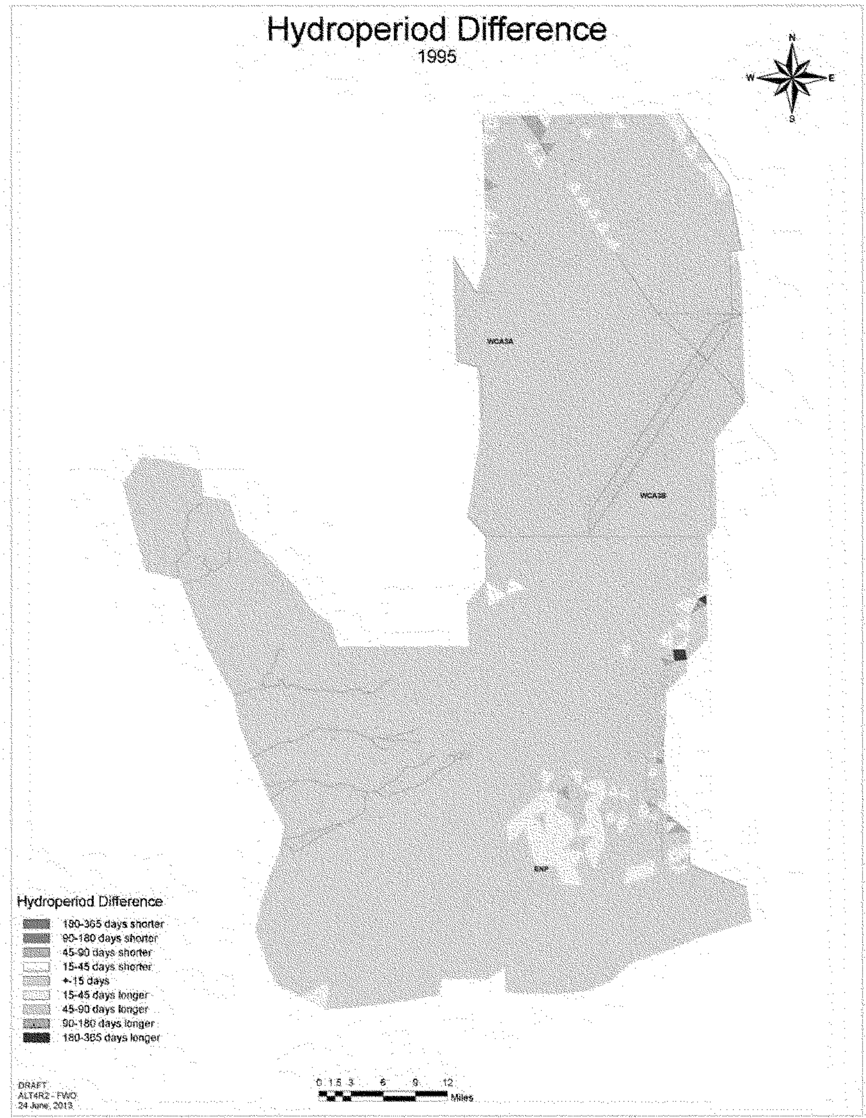

Figure 7-2 - Differences in Hydroperiod Distribution within WCA 3 and ENP between the FWO Project Condition and the TSP for a Representative Wet (1995) Year in the Period of Record (1965-2005)

Habitat unit benefits calculated during plan formulation (see **Table 3-3**) provide a means to follow the water reaching the natural system. Like the habitat units, three spatial locations were selected: the inflows to WCA 3 (along the Redline), inflows to ENP (Blueline), and overland flows to Florida Bay. Although habitat units were calculated for the Northern Estuaries, they are based on retaining water in Lake Okeechobee and sending it south to WCA 3A and ENP. Therefore, no quantification of water reaching the Northern Estuaries is needed neither is its protection.

The total water made available by CEPP is represented by the with project condition, Alt4R2. The future water in the system, including the other CERP projects assumed in place prior to CEPP implementation, is represented by the IORBL1 model simulation. The difference between these two conditions represents the water made available by the project (Alt4R2 minus IORBL1).

Surface water inflows along the Redline transect to WCA 3A correspond to the sum of structure inflows from the S-8 pump station to the Miami Canal within WCA 3A, the S-150 gated culvert, and STA-5/STA-6 outflows to northwest WCA 3A for the IORBL1 base condition; for Alternative 4R2, the combined flows from the S-8 pump station discharges to the Miami Canal and discharges to the S-8A gated culvert (which diverts water to the L-4 Levee degrade gap) are included in addition to S-150 and STA-5/STA-6 outflows to WCA 3A. Inflows to ENP are quantified for the S-12s (A-D), S-333, the S-355s (A&B), S-345 (F&G; Alternative 4R2 only) and S-356 (Alternative 4R2 only). Overland flows to Florida Bay are quantified for RSM-GL as combined Transect 23 (southeast ENP; transects 23-A, 23-B, and 23-C) and Transect 27 (Central Shark River Slough). **Figure 7-3** shows the locations of each transect studied.

The water made available by the project to WCA3, ENP and Florida Bay is displayed as a volume probability curve in **Figure 7-4**. Compared to the without project condition, with project condition inflows to WCA 3 are higher during all 40 water years as analyzed with the CEPP hydrologic modeling. Similarly, project condition inflows to ENP and Florida Bay are higher than or equivalent to the future without project inflows in 36 and 37 years of the 40 water years analyzed. The total accumulated volume of with project condition inflows to WCA3, ENP and Florida Bay provides a significant net increase in inflow volumes to these locations when compared to the future without project condition.

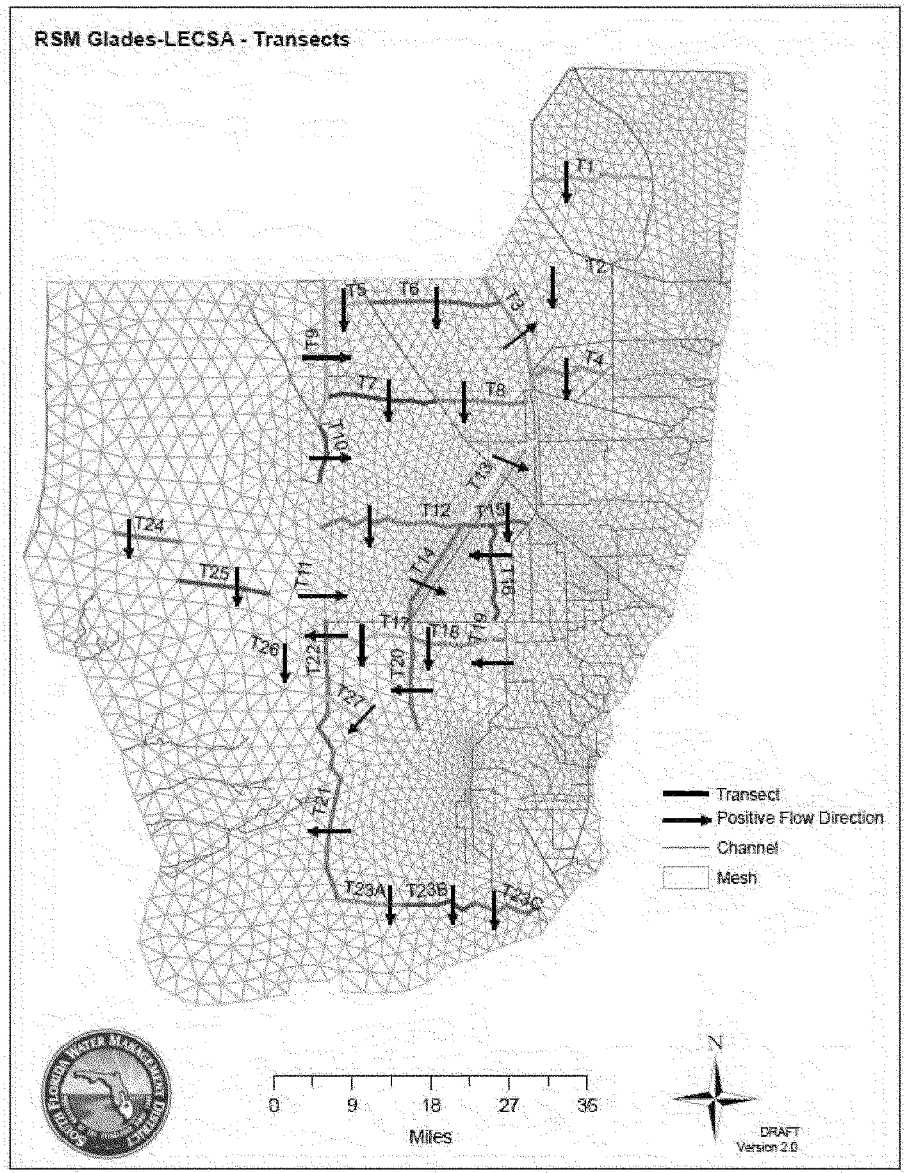

Figure 7-3 - RSM Glades-LECSA Transect Locations

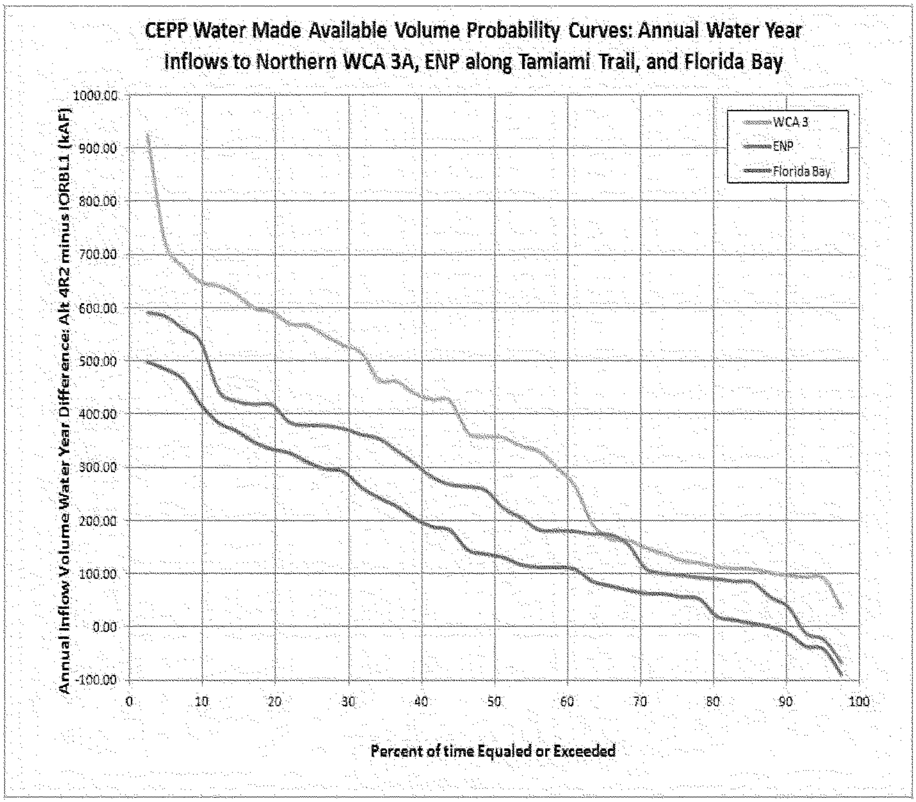

Figure 7-4 - CEPP Water Made Available Volume Probability Curves: Annual Water Year Inflows to Northern WCA 3A, ENP along Tamiami Trail, and Florida Bay.

The volume of water at the 10th, 50th, and 90th percentile was extracted from the RSM-GL simulation data applied to develop the volume probability curves. The future water in the system, including the other CERP projects assumed in place prior to CEPP implementation, is represented by the IORBL1 model simulation, the total water available (Alt 4R2), and the water made available by CEPP (differences between Alt 4R2 and IORBL1) for the natural system can be found in **Tables 7-1**, **7-2** and **7-3**.

Table 7-1. Pre-Project Volume of Water (kAF/yr) Available for the Natural System

Pre-project Water Available for the Natural System (IORBL1)			
Location	*Water Available equaled or exceeded 10% of Water Years (kAF)*	*Water Available equaled or exceeded 50% of Water Years (kAF)*	*Water Available equaled or exceeded 90% of Water Years (kAF)*
WCA 3	839	513	286
ENP	1,771	732	212
Florida Bay	1,969	704	218

Table 7-2. Total Volume of Water (kAF/yr) Available for the Natural System

Total Water Available for the Natural System (Alt 4R2)			
Location	*Water Available equaled or exceeded 10% of Water Years (kAF)*	*Water Available equaled or exceeded 50% of Water Years (kAF)*	*Water Available equaled or exceeded 90% of Water Years (kAF)*
WCA3	1,404	846	420
ENP	2,187	850	419
Florida Bay	2,113	729	287

Table 7-3. Water Made Available by the Project (kAF/yr) for the Natural System

Water Made Available by the Project (difference between Alt 4R2 and IORBL1)			
Location	Water Made Available equaled or exceeded 10% of Water Years (kAF)	Water Made Available equaled or exceeded 50% of Water Years (kAF)	Water Made Available equaled or exceeded 90% of Water Years (kAF)
WCA3	647	357	97
ENP	534	256	37
Florida Bay	418	137	-13

7.2 Water to be Reserved or Allocated for the Natural System

As required by Paragraph 373.470(3)(c), F.S., the Implementation of CERP, the water made available by the project will be protected using the State of Florida's reservation or allocation authority under state law. The SFWMD has protected the water for the natural system in the Holey Land and Rotenberger Wildlife Management Areas; WCA 1, WCA 2A, WCA 2B, WCA 3A, and WCA 3B; and ENP through the Restricted Allocation Area Rule for the Everglades and North Palm Beach/Loxahatchee River Watershed Waterbodies, which was adopted in 2007.

In February 2007, the SFWMD Governing Board adopted restricted allocation area criteria for the Everglades and Loxahatchee River Watershed water bodies (Section 3.2.1.E, Basis of Review). This criterion limits allocations to conditions or withdrawals in the Lower East Coast Service Area and North Palm Beach County/Loxahatchee River Watershed, depending on the specific use class that existed as of April 1, 2006, known as the "base condition water use." The rule only allows allocations over the "base condition water use" through alternative source development, implementation of offsets (e.g., recharge barriers and recharge trenches), or identification of terminated or reduced water uses that existed as of April 1, 2006. Wet season water can be allocated if the permit applicant demonstrates that such flows are not needed for restoration of the Everglades pursuant to CERP or for the Loxahatchee River Watershed water bodies, pursuant to the *Northern Palm Beach County Comprehensive Water Management Plan*. Otherwise, water in the Everglades and the Northwest Fork of the Loxahatchee River water bodies or their integrated conveyance systems that are hydraulically connected including primary canals of the C&SF Project and related secondary and tertiary canals cannot be allocated for consumptive uses. By limiting allocations, restricted allocation area criteria function similar to a water reservation rule that also limit allocations.

The SFWMD will continue to rely upon its existing restricted allocation area rules to protect the water made available by the CEPP project features as required by Section 373.470, F.S. Protection of water made available by CEPP project features is required in order for the SFWMD and the Department of the Army to enter into one or more Project Partnership Agreements to construct the CEPP project features. The combination of protecting the existing water and protecting the water made available by the CEPP project features is required for the CEPP to achieve its intended benefits.

7.3 Identifying Water Made Available for Other Water Related Needs

The CEPP components do not directly provide water to meet water supply demands in LOSA, LECSA 2, or LECSA 3. By virtue of additional water being stored in Lake Okeechobee, additional water may reach water users located in LOSA; however, the level of service for LOSA water supply has not improved, nor has it been degraded.

For LECSA, additional water has been made available by the project in the regional system and has been quantified for LECSA 2 and LECSA 3. An increased demand of 12 million gallons per day (MGD) in LECSA 2 and 5 MGD in LECSA 3 was included in Alt 4R2 above the demands in the future baseline (IORBL1); the public water supply demands assumed for the IORBL1 are also equivalent to the demands assumed for the ECB and 2012EC existing condition baselines (on average, 277 MGD in LECSA 2 and 412 MGD in LECSA 3). This increase in demand for other water related needs could be met without affecting the benefits accrued in the natural system.

Additional water available for allocation to consumptive use permit applicants is expected to be generated by this project in LECSA 2 and LECSA 3. The specific locations, volumes, and/or timing of where this water will be available for withdrawal will be developed when the following, project-related conditions are met: (1) completion of all CEPP project features and

(2) upon a formal determination by the SFWMD Governing Board that these project features are operational consistent with requirements of the CEPP PPA. Water will be allocated in accordance with the requirements of the SFWMD's consumptive use permitting rules in effect at that time.

7.4 Incremental Analysis during Plan Implementation

CEPP is composed of features that can be grouped into implementation phases. The USACE and the SFWMD will undertake updated analyses required by Paragraph 373.470(3)(c), F.S. for the implementation phases that are selected to be included in a Project Partnership Agreement or amendment thereto prior to entering into the PPA or PPA amendment.

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Central Everglades Planning Project
1501 Pre-Application Meeting

Meeting Summary/Minutes
SFWMD Headquarters
Thursday, September 5, 2013
Time: 10:00 to 12:00 pm

Attendees:

SFWMD	Matt Morrison, Megan Jacoby, Laura Reilly, Brenda Mills, Beth Lewis, John Morgan, Tom Teets
FDEP	Stacey Feken, Inger Hansen, Jerilyn Ashworth, Ernie Marks, Paul Julian, Frank Powell, Ann Lazar, Kristine Morris, Rhapsodie Osborne, Deinna Nicholson
USACE	Kim Taplin, Dan Crawford, Murika Davis, Melissa Nasuti, Gretchen Ehlinger, Leah Oberlin, Donna George
Miami-Dade County	Susan Markley
Broward County	Michael Zygnerski
FWC	Barron Moody
FDACS	Ray Scott, Rebecca Elliot
SHPO	Timothy Parsons
FDOT	Ann Broadwell
USEPA	Eric Hughes

A pre-application meeting was held for the Central Everglades Planning Project, in accordance with Florida Statutes 373.1501 (5)(c)(a), at SFWMD Headquarters in West Palm Beach on September 5, 2013.

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

I. Introductions

Matt Morrison, the Project Manager, welcomed attendees to the meeting. Attendees introduced themselves and noted which agency they were representing.

II. Project Compliance with Florida Statute 373.1501

Mr. Morrison reviewed the purpose for the meeting stating that the District is required, as the local sponsor, to evaluate whether the Central Everglades Planning Project (CEPP) has considered all state water resource issues and is technically feasible and cost effective. Mr. Morrison explained that the legislature had established DEP oversight to ensure that SFWMD conducted the required evaluations for CERP projects. In addition, Mr. Morrison noted that this meeting was vital so the SFWMD could obtain necessary and relevant information to determine consistency with laws and to determine if the project could be permitted and operated as proposed.

Mr. Morrison explained that there were several evaluations done to fulfill the requirements of the 373.1501 State Compliance Report:

a. Water Resource Issues including water supply, water quality, flood protection and threatened and endangered species.
b. Project Feasibility to determine in CEPP features are cost effective, consistent with CERP and can be operated as part of the C&SF system.
c. Consistency with state and federal laws
d. Project Assurances to determine that there are no adverse impacts on existing legal users, no diminishment of existing levels of flood protection and that adaptation of water management practices meet restored natural environment.
e. Coordination between Utilities and Public Infrastructure entities has taken place, thus reducing impacts to relocation of public infrastructure and utilities.

As it was noted in the pre-application meeting invitation, Mr. Moody asked if agencies were required to send a letter of support. SFWMD responded that it was not required to send such a letter, but if an agency felt it appropriate, they could send one to SFWMD. During this conversation, Ms. Feken clarified that the review of and comments on the 1501 Compliance Report was strictly between the FDEP and SFWMD.

III. Project Overview

Mr. Morrison discussed historical versus current flow in the Everglades system, noting that CEPP captured several components of the larger Comprehensive Everglades Restoration Project (CERP), which targets restoration of flow in the system. Mr. Morrison explained that CEPP was an expedited pilot project with the Corps and as such, a very robust public process was included in this project.

Mr. Morrison stated that the goal of the CEPP was to improve the quality, quantity, timing and distribution of water to the natural system as well as enhance ecological values and social well-being. Mr. Morrison discussed the performance measures used in Plan Formulation and also reviewed the final array of alternatives in detail. The Tentatively Selected Plan (TSP) had several iterations, but following optimization, Alt 4R2 was the final recommended plan.

The recommended plan, Alt 4R2, includes three components or features:

i. **Storage and Treatment**
   i. Construct A-2 FEB and integrate with A-1 FEB operations
   ii. Lake Okeechobee operation refinements within LORS

ii. **Distribution and Conveyance**
   i. Diversion of L-6 flows, infrastructure, and L-5 canal improvements
   ii. Remove western ~2.9 miles of L-4 levee west of S-8 (3,000 cfs capacity)
   iii. Construct 360 cfs pump station at western terminus of L-4 levee removal
   iv. Backfill Miami Canal and Spoil Mound Removal from ~1.5 miles south of S-8 to I-75
   v. Increase S-333 capacity to 2,500 cfs
   vi. One 500 cfs gated structure north of Blue Shanty levee and 6,000-ft gap in L-67C levee
   vii. Two 500 cfs gated structures in L-67A; 0.5 mile spoil removal west of L-67A canal north and south of structures
   viii. Remove ~8 miles of L-67C levee in Blue Shanty flow-way (no canal back fill)
   ix. Construct ~8.5 mile levee (Blue Shanty levee) in WCA 3B, connecting L-67A to L-29
   x. Remove ~4.3 miles of L-29 levee in Blue Shanty flow-way; divide structure east of Blue Shanty levee at terminus of Tamiami Trail Next Steps western bridge
   xi. Remove entire 5.5 miles L-67 Extension levee; backfill L-67 Extension canal
   xii. Remove ~6 miles of Old Tamiami Trail road (south of L-29 western levee, fromL-67 Ext to ENP Tram Rd)

xiii. **Seepage Management**
   i. Increase S-356 pump station to ~1,000 cfs
   ii. Construct 4.2 mile partial depth seepage barrier south of Tamiami Trail (along L-31N)
   iii. G-211 operational refinements; use coastal canals to convey seepage

Mr. Morrison discussed the cost of the project including construction, non-construction and contingency costs. As it is a large and extensive project with many complexities, implementation and sequencing was discussed at great length. Mr. Morrison noted that implementation of the project has many dependencies such as: C-111 South Dade and Modified Water Deliveries, other CERP projects, the State "Restoration

Strategies" projects, operational revisions and DOI "Tamiami Trail Next Steps" project. Mr. Morrison stated that, due to the complexity of the project and its dependencies, there would be a public process to discuss implementation, and that the PIR recognizes that other scenarios are possible.

Mr. Morrison discussed the water resources issues of the project including water quality, project assurances, project benefits and environmental compliance. Available water to existing legal users will not be diminished nor will flood protection be impacted as part of this project. Mr. Morrison discussed the timeline associated with the Draft PIR and noted that public comments were due to the USACE on or before October 14, 2013.

IV. Agency Discussion

Mr. Morrison opened the meeting up to discussion.

Ms. Markley commented that, while not having read through the entire Draft PIR, Miami-Dade has concerns with utilizing the IORBL in the savings clause analysis and mentioned the need for individual savings clause and project assurances analysis as project components with dependencies are sequenced and implemented. Ms. Lewis mentioned that this has been acknowledged in Chapter 6 of the PIR. Ms. Markley stated she is not in agreement with the summary conclusions and that water supply and flood protection need to be recognized in the savings clause analysis as well. She will be providing detailed comments in writing.

Ms. Elliot commented on the sequencing of the project, specifically the project's dependency on other projects such as the C-44 Reservoir connection to C-23. She wanted to ensure that it was clearly stated and understood that, with certain projects, there wasn't much flexibility about which projects had to happen first and recommended that at the PIR recognize that some sequencing has to be done in order. Mr. Morrison expressed that once the sequencing phase was imminent, there would be a public process to discuss such matters. He also mentioned that the LOSA minimal loss has been noted in Section 6 of the Draft PIR which also discusses these dependencies.

Ms. Elliot questioned I regard to flood protection in South Dade, whether the uncertainties in the modeling were addressed in the Draft PIR. Mr. Morrison stated that the resistant coefficients (model anomalies) in the L-31 Canal would be identified and documented in the Model Documentation report as well as Annex B of the Draft PIR.

Ms. Elliot discussed the upgrade of S-356; questioning the permitability of it given that the current structure is not permitted. Mr. Morrison noted the comment.

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Mr. Scott questioned if the 1501 Report would go into dependencies and sequencing of the project. He believes that it would be a critical part of the report. He also questioned whether these dependencies could be hard wired into the PIR. Mr. Morrison explained that as the local sponsor, SFWMD would not compromise on water quality. He also noted that SFWMD would develop and negotiate individual Project Partnership Agreements (PPAs) with the Corps before any project is designed or built. Each increment will meet Savings Clause and Project Assurances. Dependencies and sequencing will be part of the report.

Ms. Markley discussed the fact that as the project moves forward and phases become clearer and more information is complete, the water supply and savings clause analysis will have to be repeated. Mr. Morrison acknowledged that this is true and that such language was in Section 6 and the Executive Summary of the Draft PIR.

Mr. Hughes commented that he was confident that the USEPA would support the document in a letter, but cautioned that the water quality constraint will be drawing a lot of USEPA's attention.

Mr. Moody was concerned, regarding project dependencies, about consistency between projects. Mr. Morrison acknowledged that throughout project implementation, operations would have to be updated, specifically in regard to Lake Okeechobee revisions.

Mr. Zygnerski was confident that, because of prior conversations, Broward County concerns about C-51 had been addressed appropriately.

Ms. Feken commented the 1501 report should contain a level of reasonable certainty that the project is permittable.

Ms. Elliot questioned if the PIR could solidify permitability of the S-356 pump. Ms. Feken noted that there are concerns associated with Appendix A and Settlement Agreement compliance and language has put into the PIR to address those concerns specifically. The language requires all of the involved parties to get together and discuss these issues throughout the lifespan of the project. Mr. Marks added that there is a realization by all the parties that the original intent of Appendix A may not mesh with what happens in the future and that the parties will have to continue to talk about this. It is something that everyone is aware of and it is being worked on under the umbrella of the TOC.

V. Adjourn

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**CENTRAL EVERGLADES
PLANNING PROJECT**

ANNEX C

DRAFT PROJECT OPERATING MANUAL

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1.0 INTRODUCTION

The main purpose of this Draft Project Operating Manual (DPOM) is to provide an overview of water management operations after the integration of the Central Everglades Planning Project (CEPP) elements. The project phase that this DPOM covers is the Project Implementation Report (PIR) phase. The DPOM is intended to provide the operating criteria associated with the new CEPP features to achieve the goals, purposes, and benefits outlined in the PIR, by improving the quantity, quality, timing, and distribution of water for the natural system, while providing for other water-related needs and meeting the requirements for protection of health and public safety. Report preparation is pursuant to Engineering Regulation (ER) 1110-2-240, and is in accordance with guidance contained in Engineering Manual (EM) 1110-2-3600, ER 1110-2-8156, and the Programmatic Regulations Draft Guidance Memoranda (GM) #5. All elevations referenced in this DPOM are in feet (ft.), and reference the National Geodetic Vertical Datum of 1929 (NGVD).

The final Project Operating Manual (POM) assumes completion of all CEPP components. The POM will undergo several updates and refinements over time as explained in Section 6 of the CEPP PIR and in this document. The triggers, thresholds, and knowledge gained over time will be used in future modeling and updates, and the POM will be developed in coordination with and consistent with the CEPP Adaptive Management Plan. Modifications and/or revisions to the POM will occur during subsequent project phases. Development of the POM is an iterative process that will continue throughout the life of the project. The POM will be updated at periodic intervals during the detailed design, construction and operational testing and monitoring phases of the project. Refinements to the operating criteria in the POM will be made as more project design details, data, operational experience, and general information are gained during these project phases. An interim POM will be developed based on the implementation schedule and shall cover operation as individual component or groups of components become fully functional and shall include operation criteria for construction periods. It is also anticipated that once the POM is completed and the long-term operations and maintenance phase is underway, it may be necessary to revise the POM from time to time based on additional scientific information and implementation of new Comprehensive Everglades Restoration Project (CERP) or non-CERP activities. The adherence to the authorized project purposes will be sustained through the periodic revisions to the POM.

It is important to understand that the POM would develop over time as the details of the design of CEPP components are developed. The operations discussed herein represent the start-up operational strategy, recognizing that constraints in the system may be removed over time due to the completion of many of the CEPP components as well as other CERP and Non-CERP Projects. Refinements to the POM may be needed in response to phased implementation of CEPP components, changes during the design and construction phases, and the potential of reduced performance of components due to model limitations, among other factors. However, the fulfillment of the authorized project purposes will be preserved, through revisions and periodic updates to the POM as necessary. This draft is presented with the recognition that multiple revisions and operational refinements will occur over the life of the project, as described below in Figure 1-1.

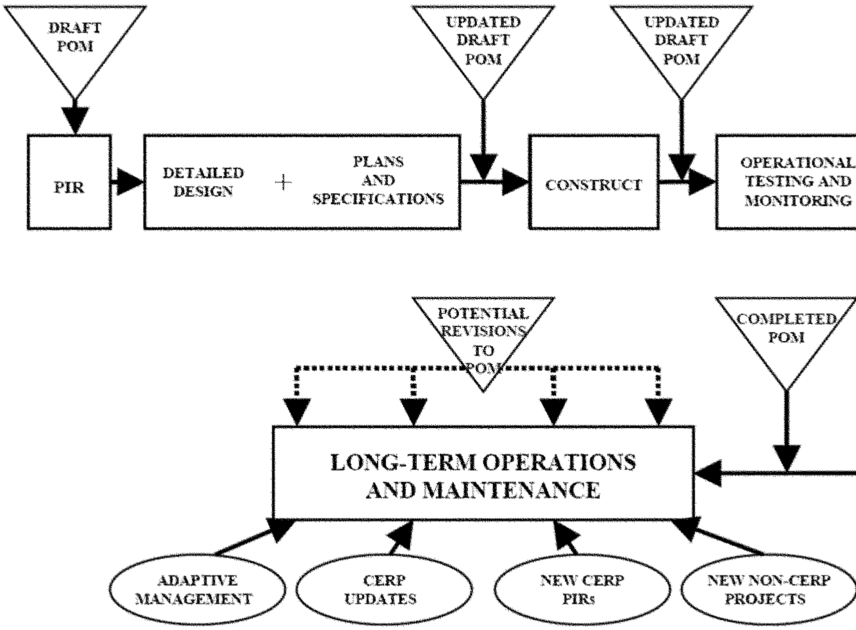

Figure 1-1 Evolution of the Project Operating Manual

2.0 GENERAL PROJECT PURPOSES, GOALS, OBJECTIVES, AND BENEFITS

The purpose of CEPP is to improve the quantity, quality, timing, and distribution of water flows to the central Everglades [Water Conservation Area 3 (WCA-3) and Everglades National Park (ENP)]. CEPP is composed of increments of project components that were identified in CERP, reducing the risks and uncertainties associated with project planning and implementation. This study approach is consistent with the recommendations from the National Research Council to utilize Incremental Adaptive Restoration to both achieve timely, meaningful benefits of CERP and to lessen the continuing decline of the Everglades ecosystem.

The goals of CEPP include the enhancement of ecological values and the enhancement of economic values and social well-being. The goal of enhancing ecological values can be realized through the achievement of the CEPP objectives as listed: restore seasonal hydroperiods and freshwater distribution to support a natural mosaic of wetland and upland habitat in the Everglades system; improve sheetflow patterns and surface water depths and durations in the Everglades system in order to reduce soil subsidence, the frequency of damaging peat fires, the decline of tree islands, and salt water intrusion; slightly reduce high volume discharges from Lake Okeechobee to improve the quality of oyster and submerged aquatic vegetation (SAV) habitat in the Caloosahatchee and St. Lucie Estuaries; reduce water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization; and restore more natural water level responses to rainfall to promote plant and animal diversity and habitat function. The goal of enhanced economic values and social well being can be realized through the achievement of the remaining CEPP objective to increase availability of water for other related water uses.

CEPP objectives are planned to be fulfilled through a variety of changes including:

- Refinements to the Lake Okeechobee regulation schedule
- Construction of the A-2 Flow Equalization Basin (FEB) to be operated integrally with the State's A-1 FEB and STA-2 and STA-3/4
- Redistribute water from STA-2 and STA-3/4 to WCA-3A
- Reestablish conveyance from WCA-3A to WCA-3B and ENP
- Mitigation for potential increase in seepage from WCA-3B and ENP
- Modifications to structures, canals, and levees to improve water deliveries
- SFWMD allocation of additional water made available to consumptive use permits in Lower East Coast Service Area 2 (LECSA 2) and LECSA 3

The recommended plan will provide approximately 210,000 acre-feet (ac-ft) per year of additional water flow to the Everglades by redirecting (through the EAA) Lake Okeechobee water which is currently being discharged to tide via the St. Lucie and Caloosahatchee Estuaries and providing FEB storage to attenuate flow rates, prior to water quality treatment using available, off-peak capacity of the state-operated STA-2 (See Figure 3-2) and STA-3/4 (See Figure 3-3). Following water quality treatment, this additional flow quantity will be re-distributed as inflows to WCA-2A and WCA-3A (See Figure 3-4), and the recommended plan features will modify the quantity, quality, timing, and spatial distribution of flows into and through WCA-3A, WCA-3B (See Figure 3-5), and ENP to Florida Bay in order to meet the project objectives. With conveyance improvements to the L-5 Canal and new water control structures along the L-5 and L-6 Canals, treated discharges from STA-2 and STA-3/4 will be distributed across the northwestern boundary of WCA-3A. Approximately 2.9 miles of the southern L-4 Levee, west of the Structure 8 (S-8), would be removed. Excluding approximately 1.5 miles of the Miami Canal immediately south of S-8, the remaining portion of the Miami Canal south of L-4 and north of I-75 would be backfilled and most spoil mounds would be removed, and multiple tree island mounds would be constructed within the prior canal footprint to provide additional habitat. The S-8 Pump Station would need to be modified through rehabilitation of the existing structure or reconstructed to allow for the same discharge capacity as the existing pump station. These actions would help provide restoration of the northern WCA-3A hydropatterns.

In order to reestablish conveyance of water from WCA-3A to WCA-3B, three new water control structures would be added along the L-67A Levee (See Figure 7-5). Two of these structures will provide water to the WCA-3B flowway, and one additional structure will be located north of the flowway. Within the WCA-3B flowway, approximately 8 miles of L-67C Levee would be removed without the backfilling of the adjacent L-67C Canal. A new 8.5 mile levee (L-67D, commonly referred to as the Blue Shanty Levee) would be constructed in the southwestern portion of WCA-3B (general north to south orientation), which would connect the L-67A Levee and the L-29 Levee. Approximately 4.3 miles of the L-29 Levee west of the Blue Shanty levee would be removed to allow the passage of water from WCA-3B to the L-29 Canal and ultimately ENP. The remaining 5.5 miles of the L-67 Extension (L-67E) Levee would be removed and the adjacent L-67C Canal would be backfilled. In addition, the capacity of S-333 would be increased to 2,500 cubic feet per second (cfs) with construction of a new gated spillway structure to allow more water to pass from WCA-3A to Northeast Shark River Slough (NESRS) in ENP.

In order to mitigate seepage from WCA-3B and NESRS, a new 1,000 cfs S-356 Pump Station would be constructed to replace the existing temporary 500 cfs S-356 Pump Station. The feasibility of constructing a seepage reduction feature (e.g. partial or fully penetrating seepage barrier of a to-be-determined length and location) will be evaluated and constructed to assist or partially replace the seepage management provide by the S-356 Pump Station. The location and depth will consider that the seepage rate per mile reduces considerably a mile south of Tamiami Trail Pump Station.

As project components become operational and the project objectives begin to be realized, numerous ecological benefits are expected. With completion of the CEPP components, some of the water which is currently being discharged to the northern estuaries would be able to be sent south to the Everglades. Restoration of the environmental conditions within WCA-3A, WCA-3B, ENP, and Florida Bay would contribute to the increased survival and reproduction of many important native species. Re-establishment can occur for tree islands and other landscape characteristics that are important for the endemic species of the Everglades system. Increased availability of fish and amphibians, which serve as essential prey sources for many predators in the ecosystem, would raise productivity in the ecosystem and a healthier, natural pattern of vegetation would be restored. Habitat function would be increased and the unique plant and animal diversity that defines the Everglades would be maintained. Management of the region's water resources would be maintained. These measures would also increase recreation opportunities.

3.0 PROJECT FEATURES

3.1 EXISTING FEATURES

3.1.1 Lake Okeechobee

Spillway S-351

S-351, which has a design capacity of 1,500 cfs, is a gated spillway located in L-D2, the perimeter dike of Lake Okeechobee, at the connection of the Hillsboro Canal and the North New River Canal to Lake Okeechobee. It is adjacent to the S-2 Pump Station. S-351 permits releases to be made from Lake Okeechobee to help meet water requirements in the Miami Canal service area, to the Lower East Coast, and to ENP. It will permit flows to be discharged from the EAA into Lake Okeechobee when the lake level is low. It will also prevent hurricane tides from entering the Hillsboro Canal and North New River Canal. S-351 will be used, under certain conditions, to make regulatory or water supply releases from Lake Okeechobee into WCA-2A or WCA-3A. S-351 is operated unless the water level in Lake Okeechobee is too high, and then S-2 is utilized. See Figure 3-1 for structure location.

S-2 Pump Station

S-2, which has a design capacity of 3,600 cfs, is a pump station located at the connection of the North New River Canal and Hillsboro Canal to Lake Okeechobee, about two miles northwest of the town of Belle Glade. It is adjacent to Spillway S-351. Pumping is initiated when the S-6 Pump Station cannot maintain the stage in the Hillsboro Canal below 12.5 ft., NGVD or when the G-370, G-434 and G-435 Pump Stations and Structure G-371 cannot maintain the stage in the North New River Canal below 12.5 ft., NGVD, unless the water level in Lake Okeechobee is low enough to permit gravity discharge into the lake through S-351 at a desirable rate, or when flooding occurs in the basin and S-2 continues to pump until the stages within the EAA can be practically controlled by the southern pump stations. The minimum desirable stage in the Hillsboro Canal or North New River Canal is 10.0 ft., NGVD. S-351 is closed when ways-2 is pumping. See Figure 3-1 for structure location.

Spillway S-354
S-354, which has a design capacity of 1,450 cfs, is a gated spillway located in L-D9, the perimeter dike of Lake Okeechobee, at the connection of the Miami Canal to Lake Okeechobee. It is adjacent to the S-3 Pump Station. S-354 permits releases to be made from Lake Okeechobee to help meet water requirements in the Miami Canal service areas. S-354 permits flows to be discharged from the EAA into Lake Okeechobee when the lake level is low. It will also prevent hurricane tides from entering the Miami Canal. S-354 will be used, under certain conditions, to make regulatory or water supply releases from Lake Okeechobee into WCA-3A via the Miami Canal. S-354 is operated unless the water level in Lake Okeechobee is too high, and then S-3 is utilized. See Figure 3-1 for structure location.

S-3 Pump Station
S-3, which has a design capacity of 2,580 cfs, is a pump station located at the connection of the Miami Canal to Lake Okeechobee just north of the town of Lake Harbor. It is adjacent to Spillway S-354. Pumping is initiated when the G-372 Pump Station and Structure G-373 cannot maintain the stage in the Miami Canal below 12.5 ft., NGVD, unless the water level in Lake Okeechobee is low enough to permit gravity discharge into the lake through S-354 at a desirable rate, or if flooding occurs in the basin and S-3 continues to pump until the stages within the EAA can be practically controlled by the southern pump stations. The minimum desirable stage in the canal is 10.0 ft., NGVD. S-354 is closed when S-3 is pumping. See Figure 3-1 for structure location.

3.1.2 Everglades Agricultural Area
(See Figure 3-1 for Everglades Agricultural Area Map)

S-6 Pump Station
The primary purpose of S-6, which has a design capacity of 2,925 cfs, is to convey stormwater runoff from the EAA collected by the Hillsboro Canal into STA-2. S-6 is located in the alignment of the Hillsboro Canal just north of WCA-2A. In addition to conveying EAA runoff to STA-2, S-6 may also be used in conjunction with G-338 and G-339 to divert Hillsboro Canal flows around STA-2. The minimum desirable stage in the canal is 10 ft., NGVD. S-2, in combination with S-351, can, when pumping at their maximum rates, remove 3/4 inch per day from the 146 square mile tributary drainage area. STA diversion, or the delivery of surface water to the Everglades Protection Area without entering an STA, may occur under one or more of the following scenarios: maintenance, flood control, to avoid substantial damage to the treatment facilities, to address conflicts with the Endangered Species Act (ESA), to address conflicts with the Migratory Bird Treaty Act (MBTA) and for low flow water supply purposes.

S-7 Pump Station
The primary purpose of S-7, which has a total capacity of 2,490 cfs, is to convey STA-3/4-treated stormwater to WCA-2A. S-7 is located in the alignment of the North New River Canal at the western corner of WCA-2A, about 30 miles southeast of the town of Belle Glade and immediately east of Highway U.S. 27. In addition to conveying STA-3/4 discharges, S-7 may also be used (when G-371 is open) to divert North New River Canal flows or Lake Okeechobee releases around STA-3/4. S-7 also has an adjacent gated spillway that allows water to enter WCA-2A via gravity when downstream stages are low.

S-8 Pump Station
The primary purpose of S-8, which has a total capacity of 4,160 cfs, is to convey STA-3/4- and STA-5/6-treated stormwater to WCA-3A. S-8 is located in the alignment of the Miami Canal at the northern boundary of WCA-3A. In addition to conveying STA discharges, S-8 may also be used (when G-373 is

open) to divert Miami Canal flows around STA-3/4. S-8 also has an adjacent gated spillway that allows water to enter WCA-3A via gravity when downstream stages are low. See Section 3.3.3 Modified Features for potential S-8 confluence modifications.

Structure S-150
Structure S-150, which has a total capacity of 1,000 cfs, is a control structure that can convey STA-3/4 discharges and Lake Okeechobee regulatory and water supply releases to northeastern WCA-3A when water levees in WCA-3A are low enough to permit gravity inflows. S-150 is located at the northeastern corner of WCA-3A just west of S-7. When WCA-3A is high, S-150 can also release water from WCA-3A into the North New River Canal.

G-434 Pump Station
The primary purpose of G-434, which has a total capacity of 1,120 cfs, is to convey stormwater runoff collected by the North New River Canal into STA-2 Cells 4, 5, and 6. G-434 may also be operated to convey limited flows to STA-2 Cells 1, 2, and 3. G-434 is located northwest of STA-2 Cell 5 and just east of the North New River Canal.

G-435 Pump Station
The primary purpose of G-435, which has a total capacity of 480 cfs, is to convey stormwater runoff collected by the North New River Canal into STA-2 Cells 7 and 8. G-435 is located northwest of STA-2 Cell 7 and just east of the North New River Canal.

G-372 Pump Station
The primary purpose of G-372 is for flood protection to the upstream S-3/S-8 Basin. G-372, which has a design capacity of 3,700 cfs, conveys stormwater runoff from the EAA collected by the Miami Canal into STA-3/4. The secondary objective of G-372 is to convey Lake Okeechobee releases to STA-3/4 for eventual conveyance to the downstream environment (i.e. WCAs and ENP) during times when Lake Okeechobee releases are required and WCA-3A conditions allow. During dry hydrologic periods, water can also be delivered from Lake Okeechobee, when available, to maintain hydration of treatment cells. S-354 would be opened to release water from Lake Okeechobee, and G-372 would pump this water into STA-3/4. It is located near the northwest corner of the Holey Land Tract at the Miami Canal.

G-370 Pump Station
The primary purpose of G-370 is for flood protection to the upstream S-2/S-7 Basin. G-370, which has a design capacity of 2,775 cfs, conveys stormwater runoff from the EAA collected by the North New River Canal into STA-3/4. The secondary objective of G-370 is to convey Lake Okeechobee releases to STA-3/4 for eventual conveyance to the downstream environment (i.e. WCAs and ENP) during times when Lake Okeechobee releases are required and WCA-2A or WCA-3A conditions allow. During dry hydrologic periods, water can also be delivered from Lake Okeechobee, when available, to maintain hydration of treatment cells. S-351 would be opened to release water from Lake Okeechobee, and G-370 would pump this water into STA-3/4.

Miami Canal Divide Structure (G-373)
G-373 primarily serves as an STA-3/4 diversion structure and is located in the Miami Canal approximately seven miles north of the S-8 Pump Station. G-373 is normally closed and serves to separate stormwater runoff in the Miami Canal from STA-3/4- and STA-5/6-treated stormwater. As stated above, STA diversion may occur under one or more of the following scenarios: maintenance, flood control, to avoid substantial damage to the treatment facilities, to address conflicts with the

Endangered Species Act (ESA), to address conflicts with the Migratory Bird Treaty Act (MBTA) and for low flow water supply purposes. The structure can also be operated to provide water supply deliveries south from Lake Okeechobee to the Big Cypress Seminole Tribe of Florida Reservation or WCA-3A or north from WCA-3A to the EAA.

North New River Canal Divide Structure (G-371)
G-371 primarily serves as an STA-3/4 diversion structure and is located in the North New River Canal just northwest of the S-7 Pump Station. G-371 is normally closed and serves to separate stormwater runoff in the North New River Canal from STA-3/4-treated stormwater. As stated above, STA diversion may occur under multiple scenarios. The structure can also be operated to provide water supply deliveries south from Lake Okeechobee to WCA-2A or north from WCA-2A to the EAA.

G-404 Pump Station
G-404 is located on the Miami Canal at its confluence with the L-4 Borrow Canal. The pump station is located south of Structure G-357 and north of the S-8 Pump Station, and adjacent to the southeastern corner of the Rotenberger Wildlife Management Area. There are two operational objectives for G-404: (1) to supply the northwest corner of WCA-3A with treated discharges from STA-3/4 and STA-5/6, and (2) to provide supplemental irrigation water supply to the Big Cypress Seminole Tribe of Florida Reservation (G-404 would be operated in conjunction with G-409 in this scenario). Although not explicit project objectives, there is another ancillary benefit of G-404; during storm events, G-404 may supplement the capacity of S-8 to remove STA-3/4 discharges. G-404 has a total nominal capacity of 600 cfs. See Section 3.3.3 Modified Features for potential S-8 confluence modifications.

Structure G-357
G-357, which is located northwest of the S-8 Pump Station, is a control structure primarily used to facilitate the movement of water from the L-4 Borrow Canal to the Miami Canal. G-357, when closed, also prevents back flow from the L-4 Borrow Canal to the Miami Canal when the G-404 Pump Station is operating. If Miami Canal water levels are higher than the L-4 Borrow Canal water levels, G-357 may also be opened to allow gravity flow to the L-4 Borrow Canal from the Miami Canal during water supply operations. See Section 3.3.3 Modified Features for potential S-8 confluence modifications.

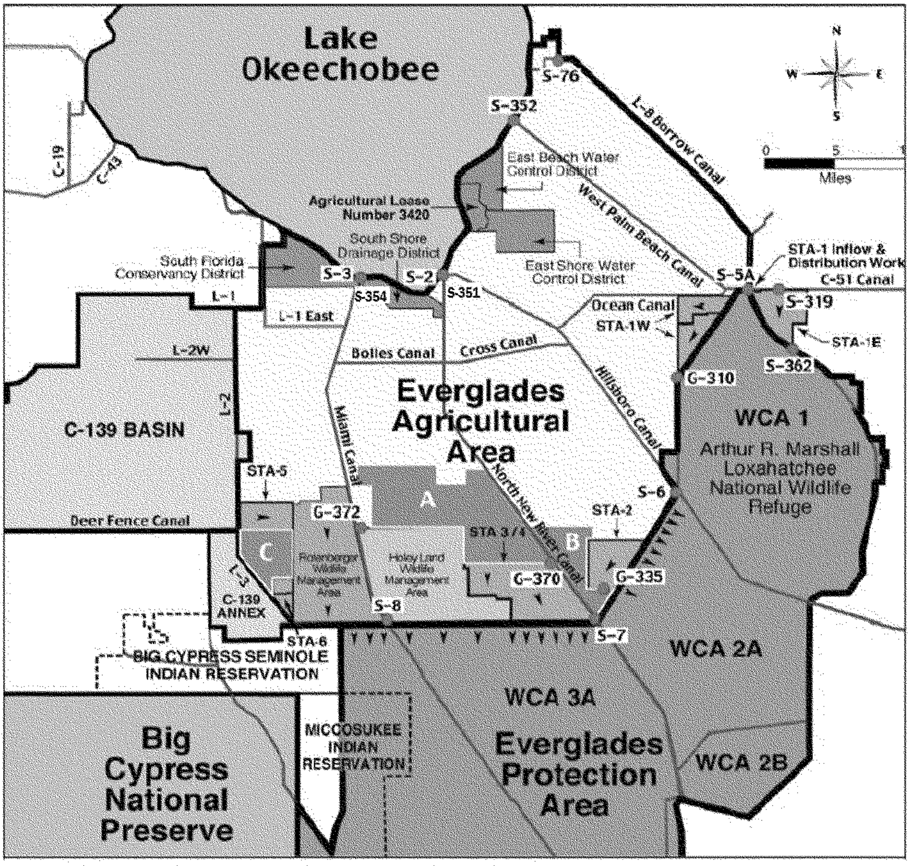

Figure 3-1 Everglades Agricultural Area Map

3.1.3 Stormwater Treatment Areas 2 and 3/4

STA-2 (Figure 3-2) is located in western Palm Beach County immediately west of WCA-2A. The STA is situated generally on and surrounding the former Brown's Farm Wildlife Management Area, Woerner Farm and the Okeelanta Farm. The original STA-2 consisted of three treatment cells (1, 2 and 3) and began operation in 2000. STA-2 was expanded by approximately 2,000 acres in December 2006 with the construction of Cell 4 and then further expanded by approximately 7,000 acres with the construction of Cells 5, 6, 7 and 8 (also known as Compartment B) which were flow capable in 2010 and permitted to operate in September 2012. Currently, STA-2 has a total of eight treatment cells and five flowways, and a total effective treatment area of approximately 15,500 acres. STA-2 receives stormwater runoff primarily from the S-6/S-2 Basin and can receive runoff from the S-2/S-7 Basin. During dry hydrologic periods, water can be delivered from Lake Okeechobee, when available, to maintain hydration of treatment cells.

STA-3/4 (Figure 3-3) is also located in western Palm Beach County, west of STA-2, northeast of the Holey Land Wildlife Management Area and north or WCA-3A. STA-3/4 began operation in 2004 and has a total of six treatment cells and three flowways, and a total effective treatment area of approximately 16,300 acres. A 445-acre section of Cell 2B is the site of the STA-3/4 Periphyton-based STA (PSTA) Project, aimed at testing and evaluating PSTA treatment technology. STA-3/4 receives stormwater runoff from the S-2/S-7 Basin (collected by the North New River Canal), the S-3/S-8 Basin (collected by the Miami Canal), and Lake Okeechobee by means of STA-3/4 inflow pump stations, G-370 and G-372. During dry hydrologic periods, water can be delivered from Lake Okeechobee, when available, to maintain hydration of treatment cells.

G-335 Pump Station
G-335, which has a total capacity of 3,040 cfs, is one of two outflow pump stations for STA-2 and is located at the southeast corner of STA-2 Cell 1. G-335 discharges STA-2-treated stormwater to the L-6 Canal. Treated stormwater within the L-6 Canal is then conveyed to northwestern WCA-2A via uncontrolled box culverts G-336A, B, C, D, E and F and to western WCA-2A via G-336G and a 4,800 ft. degraded reach of the East L-6 Levee located north of S-7.

G-436 Pump Station
G-436, which has a total capacity of 1,600 cfs, is one of two outflow pump stations for STA-2 and is located just south of G-335 at the northeast corner of STA-2 Cell 8. Similar to G-335, G-436 discharges STA-2 treated stormwater to the L-6 Canal. Treated stormwater within the L-6 Canal is then conveyed to northwestern WCA-2A via uncontrolled box culverts G-336A, B, C, D, E and F and to western WCA-2A via G-336G and a 4,800 ft. degraded reach of the East L-6 Levee located north of S-7.

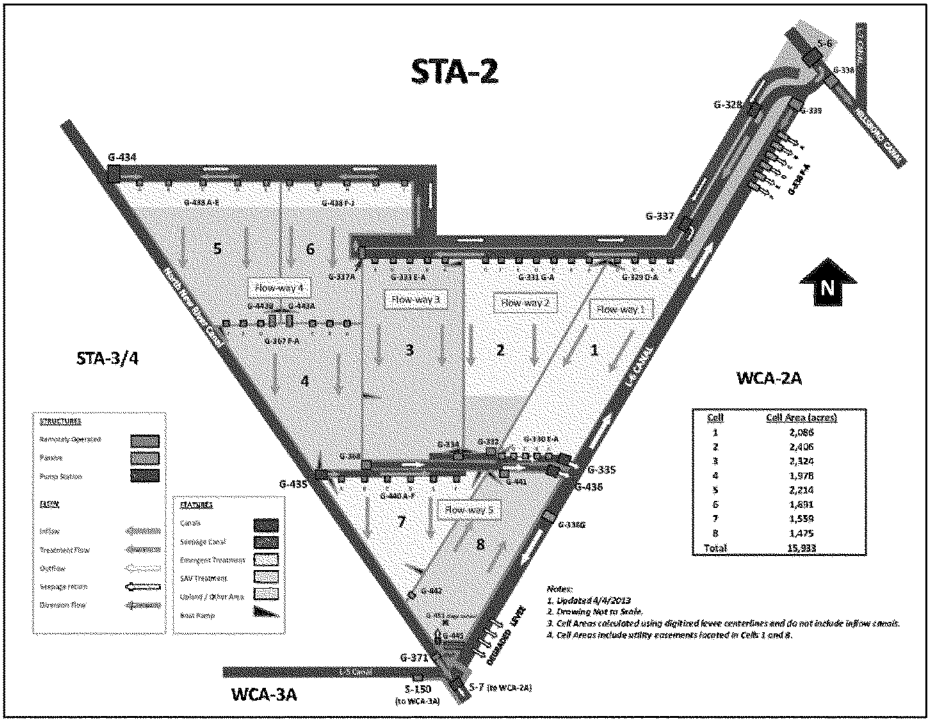

Figure 3-2 STA-2 Map

A schematic of STA-3/4 is presented in Figure 3-3. Untreated waters from the North New River Canal (S-2 and S-7 Basins) and the Miami Canal (S-3 and S-8 Basins) and Lake Okeechobee are directed into the STA at its northern boundary by means of pump stations, G-370 and G-372, respectively. Diversion structure G-371 is located on the North New River Canal at the southeast corner of the STA. Diversion Structure G-373 is located on the Miami Canal just south of G-372.

Under normal STA operations, diversion structure G-371 (located in the North New River Canal at the southeast corner of STA-3/4) and diversion structure G-373 (located in the Miami Canal just south of G-372) would be closed, and STA-3/4 inflow pump stations would convey stormwater runoff from the Miami Canal and the North New River Canal to the STA-3/4 Inflow/Supply Canal. The STA-3/4 Inflow/Supply Canal is located between G-370 and G-372 and is adjacent to the north boundary of the Holey Land Wildlife Management Area and borders the north side of the STA-3/4.

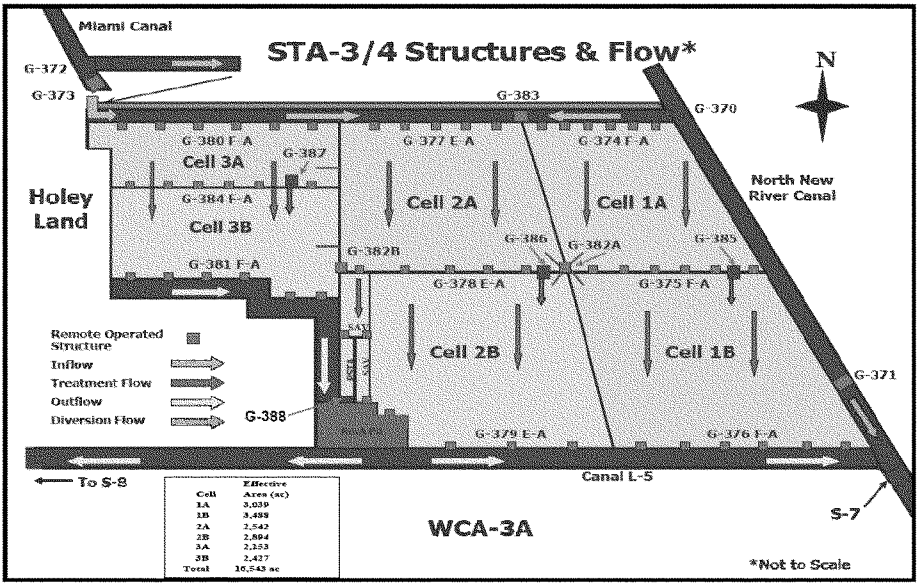

Figure 3-3 STA-3/4 Map

3.1.4 Water Conservation Area 3A and 3B

WCA-3A has an area of 767 square miles and is located in western Broward County and northwestern Miami-Dade County. Inflows to the area are from the S-11s, S-8, S-150, S-140, G-407, S-190, G-123, S-142, S-9, S-9A, and G-64. Outflows from WCA-3A are primarily made through the S-12s, S-333, S-343A, S-343B, S-344, and S-151 (see Figure 3-4 for a layout of WCA-3A and its features).

WCA-3B is approximately 154 square miles and is located in south-central Broward County and north-central Miami-Dade County. Inflows to WCA-3B are by way of S-151 and outflows are controlled via S-30, S-31, S-32, S-32A, S-335, and S-337 (See Figure 3-5 for a layout of WCA-3B and its features). There are also two discharge structures, S-355A and S-355B, along L-29 south of WCA-3B that are designed to move water from WCA-3B into the L-67C Canal, although the operation of these structures has not been previously authorized for more than short-term, temporary operations.

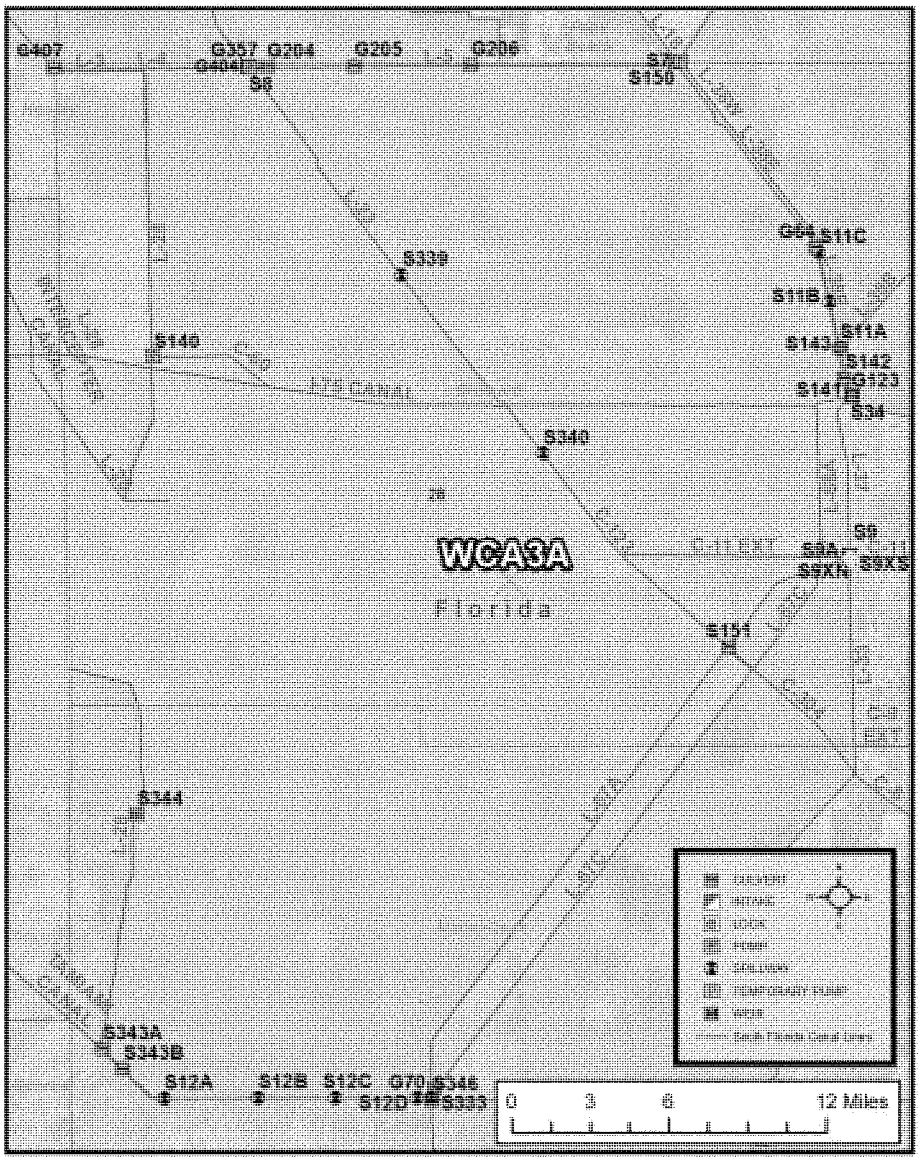

Figure 3-4 WCA-3A Map

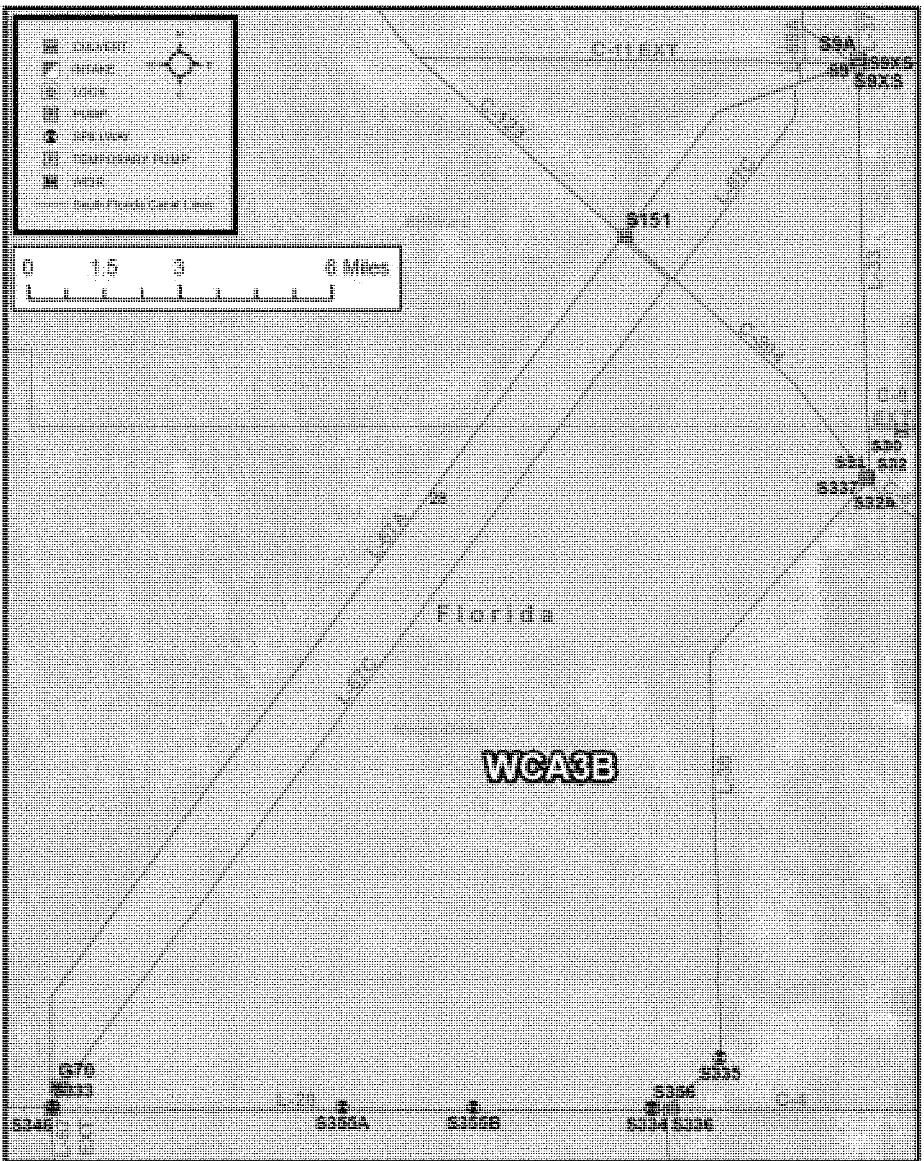

Figure 3-5 WCA-3B Map

3.1.5 South Dade Conveyance System

The South Dade Conveyance System (SDCS) supplies water to ENP and to District canals (C-6, C-4, C-1, C-102, C-103, C-113, and C-111) in Miami-Dade County during conditions of low natural flow. The purpose of the SDCS is supplying water to South Miami-Dade County canals to maintain water table elevations at high enough stages is to prevent saltwater intrusions into the Biscayne Aquifer. Design flows for the SDCS were based on maintaining South Miami-Dade County canal stage elevations at or above 2.0 ft., NGVD to prevent saltwater intrusion (See Figure 3-6 for a layout of the SDCS and its features).

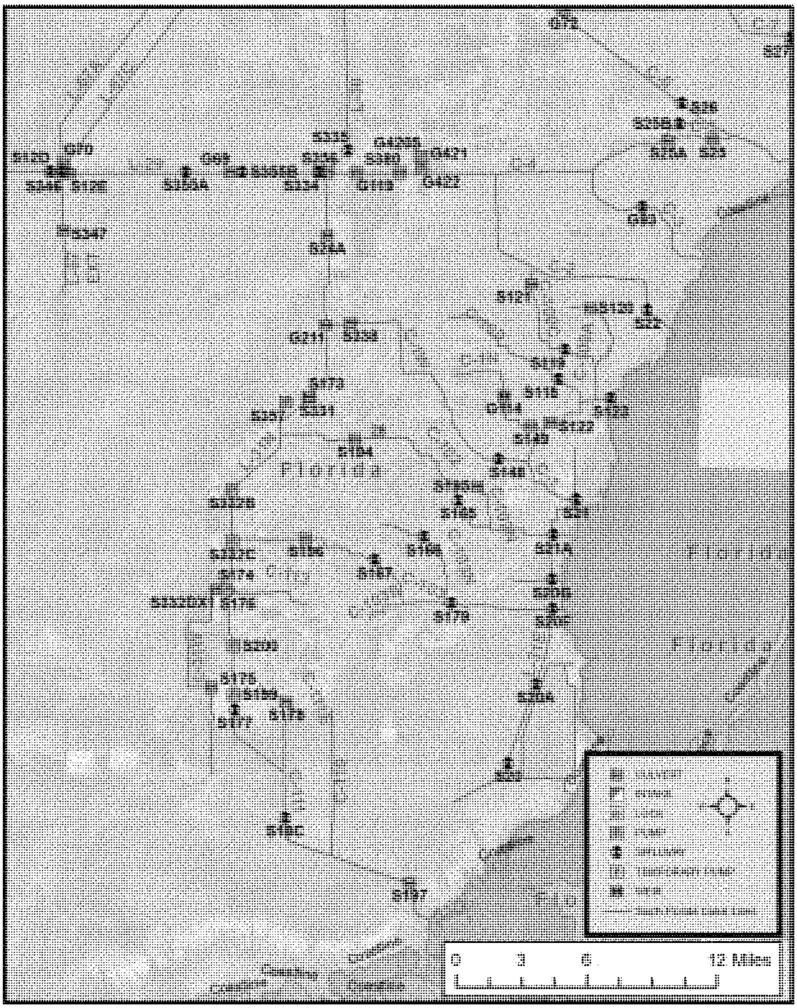

Figure 3-6 South Dade Conveyance System Map

3.2 PROPOSED FEATURES - NON-CEPP

3.2.1 Restoration Strategies - A-1 Flow Equalization Basin

The A-1 FEB, approximately 60,000 ac-ft, would be located upstream of STA-3/4 and STA-2 and serve to attenuate peak flows prior to water quality treatment in the STAs (Figure 3-7). The A-1 FEB would be designed and constructed by the South Florida Water Management District (SFWMD). The A-1 FEB would also assist in maintaining minimum water levels and reducing the frequency of dryout conditions within STA-2 and STA-3/4, which would help sustain phosphorus treatment performance. The A-1 FEB would have a footprint of approximately 15,000 acres.

Inflows would be directed towards the A-1 FEB via G-370 and G-372 along the STA-3/4 Inflow Canal and STA-3/4 Supply Canal respectively. Two sets of gated spillways would serve to control inflow to the A-1 FEB, one of which would be located on the western perimeter levee and the other in the southeastern corner of the basin. Inflows would be conveyed to the northern end of the A-1 FEB by above grade interior channels that are parallel to the east and west A-1 FEB perimeter levee. The water would be distributed to enable sheet flow from north to south within the facility to minimize short-circuiting and maximize hydraulic residence time. These conditions are expected to support emergent vegetation that would aid in the uptake of phosphorus within the A-1 FEB.

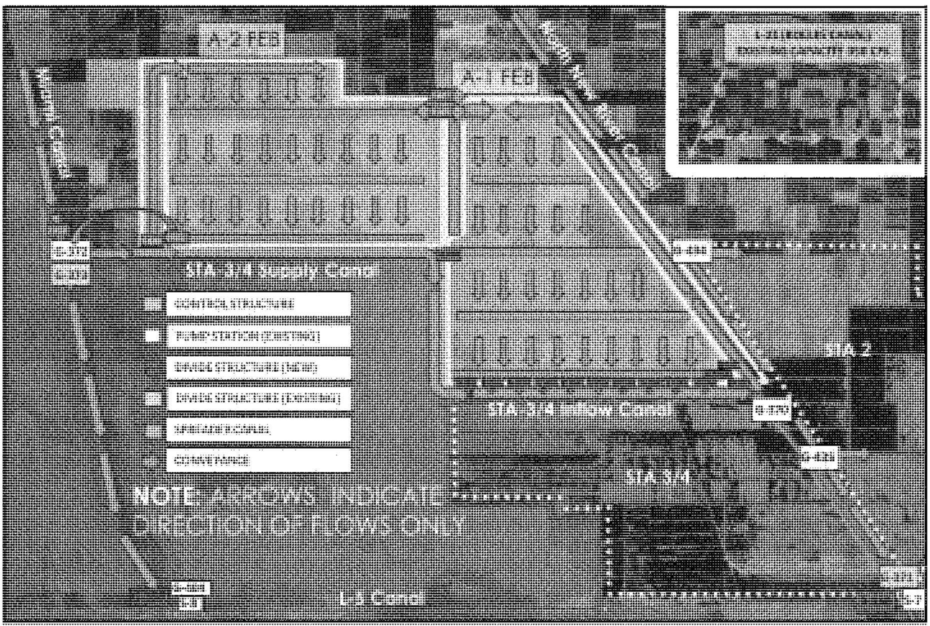

Figure 3-7 Combined FEB Flow Equalization Basin Schematic

3.3 PROPOSED FEATURES – CEPP

The features as outlined in the following subsections would be implemented as part of CEPP. In addition to construction of new features, there would be several existing features either removed or modified.

Preliminary Operating Criteria for the new and modified features listed below can be found in Section 7 of this DPOM.

3.3.1 New Features

3.3.1.1 A-2 Flow Equalization Basin

The A-2 FEB, approximately 56,000 ac-ft, would be located west of the A-1 FEB. The purpose of the A-2 FEB, which would be operated in conjunction with the use of the A-1 FEB, would be to capture additional water from Lake Okeechobee for delivery to the Everglades, while maintaining the pre-project capability to provide water quality treatment for the existing EAA runoff and limited Lake Okeechobee discharges. The combined FEB would be able to accept and provide some limited water quality pre-treatment of additional water from Lake Okeechobee during off-peak times, such as the dry season, when treatment capacity is available in the downstream STAs. See Figure 3-8 for a schematic of the A-2 FEB. The A-2 FEB would have a footprint of approximately 14,000 acres. The combined FEB would have a storage capacity of approximately 116,000 ac-ft. During the Preconstruction, Engineering, and Design (PED) phase, design of the FEB components will be assessed in further detail as described in **Appendix A Section A.10.1.5**. For operational flexibility, remotely controlling G-372 pumps for the A-2 FEB and other items described in **Appendix A Section A.10.1.5** are under operational considerations.

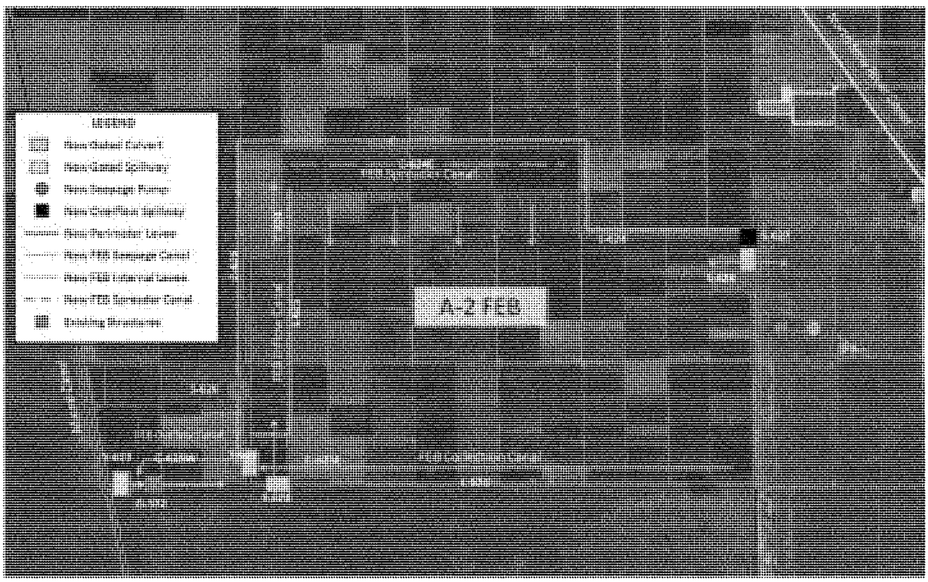

Figure 3-8 A-2 Flow Equalization Basin Schematic

Inflows from the Miami Canal would be directed towards the A-2 FEB via G-372 along the STA-3/4 Supply Canal. Inflows would be conveyed to the northern end of the A-2 FEB by an interior above-grade channel that would be parallel to the west perimeter levee. The water would be distributed to enable sheet flow from the north to the south within the facility to minimize short-circuiting and maximize hydraulic residence time. These conditions are expected to support emergent vegetation that would aid in the uptake of phosphorus within the A-2 FEB.

The following structures facilitate the operations of the combined FEB (Figure 3-7 and Figure 3-8):

S-623
The structure would be a gated spillway with a design capacity of 3,700 cfs, with less than 0.1 ft. of head loss. S-623 would serve as a divide structure to separate pre-treated FEB waters from untreated waters of the Miami Canal to maximize incidental water quality value of the flow-through impoundment. S-623 would be located in line with the STA-3/4 Supply Canal, west of the G-372 Pump Station. When open, S-623 would allow for the normal operations of G-372 to route Miami Canal water, or when closed can be used to route pre-treated FEB water through the STA-3/4 Supply Canal to STA-3/4.

S-624
The structure would be a gated sag culvert (i.e., a culvert used to convey water by gravity under another canal, also commonly referred to as an inverted siphon) with a design flow of 1,550 cfs that would serve as the inflow structure for the A-2 FEB. S-624 would be located near the southwest corner of the A-2 FEB, east of G-372. This structure would operate in conjunction with the existing G-372 to route flows from the Miami Canal into the FEB when storage capacity would be available. The structure would open for inflow operations into the FEB from G-372, and would close during A-2 FEB bypass operations (flow directly to STA-3/4 or the A-1 FEB) or to prevent back flow into STA-3/4 Supply Canal. S-624 would run from the STA-3/4 Supply canal, beneath the FEB discharge/collection canal, and into the FEB inflow canal/flowway.

S-625
The structure would be a discharge structure from the A-2 FEB. S-625 would be located in the southwest corner of the FEB in line with the western perimeter levee (L-624). This structure would be a gated culvert with a design capacity of 1,550 cfs. This structure would open to allow for the FEB to discharge from the FEB Collection Canal (C-625E) towards the headwaters of G-372 to provide hydraulic lift for redistribution through the STA-3/4 Supply Canal and for delivery to STA-3/4.

S-626
The structure would be a seepage pump station, with a design capacity of 500 cfs. S-626 would be located on the west side of seepage canal C-626 and deliver seepage back into the C-625W FEB outflow canal.

S-627
The structure would be an emergency overflow weir for the A-2 FEB, with a design capacity of 445 cfs. S-627 would be located in the northeast corner of the A-2 FEB, in line with the eastern levee of the A-2 FEB.

S-628
The structure would be a bi-directional inlet and outlet structure that hydraulically connects the A-2 FEB to the A-1 FEB with a design capacity of 930 cfs. S-628 would be located in the northeast corner of the A-2 FEB, in line with the eastern levee of the A-2 FEB. This feature would allow water to be passed between the A-2 and A-1 FEBs, depending on impoundment stages and capacity. Water from the Miami Canal could potentially be routed through the A-2 FEB by use of this structure. The opposite operation could also occur, using water routed through A-1 from the North New River Canal via G-370 to supplement water in the A-2 FEB (refer to Figure 3-8 for the A-2 FEB design layout).

L-624
L-624 would be the A-2 FEB perimeter levee, which would have a length of approximately 20 miles and an elevation of 20.3 ft., NGVD.

L-625
L-625 would be the A-2 FEB interior inflow canal levee which would have a length of approximately 4 miles.

C-624
C-624 would be the A-2 FEB inflow canal, with a design capacity of 1,550 cfs. C-624 would be located on the west side of the FEB and have an approximate length of 4 miles. The C-624 Canal would receive water from S-624; and the canal would be used to deliver water to the northern side of the A-2 FEB.

C-624E
C-624E would be a spreader canal located on the northern boundary of the A-2 FEB, with an approximate length of 4 miles. The C-624E Canal would distribute water across the northern part of the A-2 FEB.

C-625E
C-625E would be the A-2 collection/discharge canal with a design capacity of 400 cfs. C-625E would be located within the interior of the A-2 FEB along the southern perimeter. When stages in the A-2 FEB are low, sheet flow would collect in C-625E and would be conveyed to the S-625 discharge structure. When the FEB experiences greater depths, the C-625E Canal would be completely submerged, but would still provide conveyance assistance to the S-625.

C-625W
C-625W would be the A-2 FEB discharge canal, with a design capacity of 1,550 cfs. C-625W would be located exterior to the A-2 FEB between S-625 and G-372 Headwater (HW).

C-626
C-626 would be a seepage collection canal for the A-2 FEB, with a design capacity of 400 cfs. C-626 would be located along the west and northern exterior perimeter of the A-2 FEB, with a total length of approximately 4 miles.

3.3.1.2 WCAs, ENP, and SDCS

In order to improve habitat conditions and hydrologic conditions in WCA-3A, WCA-3B, and ENP, CEPP proposes to remove portions of existing levees, install new water control structures, and modify current canals and pump stations. The purpose of these system improvements would be to re-distribute flows through the landscape of WCA-3A, WCA-3B, and ENP in order to re-hydrate areas such as the northwest corner of WCA-3A, that have been considerably drier than the habitat restoration goals for northwestern WCA-3A. The following structures facilitate the operations of these areas:

S-8A (New)
For CEPP, the S-8 Pump Station (and/or G-404) may require design modifications (or possible replacement). The proposed S-8A structure would be two sets of gated culverts (with an associated canal), with a design capacity of 3,120 cfs to the L-4 Canal and 1,040 cfs to the Miami Canal. S-8A would

be located in the Miami Canal, immediately south of the existing S-8 Pump Station, to deliver water from the L-5 Canal (via S-8) west to the L-4 Canal and south to the remaining open segment of the Miami Canal (Refer to Section 3.3.3 Modified Features for potential S-8 confluence modifications). During the PED phase, the design uncertainties will be assessed/reassessed in further detail, as described in Appendix A of the PIR. For example, G-404 and G-357 could be abandoned after S-8A becomes operational. In addition, stage conditions will be checked to ensure that southern treatment cells in STA-5/6 will be able to discharge under design conditions.

S-620
The structure would be a gated culvert with a design capacity of 500 cfs. S-620 would be located at the southern end of the L-6 Canal to deliver water from the L-6 Canal to the eastern (remnant) L-5 Canal.

S-621
The structure would be a gated spillway with a design capacity of 2,500 cfs. S-621 would be located on the STA-3/4 outflow canal. S-621 would serve as a divide structure to separate STA-3/4 outflows from the eastern (remnant) L-5 Canal when L-6 deliveries are being made to the L-5 Canal. When open, S-621 would allow for a portion of the STA-3/4 outflow discharges to be delivered to the S-7 Pump Station. During normal operations, including L-6 diversion flows, CEPP would direct the majority of STA-3/4 discharges westward to the modified S-8 Pump Station, and operation of S-7 Pump Station to deliver STA-3/4 discharges to WCA-2A would be primarily during peak discharge events.

S-622
The structure would be a gated spillway with a design capacity of 500 cfs. S-622 would be located in the L-5 Canal to deliver water from the eastern (remnant) L-5 Canal to the western L-5 Canal.

S-630
The structure would be a pump station with a design capacity of 360 cfs. S-630 would be located in the L-4 Canal, east of the existing L-4 Levee gap, to maintain existing water supply deliveries to the Seminole Tribe of Florida's Big Cypress Reservation and to stage up water in the L-4 Canal to allow discharge over the L-4 Levee degrade.

S-631
The structure would be a gated culvert with a design capacity of 500 cfs. S-631 would be located in L-67A to deliver water from WCA-3A to WCA-3B, east of the L-67D Levee.

S-632
The structure would be a gated culvert with a design capacity of 500 cfs. S-632 would be located in L-67A to deliver water from WCA-3A to WCA-3B, within the WCA-3B flowway.

S-633
The structure would be a gated culvert with a design capacity of 500 cfs. S-633 would be located in L-67A to deliver water from WCA-3A to WCA-3B, within the WCA-3B flowway.

L-67D
The L-67D Levee would connect L-67A to L-29 and serve as the eastern perimeter levee for the WCA-3B flowway. It would run from due north from the L-29 Levee, starting approximately 4.3 miles east of S-333. The total length would be approximately 8.5 miles. The crest width would be 14 ft., the height would be 6 ft., and the side slopes would be 3:1.

S-333 (New)
The new S-333 gated spillway would have a design capacity of 1,150 cfs, to deliver water from the L-67A Canal to the L-29 Borrow Canal. It would be constructed just north of the existing S-333 structure, bringing the combined design capacity of both structures to 2,500 cfs. S-333 is proposed to have a tailwater constraint at 9.7 ft., NGVD. S-333 would be operated in accordance with Rainfall Driven Operations which would dictate releases based upon conditions. The combination of S-333 structures; along with the proposed S-631, S-632, and S-633; would supersede the S-12s in being the primary discharge point for WCA-3A.

S-355W
The S-355W structure would be a gated spillway located in line with the L-29 Canal at the southern extent of the proposed L-67D levee, with a design capacity of 1,230 cfs. The purpose of the S-355W would be to convey water from the L-29 Canal within the Blue Shanty Flowway, eastward towards the existing S-334 spillway to provide assistance in meeting ENP ecological objectives.

S-356 (New)
The new S-356 Pump Station would replace the current temporary pump station and have a design capacity of 1,000 cfs to provide seepage return to ENP. It would be located in the vicinity of the existing temporary pump station. This pump station should be able to concurrently handle the discharges from S-335 and the seepage into L-31N (from S-335 to G-211) without requiring discharges to tide. S-356 is proposed to have a tailwater constraint at 9.7 ft., NGVD and open/close criteria of 6.0/5.5 ft., NGVD in the wet season and 6.0/5.8 ft., NGVD in the dry season.

3.3.2 Removed Features

Miami Canal (Located from the northwestern to the eastern side of WCA-3A)
Approximately 13.5 miles of the Miami Canal would be backfilled to the north of I-75, from the I-75 highway to approximately 1.5 miles south of S-8. A significant portion of the spoil mounds adjacent to the Miami Canal would also be removed, and multiple tree island mounds would be constructed within the prior canal footprint to provide additional habitat. The backfilling would help alleviate the overdraining of the northern portion of WCA-3A by increasing hydroperiods and depths within the area.

L-4 Interior Levee (Northwest corner of WCA-3A)
Approximately 2.9 miles of the L-4 Levee would be removed from the area west of the S-8 structure. This would help promote sheetflow, rather than point source flows, into the area.

L-67C Levee (Separates WCA-3A from WCA-3B, parallel to the L-67A Levee)
Approximately 8 miles of the L-67C Levee, west of the proposed L-67D Levee, would be removed from the area north of Tamiami Trail within the WCA-3B flowway. The adjacent canal would not be backfilled. North of the new L-67D Levee, an approximate 6,000 ft. gap would be created to distribute discharges from S-631 to eastern WCA-3B. The levee removal and gapping would allow a more natural flow of water from WCA-3A to WCA-3B, and the WCA-3B flowway would provide a direct hydrologic connection to ENP.

L-67 Extension Levee (Located in ENP, south of S-333)
The entire remaining length of the L-67 Extension Levee (5.5 miles) would be removed and the adjacent borrow canal would be backfilled (5.5 miles). This would allow a more natural flow of water and provide a direct hydrologic connection between Northeast Shark River Slough and Western Shark River Slough.

The removal of this levee may be predicated on a number of factors, to include the completion of the C-111 Northern Detention Area (NDA), the 8.5 Square Mile Area (SMA) Flood Mitigation Project, and L-31N seepage management. Further details would be determined during the PED phase.

L-29 Levee (Southern boundary of WCA-3B, east of S-333)
Approximately 4.3 miles of the L-29 Levee, west of the new L-67D Levee, would be removed. This would allow water to move through the WCA-3B Flowway.

Old Tamiami Road (Located immediately south of the S-12s)
Approximately 6 miles of the Old Tamiami Trail road would be degraded, from the L-67 Extension to the ENP Tram Road, providing increased wetland acreage and increased discharge capability from the S-12C and S-12D structures.

S-346
The S-346 flashboard culvert structure is located in the L-67 Extension Borrow Canal (immediately south of Tamiami Trail) and would be removed with the corresponding removal of the L-67 Extension Levee and Canal.

S-347
The S-347 flashboard culvert structure is located in the L-67 Extension Borrow Canal (approximately 2.6 miles south of Tamiami Trail) and would be removed with the corresponding removal of the L-67 Extension Levee and Canal.

Temporary S-356 Pump Station
Due to the design of this structure being temporary in nature and the need for an increased capacity from 500 cfs to 1,000 cfs to provide increased seepage management capability, this pump station would be removed and replaced.

3.3.3 Modified Features

L-5 Canal East (Northern boundary of WCA-3A)
The eastern (remnant) L-5 Canal would be enlarged to allow a design capacity of 500 cfs.

L-5 Canal West (Northern boundary of WCA-3A)
The western L-S Canal would be enlarged to allow a design capacity of 3,000 cfs.

L-67A Levee (Levee separating WCA-3A from WCA-3B)
The L-67A Levee would have three 500 cfs gated culverts constructed in line with the levee: S-631, S-632, and S-633. The L-67A Canal would act as a collector canal for these three structures.

S-8
S-8 is an existing pump station that is currently used to discharge runoff water via the Miami Canal, as well as provide an outlet for STA-3/4 discharges, into WCA-3A. CEPP will maintain this existing design capacity for the S-8 complex through a combination of the following design considerations: pump station design modifications, a new hydraulic connection from S-8 to the degraded L-4 Levee (New S-8A), utilization of the existing G-404 Pump Station (570 cfs design capacity), and leaving the 1-2 mile segment of the Miami Canal as available getaway conveyance capacity during peak flow events. For

CEPP, the S-8 Pump Station and/or G-404 will be modified (or possibly replaced). The Recommended Plan cost estimate includes costs for the potential S-8 complex modifications, which are included as the new S-8A (canal connection to L-4 and two culverts structures). During PED, the following design uncertainties will be assessed/reassessed in further detail: modifications to S-8 and/or G-404, to address pump efficiency concerns; the proposed S-8A culvert and associated canal connecting the Miami Canal to the L-4 Canal; and the required length of the unmodified Miami Canal to maintain hydraulic getaway conveyance capacity. Flood control operation capability will be maintained during S-8 modification construction. S-8 is equipped with four 1,040 cfs diesel pumps for a total capacity of 4,160 cfs. The pump station is located in the alignment of the Miami Canal at the northern boundary of WCA-3A. The new S-8A Pump Station would need to maintain or accommodate the important capabilities of the current pump station, such as allowing for safe and dry work conditions and maintenance of the pumps during multi-day hurricanes. The "worst case" scenario of the current S-8 Pump Station must be mitigated for in the modification or replacement. This scenario is the lowest intake stage (based on the lower of the break point stage data or the lowest stage required for maintaining the marsh levels) and the highest discharge stage (daily peak stage, plus the modeling uncertainty, plus 0.5 ft.).

L-31N (Northeast boundary of ENP)

Along a portion of the L-31N Levee, south of the S-356 structure and Tamiami Trail, a seepage barrier cutoff wall would be constructed. The barrier would be approximately 4.2 miles long and 35 ft. deep. The barrier would be constructed of soil cement bentonite. For approximately the first mile south of Tamiami Trail, the soil is more transmissive than further south. This may require a change to the proposed seepage barrier. This may also change the proposed G-211 operations, in order to divert more seepage water to the coastal structures. During the PED phase, these details may be modified or changed altogether as alternatives are considered.

4.0 PROJECT RELATIONSHIPS

There are several projects that may affect or be affected by CEPP. The CEPP recommended plan has been developed based on the operations of existing related projects, and/or related planned projects with approved operating plans, including both CERP and non-CERP activities. A summary of each related project and its relationship to CEPP is provided below.

4.1 2008 LAKE OKEECHOBEE REGULATION SCHEDULE (2008 LORS)

2008 LORS is the regulation schedule used in the current management of Lake Okeechobee water levels. It was identified to be effective at decreasing the risk to public health and safety, reducing the number of high-volume discharges to the estuaries, and providing critical flexibility to perform water management operations. CEPP benefits gained from sending new water south from Lake Okeechobee are derived in part from operational refinements that can take place within the existing, inherent flexibility of the 2008 LORS, and in part with refinements that are beyond the schedule's current flexibility. Modifications to 2008 LORS will be required to optimally utilize the added storage capacity of the A-2 FEB to send the full 210,000 ac-ft/yr of new water available in CEPP south to the Everglades, while maintaining compliance with Savings Clause requirements for water supply and flood control performance levels. These changes are part of the final operational assumptions within the modeling completed for the CEPP recommended plan. See Section 7.1.1 for additional information.

Independent of CEPP implementation, there is an expectation that revisions to the 2008 LORS will be needed following the implementation of other CERP projects and Herbert Hoover Dike infrastructure remediation. The USACE expects to operate under the 2008 LORS until there is a need for revisions due to the earlier of either of the following actions: (1) system-wide operating plan updates to accommodate CERP "Band 1" projects, as described in Section 6.1.3.2 of the CEPP PIR, or (2) completion of sufficient HHD remediation for reaches 1, 2 and 3 and associated culvert improvements, as described in Section 2.5.1 of the CEPP PIR. When HHD remediation is completed and the HHD Dam Safety Action Classification (DSAC) Level 1 rating is lowered, higher maximum lake stages and increased frequency and duration of high lake stages may be possible to provide the additional storage capacity assumed with the CEPP Recommended Plan. The future Lake Okeechobee Regulation Schedule which may be developed in response to actions (1) and/or (2) is unknown at this time. It is anticipated that the need for modifications to the 2008 LORS will be initially triggered by non-CEPP actions and that these actions will occur earlier than implementation of CEPP. Therefore, the CEPP PIR, including the POM, will not be the mechanism to propose or conduct the required National Environmental Policy Act (NEPA) evaluation of modifications to the Lake Okeechobee Regulation Schedule. However, depending on the ultimate outcome of these future Lake Okeechobee Regulation Schedule revisions, including the level of inherent operational flexibility provided with these revisions, CEPP implementation may still require further Lake Okeechobee Regulation Schedule revisions to optimize system-wide performance and ensure compliance with Savings Clause requirements.

CERP envisioned that changes to system operations may be required as groups of restoration components come on line and that updates to the system operating manual may be required at certain intervals of overall CERP implementation. The CEPP is composed of increments of project components that were identified in the CERP.

4.2 MODIFIED WATER DELIVERIES TO EVERGLADES NATIONAL PARK PROJECT (MWD)

The MWD Project entails structural improvements and additions to the existing Central and Southern Everglades (C&SF) Project to improve water deliveries into ENP and, to the extent practicable, take steps to restore the natural hydrologic conditions within ENP. These proposed improvements included the construction of several structures (the S-355s in L-29, temporary S-356), removal of 4 miles of the L-67 Extension Levee, modifications to the existing S-334, and construction of a 1-mile eastern Tamiami Trail bridge and Tamiami Trail roadway modifications. In addition, the 8.5 SMA Flood Mitigation Project and associated facilities, such as the S-357 Pump Station, are also part of the MWD Project. For planning purposes, the CEPP future without project condition assumed the MWD Project to be complete upon completion of those features currently under construction.

4.3 COMBINED OPERATIONAL PLAN FOR THE MODIFIED WATER DELIVERIES TO THE EVERGLADES NATIONAL PARK AND C-111

The Combined Operational Plan (COP) for the MWD and the C-111 South Dade projects would establish a long-term operations plan for the completed features of the MWD and C-111 South Dade projects, including potential conveyance between WCA-3A and WCA-3B, seepage control along the eastern boundary of ENP, and elevated portions of Tamiami Trail between WCA-3B and ENP to restore more natural flows into ENP (L-29 Canal operational criteria). Implementation of the COP could precipitate changes to the operations described within this DPOM. However, the scope of those changes, if any, cannot be determined at this time.

The Corps is re-initiating pursuit of operational testing (relaxation of G-3273 gage operational constraint and S-356 test) to utilize the constructed MWD features. Information from the field test will be used to develop the Final Water Control Plan for the Modified Water Deliveries project which will allow for re-distribution of water flows to NESRS. The Corps anticipates an operational plan and completion of MWD prior to CEPP implementation.

4.4 BISCAYNE BAY COASTAL WETLANDS PROJECT

The Biscayne Bay Coastal Wetlands (BBCW) CERP Project is intended to rehydrate wetlands and reduce point source discharge, improve water quality and provide more natural timing and quantity of water to Biscayne Bay. The proposed project would replace lost overland flow and partially compensate for reduction in groundwater seepage by redistributing, through a spreader system, available surface water entering the area from regional canals. The project should add water to the wetlands in the northern area of the Model Land, adjacent to Biscayne Bay. The BBCW CERP project was assumed in place for the CEPP future without project condition. It is premature to determine if the BBCW CERP Project would precipitate changes to the operations described within this DPOM.

4.5 FLORIDA BAY AND FLORIDA KEYS FEASIBILITY STUDY

The Florida Bay and Florida Keys (FB&FK) Feasibility Study was intended to take a comprehensive look at the FB&FK marine environments, and the actions and land uses upstream, to determine the modifications that are needed to successfully restore water quality and ecological conditions of Biscayne Bay. The reconnaissance phase of this project was followed by the Biscayne Bay Feasibility Study, Phase 1, for which Miami-Dade County was the local sponsor. It is premature to determine if the FB&FK Feasibility Study would precipitate changes to the operations described within this DPOM.

4.6 FLORIDA POWER AND LIGHT'S SOUTH DADE MITIGATION BANK

The Florida Power and Light (FP&L) mitigation bank consists of 13,367 acres of wetland interspersed within the Model Lands project area, adjacent to Biscayne Bay. In addition to preservation, numerous hydrologic improvements have been, or will soon be, implemented. While most changes anticipated as part of this DPOM should be complementary, any unanticipated adverse impacts could precipitate changes to the operations described within this DPOM.

4.7 EVERGLADES RESTORATION TRANSITION PLAN (ERTP)

The purpose of ERTP is to define water management operating criteria for C&SF Project features and the constructed features of MWD and C-111 Projects at the time of ERTP implementation (October 2012). ERTP objectives include improving conditions in WCA-3A for the endangered Everglade snail kite, wood stork, and wading bird species while maintaining protection for the endangered Cape Sable seaside sparrow and the Congressionally authorized purposes of the C&SF Project. The ERTP plan was a modification of the Interim Operational Plan (IOP) with operational flexibilities to provide further hydrological improvements amenable to multiple listed species. The changes associated with the WCA-3A Interim Regulation Schedule as a result of ERTP were assumed for the CEPP future without project conditions.

4.8 RESTORATION STRATEGIES PROJECTS

To address water quality concerns associated with existing flows to the Everglades Protection Area (which includes Wildlife Management Areas, the WCAs, and part of ENP), the SFWMD, Florida Department of Environmental Protection (FDEP), and United States Environmental Protection Agency engaged in technical discussions starting in 2010. The primary objectives were to establish a Water Quality Based Effluent Limit (WQBEL) that would achieve compliance with the State of Florida's numeric phosphorus criterion in the Everglades Protection Area and to identify a suite of additional water quality projects to work in conjunction with the existing Everglades STAs to meet the WQBEL.

Based on the collaborative effort described above, a suite of projects have been identified that would achieve the WQBEL. The projects have been divided into three flow paths (Eastern, Central and

Western), which are delineated by the source basins that are tributary to the existing Everglades STAs. The identified projects primarily consist of FEBs, STA expansions, and associated infrastructure and conveyance improvements. The primary purpose of FEBs proposed with the SFWMD Restoration Strategies is to attenuate peak stormwater flows prior to delivery to STAs and provide dry season benefits, while the primary purpose of STAs is to utilize biological processes to reduce phosphorus concentrations in order to achieve the WQBEL. The proposed CEPP A-2 FEB would work in conjunction with the proposed Restoration Strategies A-1 FEB.

4.9 INDIAN RIVER LAGOON – SOUTH AND C 44 CANAL

Some of the water utilized by agricultural users in the Lake Okeechobee Service Area (LOSA) from Lake Okeechobee will be transferred to WCA-3 and further south as a result of the implementation of the recommended plan. This transfer is anticipated to occur after the modification of the Lake Okeechobee Regulation Schedule that will allow full utilization of the CEPP A-2 FEB. The recommended plan has identified an additional source of water of comparable quantity and quality that will be available to replace the water sent south. Instead of discharging all water stored in the reservoir to tide via the S-80 or to meet C-44 Basin agricultural water supply demands, as assumed in the future without project baseline condition operations, the recommended plan retains a portion of the water stored in the CERP IRL-S C-44 Reservoir/STA in the regional system for backflow to Lake Okeechobee via the C-44 Canal and raises the Lake Okeechobee stage criteria to allow increased C-44 Canal backflow. The additional C-44 Canal backflow operations to Lake Okeechobee included in the CEPP recommended plan improves the ability to meet existing permitted demands in LOSA by retaining more water in the regional system and making it available to agricultural users.

The CEPP future without project condition allows backflow to Lake Okeechobee from the C-44 Canal when S-308 is not open for regulatory discharges and when the stage in Lake Okeechobee is 0.25 feet below the base of the 2008 LORS low sub-band (within the baseflow sub-band), which varies between 13.0 and 14.5 feet NGVD seasonally. This operational assumption is consistent with the existing operational protocols of Lake Okeechobee (2008 LORS) and the SFWMD Lake Okeechobee Water Shortage Management (LOWSM) operations. Discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are otherwise limited to environmental deliveries for the St. Lucie Estuary and C-44 Basin agricultural water supply demands during these backflow operations.

The CEPP recommended plan operations expand on the 2008 LORS backflow operations (included in the future without project condition) to Lake Okeechobee through the following operational changes: (1) backflow to Lake Okeechobee from the C-44 Canal is allowed when S-308 is not open for regulatory discharge and the stage in Lake Okeechobee is below 14.5 feet NGVD (no seasonal variability); and (2) discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are made when the stage in Lake Okeechobee is below the baseflow zone of the 2008 LORS schedule (the bottom of this zone varies between 12.6 and 13.0 feet NGVD seasonally) to provide an additional source of backflow water to Lake Okeechobee. The recommended plan operational changes result in an average annual increase in C-44 Canal backflow volume to Lake Okeechobee of 57.3 kAF (97.3 kAF in the recommended plan, compared to 40.0 kAF in the IORBL1) and an average annual increase in C-44 Reservoir discharges to the C-44 Canal of 21.3 kAF (37.6 kAF in the recommended plan, compared to 16.3 kAF in the IORBL1).

4.10 SITE 1 IMPOUNDMENT

The Site 1 Impoundment / Fran Reich Preserve Project, a component of CERP, would capture and store excess surface water runoff from the Hillsboro watershed as well as releases from the Arthur R. Marshall Loxahatchee National Wildlife Refuge and Lake Okeechobee. Located in the Hillsboro Canal Basin in southern Palm Beach County, the project would supplement water deliveries to the Hillsboro Canal by capturing and storing excess water currently discharged to the Atlantic Intracoastal Waterway. These supplemental deliveries would reduce demands on the Loxahatchee National Wildlife Refuge. The 1,660-acre impoundment would also provide groundwater recharge, reduce seepage from adjacent natural areas, and prevent saltwater intrusion by releasing impounded water back to the Hillsboro Canal when conditions dictate. The operation of the Site 1 impoundment would aid in the better management of water supply needs in the Lower East Coast and help reduce the demands upon the Everglades Protection Area, hence furthering CEPP environmental goals for the Everglades Protection Area. The Site 1 CERP project was assumed in place for the CEPP future without project condition.

4.11 C-43 WEST BASIN STORAGE RESERVOIR

The Caloosahatchee River (C-43) West Basin Storage Reservoir CERP project would improve the timing, quantity, and quality of freshwater flows to the Caloosahatchee River and Estuary. The C-43 West Basin Storage Reservoir would help ensure a more natural, consistent flow of fresh water to the estuary. To restore and maintain the estuary during the dry season, the project would capture and store basin stormwater runoff, along with a portion of water discharged from Lake Okeechobee. Operating intent includes a slow release of the impounded water into the Caloosahatchee River, as needed. These features help to better balance the overall environmental needs as defined by CEPP planning for the Caloosahatchee Estuary. The C-43 West Basin Storage Reservoir CERP project was assumed in place for the CEPP future without project condition.

4.12 BROWARD COUNTY WATER PRESERVE AREAS

The Broward County Water Preserve Areas (BCWPA) CERP project is designed to reduce seepage loss from WCA-3A/3B to the C-11 and C-9 basins and to capture, store and distribute surface water runoff from the western C-11 Basin that has been discharged into WCA-3A/3B. Additional project functions include maintaining existing level of service flood protection, groundwater recharge, increasing spatial extent of wetlands, and improving hydroperiods and hydropatterns in WCA-3A/3B. The selected plan includes two above-ground impoundments, associated pumps, and water control structures. The C-11 Impoundment has an effective interior storage of 1,068 acres and two wetland marsh mitigation areas north of the C-11 Impoundment with 488 acres of wetland marsh. The C-9 Impoundment has an effective interior storage of 1,641 acres. The 4,353-acre WCA-3A/3B Seepage Management Area would manage seepage loss from the WCA-3A/3B and connect the two impoundments with a conveyance canal. The three components work together to form a regional project that manages seepage loss, captures stormwater, and conveys water for other purposes. This project aids in the reduction of seepage from the Everglades Protection Area, which is an objective of CEPP planning. The BCWPA CERP project was assumed in place for the CEPP future without project condition.

4.13 C-111 SPREADER CANAL (C-111 SC)

The overall C-111 SC Project would be authorized via two separate, yet related, PIRs, the C-111 SC Western Project and the C-111 SC Eastern Project. The C-111 SC Project is intended to improve quantity, timing and distribution of water delivered to Florida Bay via Taylor Slough; improve hydroperiods and hydropatterns in the Southern Glades and Model Lands to restore historic vegetation patterns; and to return coastal salinities to historical recorded conditions though the redistribution of water that is currently discharged to tide. These objectives will be realized through the creation of a hydrologic ridge between Taylor Slough and the C-111 Canal, to reduce seepage loss from Taylor Slough and its headwaters. Information gained from the C-111 SC Western Project will be used for the planning and design of a spreader canal system to replace the existing C-111 Canal (C-111 SC Eastern Project). Although the C-111 SC Eastern Project would chronologically follow the C-111 SC Western Project, it is important to note that the POM for the C-111 SC Eastern Project could precipitate changes to the C-111 SC Western Project POM, or wholly supersede it. The C-111 SC Project was assumed in place for the CEPP future without project condition.

5.0 MAJOR CONSTRAINTS

5.1 STA-3/4 AND STA-2 DESIGN AND OPERATIONAL LIMITATIONS

STA operational decisions are based on various factors and STA conditions such as water depths, depth-durations, vegetation conditions, outflow phosphorus concentrations, inflow phosphorus concentrations, phosphorus loading rates, hydraulic loading rates, etc. Many of these parameters are available in real-time and are summarized for the previous week, month and year to assist with operational decisions and ensure STAs are operated consistent with their objective of reducing phosphorus concentrations to improve Everglades water quality.

Essential vegetation rejuvenation and rehabilitation activities, which help to sustain vegetation health and maintain treatment performance, typically occur during the dry season (November – May). These activities may result in portions of STAs or STA cells being temporarily unable to receive inflows (i.e. offline), referred to as STA resting periods, or operated with temporary flow or depth restrictions. STA resting periods were implemented in CEPP water quality modeling for each of the three flowways of STA-3/4 starting 1 April of each year for 45 days with a rotating frequency of once every three years to simulate conditions that would allow essential vegetation rejuvenation and rehabilitation activities. In addition, the water quality modeling of STA-2 and STA-3/4 performed for CEPP included assumptions intended to address STA offline time for major maintenance or rehabilitation activities.

STAs were built specifically for improving Everglades' water quality. However, their vast, shallow waters and rich plant life also make them outstanding habitat for wildlife, including threatened and endangered species. In particular, two avian species protected by Federal law have been observed nesting in the STAs which has resulted in operational limitations. The Everglade snail kite (*Rostrhamus sociabilis plumbeus*), protected by the Endangered Species Act, typically nests from March to August, but has been observed nesting as early as January and as late as October. The Black-necked stilt (*Himantopus mexicanus*), protected by the Migratory Bird Treaty Act, typically nests from April to July. Nesting activity in the STAs for both of these federally-protected birds has resulted in various degrees of STA operational limitations and is anticipated to continue to affect STA operations in the future.

Other physical or structural limitations (e.g. structure capacities and levee heights) to STA operations are documented in the Operation Plans for STA-2 and STA-3/4. These plans are revised on an as-needed basis by the SFWMD to incorporate new information such as project modifications, updated structure flow ratings, and revised operational guidance. In summary, FEB releases to STA-2 and STA-3/4 may be constrained based on various factors and STA conditions such as those described above. A-2 FEB inflows from G-370 and G-372 are constrained by STA-3/4 supply canal stages, which are maintained between 11.0 and 15.0 ft., NGVD.

5.2 S-12 OPERATIONAL LIMITATIONS

ERTP requires seasonal closure of S-12A from 01 November through 14 July and seasonal closure of S-12B from 01 January through 14 July in an attempt to provide favorable conditions for CSSS Subpopulation-A nesting and breeding. These flow limits can result in increased storage in WCA-3A, which may affect the ability of WCA-3A to receive inflows without exacerbating negative impacts caused by excessive water depths. The future without project condition assumes ERTP operations for WCA-3A, including the seasonal closure periods for S-12A and S-12B. Seasonal closure periods for the S-12A and S-12B are also assumed for the CEPP recommended plan. Upon implementation of the CEPP components, it is anticipated that some of the previously defined WCA-3A discharge limitations may have a lesser impact due to the reduction in reliance of the S-12s as the major outlet of WCA-3A.

5.3 DISCHARGE CAPACITY ACROSS THE EASTERN SIDE OF TAMIAMI TRAIL (L-67 TO L-30)

Prior to MWD and CEPP implementation, there are limitations on the amount of flow that can be introduced across this reach of Tamiami Trail using the L-29 Canal. Under the existing conditions, the L-29 Canal stage is assumed limited due to concerns regarding potential flooding and seepage effects within residential or agricultural areas of Miami-Dade County and potential damage to the Tamiami Trail roadway sub-base. The water management operating criteria for the L-29 Borrow Canal between S-333 and S-334 is meant to limit the L-29 Borrow Canal stage to no more than 7.5 ft., NGVD in response to roadway sub-base concerns identified by the Florida Department of Transportation (FDOT), although short-term deviations have been previously implemented in response to specific hydrologic conditions. Higher water levels within the canal may erode the roadway sub-base and create a potential safety hazard, until completion of the MWD Tamiami Trail Modifications project. In addition, the L-29 Borrow Canal water level has an additional constraint related to potential flooding and seepage effects within residential and/or agricultural areas of Miami-Dade County. When the G-3273 water level within NESRS reaches 6.8 ft., NGVD, S-333 discharges to NESRS (design capacity of 1,350 cfs) will be discontinued until G-3273 falls below 6.8 ft., NGVD. Tamiami Trail roadway modifications, to accommodate potential maximum L-29 Borrow Canal water levels up to 8.5 ft., NGVD are currently in progress with the ongoing MWD project. Additionally, a one-to-two-year field test to incrementally relax the G-3273 operational constraint is under consideration for 2014.

The DOI, through the National Park Service (NPS) and ENP, completed a study to evaluate the feasibility of additional Tamiami Trail bridge length, beyond that to be constructed pursuant to the MWD Project to restore more natural water flow to ENP and Florida Bay and for the purpose of restoring habitat within ENP. This project arose as part of the 2009 Omnibus Appropriations Act passed by Congress on 10 March 2009. The Tamiami Trail Modifications Next Steps (TTNS) approved plan called for 5.5 miles of bridging, which would be in addition to the 1-mile bridge authorized by the MWD Project. The remaining un-bridged sections of roadway would be elevated to allow a design high water stage of 9.7 ft., NGVD in the L-29 borrow canal. This road height is expected to accommodate the maximum potential range of future stage increases envisioned by CERP without damage to the road. The project was authorized by Congress in the Consolidated Appropriations Act, 2012. The DOI is preparing an implementation strategy. Preliminary indications from the DOI are that the proposed western bridging along Tamiami Trail will be included in the initial DOI implementation increment.

The CEPP future without project condition assumed completion of the MWD and TTNS Tamiami Trail bridging and roadway modifications. However, since the final operational plan for MWD and the subsequent TTNS projects has not been developed, for planning purposes the CEPP future without project condition includes ERTP as the operational plan, with the L-29 Canal maximum operational stage limit of 7.5 ft., NGVD and the G-3273 constraint of 6.8 ft., NGVD. The CEPP future with project condition assumes the L-29 Canal maximum operational stage limit to be increased to 9.7 ft., NGVD and removal of the G-3273 constraint.

5.4 STRUCTURAL STABILITY

CEPP management measures involve the use of some existing facilities (i.e. G-370, G-372, S-8, S-7), which would be utilized more often under the CEPP recommended plan than under pre-project operations. It is important that operators consider the limitations of existing facilities being used for CEPP purposes when applying any necessary adaptive management measures. Existing structures would be operated in accordance with their current operational limits for structural stability; in that same regard, new structures would be operated in accordance with their design operational limits for structural stability.

6.0 STANDING INSTRUCTIONS TO PROJECT OPERATORS

Once the operational testing and initial monitoring phase for the interim operations for the new CEPP components is concluded, the SFWMD will manage the day-to-day project operations of the newly constructed FEB storage area, control structures, and pump stations. Standing instructions for the project operators would be further developed during the interim operations phase of the project that include refinements in operations due to general and past operational experience, additional scientific information, CERP updates, new CERP or non-CERP activities that have been completed and the status of the removal of the constraints discussed in **Section 5** of this document.

During normal conditions, the project structures shall be operated in accordance with the approved operating manual. Deviations from the normal operations would be permitted as outlined in Section 15 of this DPOM.

The operator has the operational flexibility on where to maintain the canal stage within the limits of the operating criteria to allow the operator to respond to factors such as antecedent, current, and forecasted conditions.

6.1 STRUCTURE OPERATIONS

Actual structure operations should achieve or improve on the performance demonstrated by the modeling but should not be required to mimic the operation used by the models. The goal of the structure, whether with continuous staffing (24 hours per day) or partial staffing (e.g. 8 hours per day), is to control the water level within the required or desired range while averaging a stage appropriate for the conditions. For example, the target (average daily stage) may be near the bottom of the range early in the wet season or during especially wet periods and then change to the middle of the operation range at the end of the wet season. For pump stations, a pumping range or ranges should be developed which allows relatively steady running of pumps based on the number of pumps, capacity of the pumps, and stage response (quick or slow) to pumping. Specifically, the pumping range should be large enough to prevent rapid cycling of the pumps. Within the pumping range pumping rates may be changed by varying revolutions per minute (RPM) or changing the number of pumps in response to raising stage levels in the canal. In addition, the operator has operational flexibility on where in the range (top, middle, bottom) to maintain the stage to allow the operator to respond to factors such as 1) high stages in Northeast Shark Slough, 2) expected rain (e.g. the wet season rainfall), 3) large forecast rainfall events, 4) transition from the wet to the dry season, 5) operation during the dry season.

7.0 OPERATIONAL STRATEGY TO MEET PROJECT OBJECTIVES

The operational strategies described in this plan are intended to meet the goals, purposes, and benefits outlined in the PIR by improving the quantity, quality, timing, and distribution of water for the natural system while providing for other water-related needs and meeting the requirements for protection of health and public safety. These goals, purposes, and benefits will not be fully realized until the completion of the construction and implementation of the CEPP components. These components will be phased in as they become operational. The interim operations have not yet been developed.

Additional "new" water may be made available for restoration purposes through modified Lake Okeechobee operations and the efficient use of the combined FEB and STAs to improve the quantity, timing, and distribution of environmental deliveries to the WCAs and ENP during the wet and dry seasons. Operational changes to deliver this new water would be conducted in a manner consistent with stage, volume, and/or flow-based restoration targets by treating and delivering water from Lake Okeechobee, water detained by CEPP components, or a combination of both and by providing temporary storage for releases from Lake Okeechobee to reduce the harmful effects of flood control releases on the St. Lucie and Caloosahatchee Estuaries.

It should be recognized that most of the EAA flood control discharge that is currently passed to the WCAs is an important part of the water budget of those areas. Additionally, some regulatory releases from Lake Okeechobee to the WCAs are also beneficial to the WCAs, provided that the regulatory releases have water quality treatment sufficient to maintain compliance with both the legal and restoration goals. However, there are times when the stages in the WCAs are higher than restoration targets. During those times, the runoff and regulatory releases to the WCAs can exacerbate both short and long term impacts due to high stages. The combined FEB system provides approximately 116,000 ac-ft of effective detention volume to attenuate EAA runoff flows and lake water, rather than sending the water to the WCAs when they are not ready to receive additional water. The combined FEB may be filled and emptied multiple times throughout the year in order to handle flows to the STAs. As a general operational strategy, the combined FEB would be operated to attenuate flows during the wet season and carry over water from September and October into the dry season when the release to the WCAs would be beneficial or cause less harm.

7.1 ACHIEVING NATURAL SYSTEM GOALS, OBJECTIVES, AND BENEFITS WITH CEPP

By changing the annual distribution cycle of releases, the WCAs and ENP would be able to receive, on average, an annual increase of over 210,000 ac-ft more water than under current operating regimes. Many components of CEPP, such as the increased hydrologic connectivity between WCA-3A and WCA-3B, are designed to provide an improved distribution of surface and groundwater flows such that improved hydration can occur in the central and southern wetland systems. The seepage management components are designed to reduce the loss of fresh water from the eastern area of ENP while maintaining pre-project levels of service for water supply and flood protection for the Lower East Coast. As the designs are finalized for each component, the operational specifics will be identified. For example, currently the improvements to the L-5 canal and associated water control structures would be operated to deliver up to 500 cfs from STA-2/L-6 to S-8 when capacity within the L-5 Canal is available and diverting water away from WCA-2 is desirable.

7.1.1 Lake Okeechobee Operations

Lake Okeechobee is currently operated in accordance with the 2008 LORS and the 2008 Lake Okeechobee and EAA Water Control Plan. CEPP benefits gained from sending new water south from Lake Okeechobee are derived in part from operational refinements that can take place within the existing, inherent flexibility of the 2008 LORS, and in part with refinements that are beyond the schedule's current flexibility. Modifications to 2008 LORS will be required to optimally utilize the added storage capacity of the A-2 FEB to send the full 210,000 ac-ft/yr of new water available in CEPP south to the Everglades, while maintaining compliance with Savings Clause requirements for water supply and flood control performance levels. These changes are part of the final operational assumptions within the modeling completed for the CEPP recommended plan.

Independent of CEPP implementation, there is an expectation that revisions to the 2008 LORS will be needed following the implementation of other CERP projects and Herbert Hoover Dike infrastructure remediation. The USACE expects to operate under the 2008 LORS until there is a need for revisions due to the earlier of either of the following actions: (1) system-wide operating plan updates to accommodate CERP "Band 1" projects, or (2) completion of sufficient HHD remediation for reaches 1, 2 and 3 and associated culvert improvements. When HHD remediation is completed and the HHD DSAC Level 1 rating is lowered, higher maximum lake stages and increased frequency and duration of high lake stages may be possible to provide the additional storage capacity assumed with the CEPP Recommended Plan. The future Lake Okeechobee Regulation Schedule which may be developed in response to actions (1) and/or (2) is unknown at this time. It is anticipated that the need for modifications to the 2008 LORS will be initially triggered by non-CEPP actions and that these actions will occur earlier than implementation of CEPP. Therefore, the CEPP PIR, including the POM, will not be the mechanism to propose or conduct the required NEPA evaluation of modifications to the Lake Okeechobee Regulation Schedule. In balancing the multiple project purposes, USACE, will timely shift from the interim 2008 LORS to a new schedule with the intent to complete any necessary schedule modification or deviations concurrent with the completion of (1) or (2). However, depending on the ultimate outcome of these future Lake Okeechobee Regulation Schedule revisions, including the level of inherent operational flexibility provided with these revisions, CEPP implementation may still require further Lake Okeechobee Regulation Schedule revisions to optimize system-wide performance and ensure compliance with Savings Clause requirements. CERP envisioned that changes to system operations may be required as groups of restoration components come on line and that updates to the system operating manual may be required at certain intervals of overall CERP implementation. The CEPP is composed of increments of project components that were identified in the CERP.

The hydrologic modeling conducted for all CEPP alternatives to optimize system-wide performance incorporated the current Regulation Schedule management bands of the 2008 LORS. The hydrologic modeling of the CEPP alternatives included proposed revisions to the 2008 LORS flow chart guidance of maximum allowable discharges, which are dependent on the following criteria:

- Class limits for Lake Okeechobee inflow and climate forecasts, including tributary hydrologic conditions, seasonal climate outlook, and multi-seasonal climate outlook
- Stage level, as delineated by the Regulation Schedule management bands
- Stage trends (whether water levels are receding or ascending)

Most of the 2008 LORS refinements applied in the CEPP modeling lie within the bounds of the operational limits and flexibility available in the current 2008 LORS, with the exception of the adjustments made to the class limits for the Lake Okeechobee inflow and climate forecasts. Under some hydrologic conditions, the class limit adjustments made to the Lake Okeechobee inflow and climate forecasts reduced the magnitude of allowable discharges from the Lake, thereby resulting in storage of additional water in the Lake in order to optimize system-wide performance and ensure compliance with Savings Clause requirements. However, these class limit changes represent a change in the flow chart guidance that extends beyond the inherent flexibility in the current 2008 LORS. As described in Section 4.9, the CEPP recommended plan operations also expand on the 2008 LORS backflow operations to Lake Okeechobee through the following operational changes: (1) backflow to Lake Okeechobee from the C-44 Canal is allowed when S-308 is not open for regulatory discharge and the stage in Lake Okeechobee is below 14.5-feet NGVD (no seasonal variability); and (2) discharges from the IRL-S project C-44 Reservoir to the C-44 Canal are made when the stage in Lake Okeechobee is below the baseflow zone of the 2008 LORS schedule to provide an additional source of backflow water to Lake Okeechobee. Additional information and summary documentation of these assumptions can be found in Section A.8.3.2.3.3 of the CEPP PIR Engineering Appendix (Appendix A).

As a general guideline, the following figure, Figure 7-1, displays the Lake Okeechobee stage ranges assumed for the CEPP recommended plan hydrologic modeling in which a basic decision was made as to when to deliver water from the lake to either the STAs and/or the combined CEPP FEB in the Regional Simulation Model for Basins (RSMBN). The net result of utilizing these criteria is the revised seasonal distribution of southward flows, as shown in Figure 7-2. In addition, the frequency of harmful peak discharges into the estuaries would be reduced with these CEPP revisions.

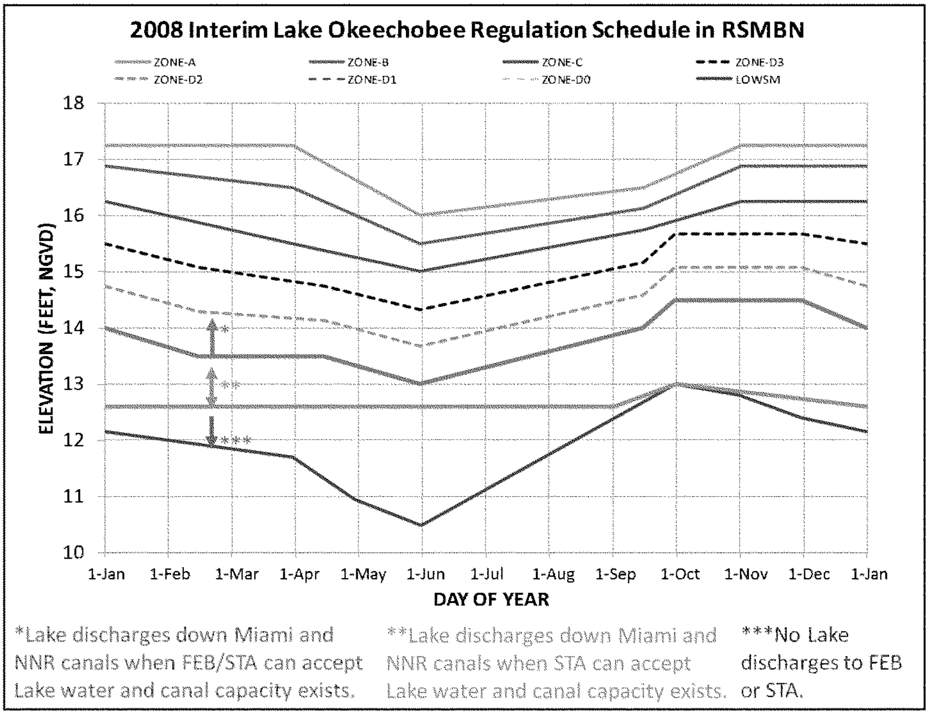

Figure 7-1 2008 Interim Lake Okeechobee Regulation Schedule in RSMBN

The proposed operational protocols for release of water from Lake Okeechobee provide for an increase in the dry season releases southward without significant increases in the wet season discharges when the WCA stages may be too high. The following figure of average annual monthly simulated releases southward, Figure 7-2, shows the considerable increase in the dry season releases southward without significant increases in wet season discharges.

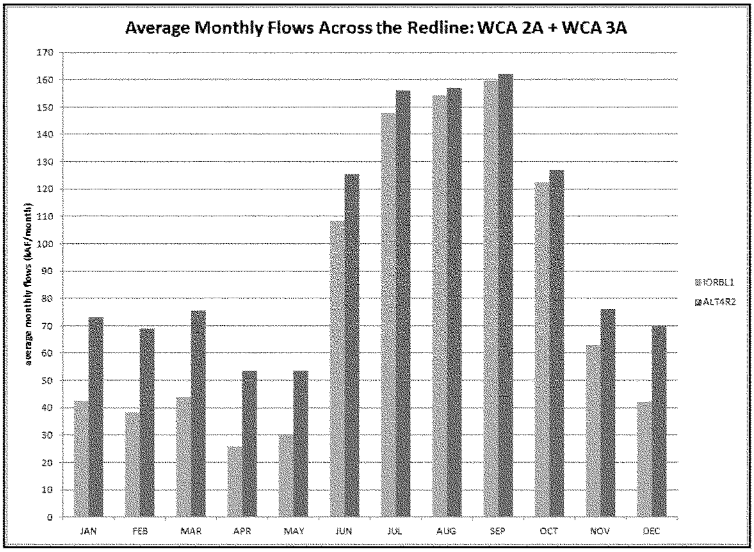

Figure 7-2 Average Monthly Flow Across the Redline: WCA 2A + WCA 3A

7.1.2 FEB Operations

The A-1 FEB is a component of the future without condition. Upon the A-2 FEB's completion, the A-2 FEB will be operated in conjunction with the A-1 FEB and STAs. After completion of the A-1 FEB prior to CEPP implementation, significant experience with the physical operational capabilities are expected to yield better guidelines for long-term operations. As additional design details are developed during the PED phase, the operational criteria for the A-2 FEB, including the integrated relationship with A-1 FEB operations, will become more refined. Based on the results of the initial optimization for the CEPP hydrologic modeling, the FEBs may be operated as follows:

- FEB accepts EAA runoff when the FEB depth is below 3.8 feet
- FEB accepts Lake Okeechobee water when the FEB depth is below 2.0 feet
- FEB continually discharges via gravity constrained by the ability of the emergent marsh to convey water to outflow works. (note that the discharge capability is a non-linear function with actual flow rates being significantly reduced as the depth of water in the FEB declines)
- FEB discharges discontinued when FEB depth is below 0.5 feet
- No supplemental water supply is provided to the FEB to prevent dryout

Initial operations of the FEBs would be closely monitored from the standpoint of levee and structural stability, especially during the initial filling operations. In addition, the quality of the water discharged from the FEBs would be monitored to ensure compatibility with the inflow assumptions and discharge requirements for both STA-3/4 and STA-2. Operational decisions on the amount of FEB discharges sent to STA-3/4 and STA-2 would consider the vegetative health of the receiving treatment cells as well as their maximum monthly and annual limitations. These decisions would consider the necessity for protection of the combined FEB and the STAs from harmful over loadings, damaging flows, and detrimentally high water (combination of depth and duration).

7.1.3 WCA Operations

The current water management operations for the WCAs, ENP, and ENP-SDCS can be found in the corresponding 2012 WCAs, ENP, and ENP-SDCS Water Control Plan. Table 1, Table 2, and Table 3 collectively contain the current operating criteria for the existing structures and the current applicable WCA Interim Regulation Schedules, which were included in the modeling assumptions for the future without project condition. The information contained in the below tables represent this current information for the existing structures in each corresponding area WCA-3A, WCA-3B, and the SDCS. Proposed operating criteria for the proposed CEPP features are also listed in Table 4.

Table 1: Operating Criteria for Existing Structures Related to WCA-3A

Structure	Type	Design HW Stage (ft., NGVD)	Design TW Stage (ft., NGVD)	Optimum Stage (ft., NGVD)	Design Capacity (cfs)
S-8	Pump Station	12.0	16.5	10.0 - 12.5	4170
	Gated Box Culvert	12.0	11.9	10.0 - 12.5	500
S-9	Pump Station	4.0	14.4	3.0 - 4.0	2880
S-9A	Pump Station	3.0	10.5	3.0 - 4.0	500
S-11A	Gated Spillway	15.6	14.6	Reg. Sch. in WCA-2A	5570
S-11B	Gated Spillway	15.6	14.6	Reg. Sch. in WCA-2A	5570
S-11C	Gated Spillway	15.6	14.6	Reg. Sch. in WCA-3A	5570
S-12A	Gated Spillway	12.4	11.9	Reg. Sch. in WCA-3A	8000
S-12B	Gated Spillway	12.4	11.9	Reg. Sch. in WCA-3A	8000
S-12C	Gated Spillway	12.4	11.9	Reg. Sch. in WCA-3A	8000
S-12D	Gated Spillway	12.4	11.9	Reg. Sch. in WCA-3A	8000
S-140	Pump Station	10.5	14.6	10.5	1300
	Gated Box Culvert	10.5	10.3	10.5	300
S-142	Gated Culvert	11.0	9.0		500
S-150	Gated Culvert	11.0	10.0	Not used to control stage	1000
S-151	Gated Culvert	7.5	6.4	Reg. Sch. in WCA-3A	1105
S-333	Gated Spillway	7.5	7.0	Reg. Sch. in WCA-3A	1350
S-339	Gated Sheetpile Barrier Dam	11.0	10.8	HW = 11.0	1100
S-340	Gated Sheetpile Barrier Dam	9.3	9.1	HW = 9.3	1100
S-343A	Gated Culvert	9.5	9.3		195
S-343B	Gated Culvert	9.5	9.3	Reg. Sch. in WCA-3A	195
S-344	Gated Culvert	9.9	9.7	Reg. Sch. in WCA-3A	135
G-64	Gated Culvert				
G-123	Pump Station	20.0	12.0		400
G-155	Sheetpile Weir with Stoplogs	14.5	14.0		890

The preceding table presents the original "design discharge" values but may not reflect actual performance. For example, the performance in the field of the S-12s has been affected by vegetative resistance which limits their effective capacity.

Table 2: Operating Criteria for Existing Structures Related to WCA-3B

Structure	Type	Design HW Stage (ft., NGVD)	Design TW Stage (ft., NGVD)	Optimum Stage (ft., NGVD)	Design Capacity (cfs)
S-9XS	Culvert with Riser and Stoplogs			HW = 6.0	
S-30	Gated Culvert				560
S-31	Gated Culvert	6.0		Reg. Sch. in WCA-3B	700
S-32	Gated Culvert	2.5	1.6	HW = 2.0	
S-32A	Gated Culvert				
S-151	Gated Culvert	7.5	6.4	Reg. Sch. in WCA-3A	1105
S-335	Gated Spillway	5.0	4.8		525
S-337	Gated Culvert	5.5	5.2		605

Table 3: South Dade Conveyance System Design Flows and Stages

Location	Upstream or Downstream	Stage (ft., NGVD)	Design Capacity (cfs)
L-29 @ S-333		7.0	1350
L-29 @ S-334		5.0	1230
L-30 @ S-337		5.2	605
L-30 @ S-335	Upstream	5.0	525
	Downstream	4.8	525
L-30 @ L-29 or L-31N		4.7	500
L-31N @ US41		4.7	1585
L-31N @ C-1	Upstream	3.5	1490
	Downstream	3.5	1185
L-31N @ S-331	Upstream	3.0	1160
	Downstream	6.0	1160
L-31N @ C-102	Upstream	5.4	1115
	Downstream	5.4	855
L-31N @ C-103	Upstream	4.7	740
	Downstream	4.7	530
L-31N @ S-174	Upstream	4.6	485
	Downstream	3.1	210
L-31N @ S-176	Upstream	4.6	275
C-111 @ S-176	Downstream	3.0	275
C-111 @ C-113	Upstream	3.0	275
	Downstream	3.0	135
C-111 @ S-200		3.8	225
C-111 @ S-199		4.0	225
C-111 @ S-177	Upstream	3.0	135
	Downstream	2.0	135
C-111 @ C-111E	Upstream	2.0	97
	Downstream	2.0	97
C-111 @ S-18C	Upstream	2.0	75
	Downstream	1.4	75

Table 4: New Operating Criteria for Proposed and Existing Structures

Structure Number	Wet Season Open/Close (ft., NGVD)	Dry Season Open/Close (ft., NGVD)	Tailwater Limit (ft., NGVD)	Design Capacity (cfs)
S-356	6.0/5.5	6.0/5.8	9.7	1000
S-335	7.6/7.4	7.6/7.4		1170
S-338	5.7/5.5	5.6/5.5		305
G-211	6.0/5.7	5.8/5.5		1100
S-176	5.0/4.75	5.1/4.8		1100
S-357 (Pumps 1 & 2) S-357 (Pumps 3 & 4)	5.2/4.9 5.5/5.2	5.7/5.4 6.0/5.7		250 250
S-177	4.2/3.6	4.2/3.6		2900
S-18C	2.6/2.3	2.6/2.3		3200
S-197	ERTP	ERTP		6000
S-333	ERTP and RDO	ERTP and RDO	9.7	1350

Structure Number	Wet Season Open/Close (ft., NGVD)	Dry Season Open/Close (ft., NGVD)	Tailwater Limit (ft., NGVD)	Design Capacity (cfs)
S-333N	ERTP and RDO	ERTP and RDO	9.7	1150
S-355A	RDO	RDO	9.7	1000
S-355B	RDO	RDO	9.7	1000
S-631	RDO	RDO		500
S-632	RDO	RDO		500
S-633	RDO	RDO		500
S-12s	ERTP and RDO	ERTP and RDO		32000
S-355W	Open when TW is below 7.0		9.7	1230

7.1.4 WCA-2A Distribution and Conveyance Improvements

In addition to the construction and operation of the A-2 FEB, CEPP proposes several new structures to allow for the diversion of water from WCA-2A to WCA-3A via the L-5 and L-6 Canals and S-8. A control structure is proposed to be located at the western terminus of the L-6 Canal (S-620) which would allow for the discharge of up to 500 cfs into the (remnant) east L-5 Canal. The water would be conveyed to a new 500 cfs control structure along the L-5 Canal (S-622) and then west to S-8 for discharge into the northwest corner of WCA-3A. During the CEPP modeling of the final array of alternatives, it became clear that there was the potential to divert too much water away from WCA-2A, to the potential detriment of WCA-2B and the adjacent Lower East Coast areas. Therefore, for the recommended plan, the operations of the "L-6 Diversion" facilities were modeled using limiting constraints based upon a new CEPP Diversion Line concept for WCA-2A (Figure 7-3).

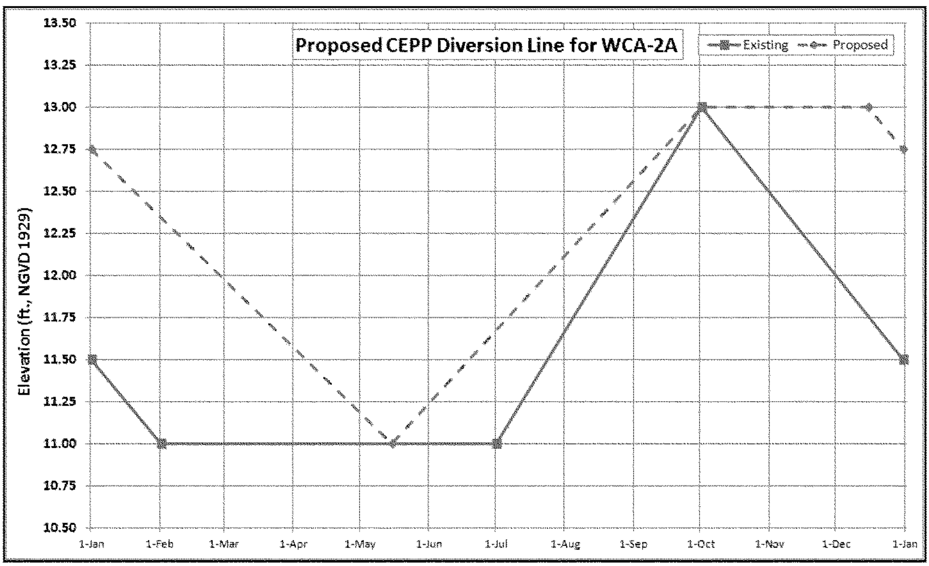

Figure 7-3 Proposed CEPP Diversion Line for WCA-2A

The distribution of outflows from STA-2 was modeled with the following criteria:

- When the WCA-2A stage (measured at either gage 2-17 or S-11B Headwater, per the existing WCA-2A Interim Regulation Schedule) is below the CEPP Diversion Line, the first 2,500 cfs is discharged into WCA-2A and then 20% of higher discharges, if applicable, are discharged toward WCA-3A via L-5 subject to conveyance limitations (up to 3,000 cfs);
- When the WCA-2A stage is above the CEPP Diversion Line, discharge 67% towards WCA-3A via L-5 subject to conveyance limitations.

It is recognized that a revised operation as proposed represents a departure from the existing operational methodology. Day-to-day operations of the system are mostly based on real-time monitoring of stages in canals and at key gauges, but not on determination of instantaneous flows, which are highly uncertain. Translation of the model assumptions to stage-based water management operations will need to consider the feasibility of the above-stated percentages. However, the proposed CEPP criteria were derived from a review of the model output which showed very favorable environmental conditions for both WCA-2A and WCA-2B, and is recommended for consideration for operational criteria under the CEPP initiative. L-6 Diversion operations will be addressed during CEPP implementation of PPA North. NEPA documentation will be updated, if applicable, as revisions are made to Water Control Plans and/or Project Operating Manuals associated with each PPA.

7.1.5 WCA-3A Distribution and Conveyance Improvements

In order to improve habitat conditions in the northwestern portion of WCA-3A, CEPP proposes to remove the western 2.9 miles of the L-4 Levee, install a 360 cfs pump station (S-630) at the terminus of the levee, and modify the Miami Canal downstream of S-8 with a control structure to divert 3,000 cfs into the L-4 Canal while allowing the remaining flow (approximately 1,000 cfs) to continue southward down a shortened Miami Canal. Approximately 14 miles of the Miami Canal would be backfilled between S-8 and I-75. The purpose of these system improvements is to re-distribute flows through the landscape of WCA-3A in order to re-hydrate portions, such as the northwest corner, that have been considerably drier than the habitat restoration goals for northwestern WCA-3A (See Figure 7-4).

Figure 7-4 WCA-3A Distribution and Conveyance Improvements

7.1.6 WCA-3B Distribution and Conveyance Improvements

Two 500 cfs gated structures (S-632 and S-633) would be installed in the L-67A Levee south of the intersection between L-67A and a new north-south levee, designated the Blue Shanty Levee. The Blue Shanty Levee would be an approximately 8.5 mile long north-south levee constructed from the L-67A Levee to the L-29 Levee. The Blue Shanty Levee would become the eastern boundary of a new flowway for water from WCA-3A to the L-29 Canal. In addition, approximately 8 miles of the L-67C Levee would be removed starting at Blue Shanty Levee and proceeding southwest to allow flow through the most of the WCA-3B flowway width. Approximately 4.3 miles of the L-29 Levee would be removed to allow flow out of the southern end of the proposed WCA-3B flowway area.

To provide the capacity for additional inflow into the portion of WCA-3B located east of the Blue Shanty Levee, a 500 cfs gated control structure (S-631) is proposed to be installed in the L-67A Levee north of the intersection of the Blue Shanty Levees intersection with the L-67A Levee. This structure would be located in the L-67A Levee northwest of the center of a 6,000-foot gap in the L-67C Levee (potentially created by expanding the existing 1,000 ft. long gap in L-67C).

CEPP includes the construction of a new step down/divide structure (S-355W) in the L-29 Canal at the southern terminus of the new Blue Shanty Levee, removal of the entire remaining 5.5 miles of the L-67 Extension Levee and backfilling of the adjacent canal, and the removal of the Old Tamiami Trail road from L-67 Extension to the ENP Tram Road. The purpose of these components is restoration of flow directions and quantities in the WCAs and ENP (See Figure 7-5).

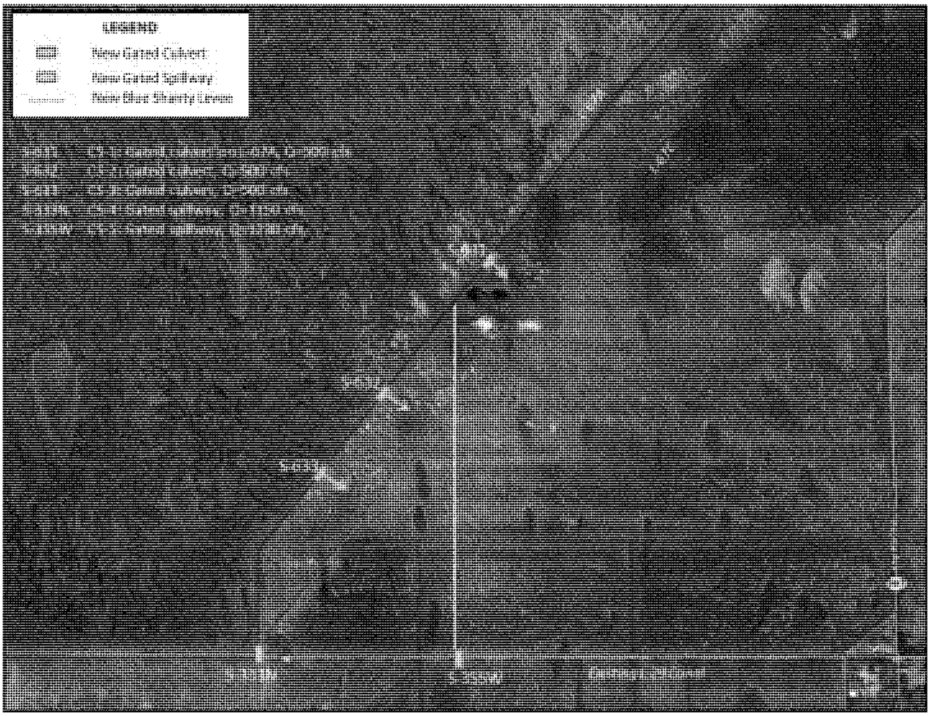

Figure 7-5 WCA-3B Distribution and Conveyance Improvements

7.1.7 Water Conservation Area 3 Operations

WCA-3A outflows are currently operated in accordance with the 2012 Water Conservation Areas, Everglades National Park, ENP-South Dade Conveyance System Water Control Plan. More specifically, WCA-3A outflows adhere to the Rainfall Plan for Everglades National Park (Rainfall Plan). Under CEPP, the Rainfall Plan would be revised but still be comprised of two distinct components: (1) a regulatory component operated in accordance with the 2012 WCA-3A Interim Regulation Schedule, and (2) an environmental rainfall component that consists of Rainfall Driven Operations (RDO).

The RDO is currently conceptual in nature and variables such as the target stages have not yet been developed. Unlike regulation schedule-based operations, the new RDO component would estimate inflows and outflows in response to weekly rainfall and Potential Evapotranspiration (PET), so that the weekly stage at target locations approach the corresponding weekly restoration targets (see Figure 7-6 for the WCA-3A target locations).

Figure 7-6 WCA-3A Restoration Target Locations

In addition to meeting these targets, the RDO aims at improved recession rates (measured in feet per week) in three range categories: excellent (0.03 to 0.06), acceptable (0 to 0.03 and 0.06 to 0.10) and unacceptable (> 0.10). The recession rate would be calculated as the difference between the current stage and the previous week's stage. The WCA-3A stage would be calculated as the average of three locations: 3A4, 3A28 and 3A3. The WCA-3A RDO would employ a mechanism that resists the stage going into Zone A of the WCA-3A Interim Regulation Schedule. As part of a system-wide optimization, the WCA-3A RDO would be constrained with the amount and timing of inflows upstream, and the restoration targets and constraints in WCA-3B and the ENP (these have not yet been developed for WCA-3B or ENP).

It is recognized that transitioning to RDO would likely be a lengthy and complex process for the USACE, but a necessary step to achieve the proposed restoration objectives within WCA-3A and ENP. The process for making this transition has not yet been developed, but it is envisioned for RDO to be phased in gradually as CEPP components become operational. RDO operations may also be considered by the USACE during future operational planning studies prior to CEPP, as appropriate. Initially, system operations would be conducted under the current Rainfall Plan, with modeling and testing of RDO to occur alongside the Rainfall Plan; development and limited testing of RDO modeling tools should be initiated prior to this operational testing period. When RDO has been developed and approved for use, the Corps will fully implement it.

Based on the modeling of the recommended plan, the flow targets for deliveries through WCA-3B would be distributed as 40% through S-631, 35% through S-632, and 25% through S-633. Discharges from WCA-3A would primarily be made through these structures and secondarily through the S-12 structures, depending upon operational constraints and the overall hydrologic conditions in ENP, WCA-3A and WCA-3B.

7.1.8 Everglades National Park Seepage Management

CEPP proposes to replace the 500 cfs temporary S-356 pump station with a permanent 1,000 cfs pump station and to install a 4.2 mile seepage cutoff wall along the L-31N Levee south of Tamiami Trail. The combined effect of the seepage barrier and the seepage return pump(s) such as S-356 should be able to concurrently handle the discharges from S-335 and the seepage into L-31N (from S-335 to G-211) without requiring discharges to tide through S-338 via the C-1 Canal. Consistent with the conclusions identified during the CEPP formulation and hydrologic modeling efforts, it is anticipated that these improvements can make a significant difference in the preservation of the seepage waters in and adjacent to ENP. In addition, during the years when additional water is delivered or carried over from the wet season, there is the opportunity to provide some additional water to the coastal wetland systems. This can be done by either releasing water directly to tide or using the available water to maintain the coastal canals higher but not above the top of the normal operating range for the conditions and time of year. Figure 7-7 shows the locations of the features along Tamiami Trail and L-31N.

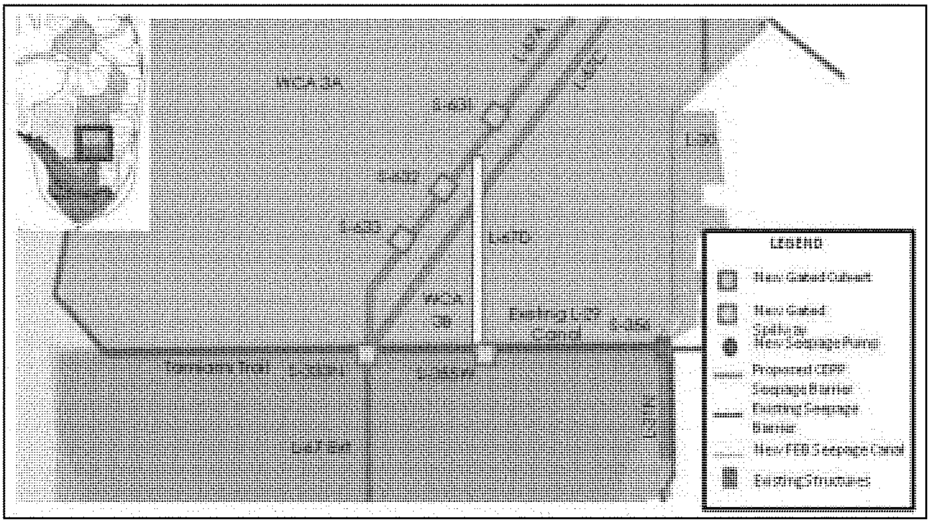

Figure 7-7 Lower WCA-3, Upper ENP, and L-31N

7.2 FLOOD DAMAGE REDUCTION

The revised operational protocols for southward releases from Lake Okeechobee to the FEBs and STAs will be designed to ensure that the stages and flows through the EAA do not reduce the level of flood control and operating details will be developed to ensure that water supply is not adversely affected. Since the SFWMD monitors on a real-time basis all hydrologic and hydraulic parameters within the EAA area, it is reasonable to expect that the existing levels of service for flood protection will be improved or unchanged with effective utilization of CEPP. Additional discussion of CEPP Savings Clause compliance is provided in Annex B of the CEPP PIR.

7.2.1 Normal and Emergency Operations

All criteria previously established for normal water management operations would continue under CEPP. Additional system components constructed as part of CEPP would use operational criteria contained in this document. Refinements to the DPOM will occur throughout the life of the project.

7.2.2 Hurricane or Tropical Storm Operations

All system components with primary flood control requirements would follow the pre-storm protocols for the C&SF System.

7.3 WATER QUALITY

Planning Letter 92-500 requires that all Federal facilities be managed, operated, and maintained to protect and enhance the quality of water and land resources through the conformance with applicable Federal, State, Interstate and local substantive standards.

The WQBEL is a numeric discharge limit applied to permitted discharges from EAA STAs, including STA-2 and STA-3/4, to assure that such discharges do not cause or contribute to exceedances of the 10 micrograms per liter (µg/L) TP criterion within the Everglades Protection Area. The WQBEL was developed to allow for expected year-to-year variability in the STA discharge TP concentration, as observed at the marsh reference sites used to develop the TP criterion, while attaining the long-term TP criterion. The WQBEL must be met for existing flows prior to initiating additional flows as a result of CEPP. Furthermore, the WQBEL will also need to be met when operating the recommended CEPP project features.

Implementation of the recommended CEPP project features is likely to improve water column TP concentrations within most areas of WCA-3 primarily because of state owned water quality treatment features, additional storage from the A-2 FEB and redistribution of flows into the northwestern corner of WCA-3A. Over the long-term it is uncertain, but unlikely that the project will adversely affect WCA-3 however there may be temporally and spatially limited impacts to TP conditions within the marsh until more consistent hydroperiods are established.

The Corps and its federal and state partners recognize that to achieve long-term hydrologic improvement, water quality may be impacted, particularly as measured by the current Consent Decree Appendix A compliance methodology. The limitation of predictive tools, uncertainties in the systems response and the lack of historic data that reflects the significantly altered flow and loading patterns contribute to this recognition. As a result, the Technical Oversight Committee (TOC) is reviewing applicability of the current Appendix A compliance methodology for a restored ecosystem. Notwithstanding the inability to confidently predict future SRS inflow concentrations, SRS TP concentrations are expected to improve relative to both the ECB and FWO conditions.

Given the magnitude of the hydrologic changes proposed in the recommended CEPP project features, this project presents minimal risk of future non-compliance with water quality criteria as discussed in Annex F Phosphorus Assessment for WCA-3 and ENP. With an extended implementation schedule and initial construction efforts that focus on features with positive water quality impacts there will be sufficient time to evaluate and address potential water quality concerns before the additional CEPP flows are delivered through the system. As the CEPP proceeds and data from individual project sequencing is gathered, these data are expected to feed back into the CEPP adaptive management plan. Integration of adaptive management/operations/monitoring into the CEPP will help provide reasonable assurance associated with water quality issues and uncertainties. Ideally, adaptive management will be applied iteratively throughout the sequence phasing of the CEPP to address issues early and allow for lessons learned to be applied for future phases. Commitment to adaptive management is key to moving this restoration project forward with the uncertainties associated with water quality.

An Adaptive Operations and Management Plan (AOMP) for the A-1 FEB that is required to be developed by SFWMD will likely provide information that is relevant to the future adaptive management/operations/monitoring of CEPP, and more specifically the combined FEB. The A-1 FEB AOMP will document the operational strategies to be implemented and evaluated during the Operational Testing and Monitoring Phase (OTMP) and will document all relevant monitoring that is needed to conduct an evaluation. The OTMP is intended to allow testing of a variety of sub-regional and project-specific A-1 FEB operational scenarios that are integrated with STA-2 and STA-3/4 operations.

7.4 WATER SUPPLY OPERATIONS

The operation of CEPP components will take into account the existing water supply criteria and would be developed to ensure that water supply is not adversely affected. Additional discussion of CEPP Savings Clause compliance is provided in Annex B of the CEPP PIR.

7.5 RECREATION

Additional recreational opportunities are a benefit of CEPP. There are abundant recreational facilities within the project area, both private and public; however, no specific water control regulations are required for this purpose. Water levels are not specifically managed for recreation, although levels may affect recreation facilities. For example, boat launching ramps, pleasure craft, sightseeing vessels, and bank and small boat fishing may all influenced by water levels. Regulations concerning USACE public use areas are contained in other publications.

7.6 FISH AND WILDLIFE

The design of CEPP components are such that hydrologic conditions would be established that significantly benefit fish and wildlife through improvements in the types and diversity of habitats, including estuaries.

8.0 NAVIGATION

There are no authorized project features for navigation within the WCAs. There is significant recreational boating in the WCAs and associated C&SF Project canals. The minimum stages for the conservation pools in the WCAs help reduce adverse impacts on recreational boating during drought periods.

9.0 OTHER

There is currently no further information for this section.

10.0 PRE-STORM/STORM OPERATIONS

The hurricane season is from 1 June through 30 November. In the event of a tropical depression(s), tropical storm(s), and/or hurricane(s) in the Atlantic/Caribbean Basin or Gulf of Mexico, the National Hurricane Center issues products including tropical cyclone public advisories, forecast advisories, forecast discussions, warnings and strike probability forecasts. The SFWMD meteorologists and the SFWMD Emergency Operations Center (EOC) also provide specific advisories for different regions of SFWMD. Pre-storm canal drawdowns may be initiated up to 72 hours in advance of a severe storm event based upon such forecasts, prevalent conditions within the project area, and/or emergency operations directive(s) by the SFWMD EOC. Any drawdowns would be consistent with SFWMD emergency operations procedures. Pre-storm drawdowns would be dependent on the severity of the storm, amount of predicted rainfall and antecedent moisture condition in the watershed.

11.0 CONSISTENCY WITH THE IDENTIFICATION OF WATER AND RESERVATIONS OR ALLOCATIONS FOR THE NATURAL SYSTEM

The Programmatic Regulations [Section 385.28(a)(6)(vi)] for CERP require that the operating manual be consistent with the reservation or allocation of water for the natural system made by the State (in accordance with section 601 of WRDA 2000). The operating criteria within this CEPP DPOM are consistent with the operating criteria used to identify the water available for the natural system during wet, average, and dry periods as described in the Project Assurances section of the PIR. The operating criteria contained in this DPOM will be in accordance with section 601 of WRDA 2000. The operating criteria may be further refined during detailed design and captured in the Preliminary POM phase. These refinements would also need to be consistent with any reservation or allocation of water for the natural system. Additional discussion of the CEPP Assurances analyses is provided in Annex B of the CEPP PIR.

12.0 CONSISTENCY WITH SAVINGS CLAUSE AND STATE ASSURANCES PROVISION

In accordance with Water Resources Development Act (WRDA) 2000, CERP projects may not eliminate or transfer existing (as of December 2000) legal sources of water until a new source of water of comparable quantity and quality is available to replace the water lost as a result of project implementation. The implementation of CEPP would not preclude operation of the C&SF Project to deliver water from Lake Okeechobee to meet agricultural water supply needs or to the WCAs and ENP to meet environmental demands for water supply in those areas. Therefore, no additional sources of water need to be identified since Lake Okeechobee would continue to provide water to agricultural users and the WCAs and ENP. An explanation of the modeling performed and the results of the evaluation can be found in Section 5 of the PIR Main Report and Annex B.

CEPP is composed of features which can be grouped into implementation phases. The USACE and the SFWMD will undertake updated project assurances and Savings Clause analyses for the implementation phases that are selected to be included in a Project Partnership Agreement (PPA) or amendment thereto prior to entering into the PPA or PPA amendment. The USACE District Engineer will ensure that Project-Specific Assurances and Savings Clause requirements are met per PPA, per applicable policies and laws. NEPA documentation will be updated, if applicable, as revisions are made to Water Control Plans and/or Project Operating Manuals associated with each PPA. Compliance with the requirements of the Savings Clause will be maintained throughout the entirety of the CEPP implementation period.

13.0 DROUGHT CONTINGENCY PLAN

Drought contingency plans are regulated by ER 1110-2-1941. There is no drought contingency plan in place for the FEB. No additional water would be provided to the FEB to prevent dry-out conditions. There is no minimum water depth in the FEB.

The current drought contingency plan in place for the WCAs, ENP, and ENP-South Dade Conveyance System is located in the *C&SF Project Master Water Control Manual, Volume 4*, Appendix B.

14.0 FLOOD EMERGENCY ACTION PLAN

At this time, a Flood Emergency Action Plan has yet to be determined.

15.0 DEVIATION FROM NORMAL OPERATING CRITERIA

The USACE District Commander is occasionally requested by the non-Federal sponsor to approve deviations from normal operating criteria. Prior approval for a deviation is required from USACE-South Atlantic Division (SAD) except as noted in Section 15.1 below. Deviation requests usually fall into the following categories:

15.1 EMERGENCIES

Examples of emergencies that may result in a need to deviate from normal operating criteria include: drowning and other accidents; failure of the operation facilities; chemical spills; treatment plant failures; and other temporary pollution problems. Water control actions necessary to abate the problem should be implemented immediately unless such action would create equal or worse conditions. SAD must be informed of the problem and the emergency operating changes as soon as practicable. In addition, the non-Federal sponsor, the State of Florida (FDEP and SFWMD), should be informed.

15.2 UNPLANNED MINOR DEVIATIONS

There are unplanned instances that create a temporary need for minor deviations from the normal operating criteria, although these deviations are not considered emergencies. Construction accounts for the major portion of these incidents requiring minor deviations. Examples of activities that may require short-term deviations include construction of utility stream/canal crossings and bridge work. Deviations are also sometimes necessary to carry out maintenance and inspection of facilities. Requests for changes in release rates generally involve time periods ranging from a few hours to a few days. Each request should be analyzed on its own merits. In evaluating the proposed deviation, consideration must be given to upstream watershed conditions, potential flood threat, existing conditions of the reservoir/storage area, and alternative measures that can be taken. In the interest of maintaining good public relations, requests for minor deviations are generally granted, providing that these deviations will not have adverse effects on the ability of the project (or projects) to achieve the authorized purposes. Approval for these minor deviations normally will be obtained from USACE SAD by telephone. Written confirmation explaining the deviation and the cause will be furnished to the SAD water control manager. In addition, the non-Federal sponsor, the State of Florida (FDEP and SFWMD), should be informed.

15.3 PLANNED DEVIATIONS

Each circumstance should be analyzed on its own merits. Sufficient data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, together with the USACE district recommendation, will be presented by memorandum, facsimile, or electronic mail to the USACE-SAD for review and approval. In addition, the non-Federal sponsor, the State of Florida (FDEP and SFWMD), should be consulted as part of the process of receiving approval from SAD for the deviation.

16.0 SEEPAGE CONTROL

16.1 A-2 FEB SEEPAGE CONTROL

The total linear length of seepage canal around the FEB area is approximately 14 miles, around the northern, eastern, and western perimeter of the A-2 FEB. This length includes the conservative assumption that the A-1 FEB western perimeter levee will not be integrated into the A-2 FEB design. A seepage return pump (S-626) with a capacity of 500 cfs would be required to deliver seepage back into the C-625W FEB outflow canal (See Figure 3-8 for map detailing the above information).

16.2 SEEPAGE BARRIER SOUTH OF TAMIAMI TRAIL

A 4.2 mile long, 35 foot deep seepage barrier wall has been identified as a necessary component to mitigate for seepage effects. It would be constructed along the L-31N Levee, just south of Tamiami Trail.

17.0 INITIAL FLOW EQUALIZATION BASIN FILLING PLAN

At this time, detailed information on the FEB initial filling plan has yet to be determined. This plan would be developed as part of the operational testing and monitoring phase.

18.0 NON-TYPICAL OPERATIONS FOR FLOW EQUALIZATION BASIN PERFORMANCE

There are no unforeseen non-typical operations that have been identified in the PIR Phase. This section would be updated in the future if necessary, as non-typical operations may apply during periods of extreme drought or rainfall. During drought conditions, for example, it may be necessary to pump water more often at lower rates or to release water more slowly from the A-2 FEB.

19.0 WATER CONTROL DATA ACQUISITION SYSTEM PLAN (WCDASP)

This WCDASP discusses data acquisition essential to the water control management function. This would be a subset of the Water Control Data System (WCDS) specific to CERP.

Some of the pump stations and gates located within the project area will be equipped with automation components. All of the automation components which are to be operated and maintained by the SFWMD will conform to SFWMD standards of water control data acquisition. Water control data acquisition for operation of the pump stations will be performed via a real time telemetry system known as Supervisory Control and Data Acquisition (SCADA). The communications for the pump stations will be through either microwave communication towers or through SFWMD's Loggernet telemetry network.

During critical storm events such as tropical storms and hurricanes, the operation of the pump stations will follow the guidelines of SFWMD's Emergency Preparedness Manual - Suggested Hurricane Operating Procedures.

The stage recorders to be installed will be incorporated into the SFWMD real time data acquisition network. Stage data from these sites and flow data and pump on/off data will be accessible by the SFWMD and the Water Management Section, Jacksonville District, USACE via the present telemetry system and/or Geostationary Operational Environmental Satellite (GOES) telemetry and/or interagency data exchange procedures.

Stage alarms are monitored using the SCADA system in the SFWMD Operations Control Center (OCC) in West Palm Beach. Orders for major pump stations are issued as needed by the OCC based on anticipated rainfall and stage trends.

Stage, flow, and any precipitation data for the project will be maintained in SFWMD and USACE databases. The data from the SFWMD operated SCADA system such as stage, flow, and rainfall data will be available on a near real-time basis.

20.0 CONSISTENCY WITH THE ADAPTIVE MANAGEMENT PROGRAM AND PERIODIC CERP UPDATES

After initiation of long-term operations and maintenance of this project, the operating manual may be further modified based on operating criteria approved by the USACE and the SFWMD that results from CERP updates and/or recommendations from the adaptive assessment process as outlined in draft GM #6, Section 6.3.1.

21.0 INTERIM OPERATIONS DURING CONSTRUCTION

At this time, interim operations during construction cannot be determined.

22.0 STRUCTURE DESIGN DATA TABLES

This section will be updated to include the Structure Descriptions, after the structures have been further designed during the PED phase. The descriptions will include each structures respective location, purpose, and technical data.

Annex D

Adaptive Management and Monitoring Plans for the Central Everglades Planning Project (CEPP)

Introduction to Annex D: the CEPP Adaptive Management and Monitoring Plans

The CEPP PIR Annex D contains four plans: the adaptive management plan required by USACE implementation guidance for WRDA 2007 Section 2039[1], the 2003 Programmatic Regulations for the Comprehensive Everglades Restoration Plan and CERP Guidance Memorandum 56[2], and the three monitoring plans required to address various laws, regulations, and permits necessary to implement CEPP. The items identified in this annex are based on knowledge formed from extensive scientific work on Everglades ecology and restoration, some initiated several decades ago, as well as USACE guidance and regulatory agency permit requirements. In particular the long-term, system-wide monitoring and modeling conducted by Comprehensive Everglades Restoration Plan's (CERP) interagency science group (the REstoration COordination and VERification group, or RECOVER) informed the planning of CEPP and the development of the adaptive management plan. *The overall objective of the adaptive management and monitoring plans in this annex is to: (1) identify the primary areas were restoration efforts will benefit from monitoring and assessment and specify the monitoring and assessment resources needed; (2) define how the monitoring and assessment can be used to refine CEPP implementation to improve restoration performance in the face of inevitable uncertainties, using existing knowledge complimented by CEPP's monitoring and assessment, and (3) meet regulatory and permit objectives to understand whether constraints are avoided and/or minimized.*

The monitoring plans contained in Annex D were guided in part by two objectives. First, they needed to be complete from a CEPP perspective by providing all monitoring required to address CEPP-specific needs. Second, they must be integrated with other Everglades monitoring to take advantage of existing monitoring efforts, knowledge, and information and thereby leverage dollars committed and spent elsewhere to avoid redundancies and insure cost-effectiveness. These two objectives have been accomplished in the adaptive management plan, hydrometeorological monitoring plan, water quality monitoring plan, and the ecological monitoring plan. It is expected that document reviews and future reassessments of CEPP monitoring needs will identify additional monitoring to address regulatory and consultation needs, as well as additional efficiencies that can be gained. Where possible, CEPP monitoring described here relies on existing monitoring resources including physical instrumentation, stations, locations, servicing, and analysis efforts funded by RECOVER, CERP sponsors, and partner agencies. Therefore the monitoring requirements described and budgeted in the CEPP monitoring plan are limited to the additional, marginal increase in monitoring resources and analysis efforts needed to address CEPP-specific questions. The CEPP monitoring plan relies on other monitoring in order to keep its monitoring costs to a minimum and assumes these other monitoring efforts will continue at least for the period required by CEPP. A table and diagram of leveraged monitoring is provided in the Implementation section of Part 1, the Adaptive Management Plan.

Part 1: Adaptive Management Plan – The first section, the Adaptive Management Plan (Annex D, Part 1), provides the strategies to address prioritized project uncertainties that will be faced as CEPP progresses toward achieving restoration goals and objectives while remaining within constraints. Each

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[1] USACE, 2009. USACE HQ Implementation Guidance on Section 2039 of Water Resources Development Act. http://cw-environment.usace.army.mil/pdfs/09sep2-wrda-monitor.pdf

[2] USACE and SFWMD 2011. CERP Guidance Memorandum 56: Integration of Adaptive Management into Program and Project Management. http://www.cerpzone.org/documents/cgm/CGM_56_Adaptive_Management.pdf

strategy follows a scientific approach that uses performance measures, monitoring, triggers and/or thresholds to inform restoration progress and support decisions regarding the need to adjust CEPP to improve restoration performance. Suggestions for informing future increments of CERP that were discussed by the adaptive management team during the development of the CEPP Adaptive Management Plan have been included, but demarcated to show that they are not expected to be authorized as part of the CEPP Plan. Rather, these are described here to record current understanding of needs that may be considered in the future to further improve restoration. These suggestions are summarized in the CEPP PIR Section 6.10.1, Incremental Restoration and Future Opportunities.

The management options included in the CEPP Adaptive Management Plan can be described as the following:

1. *Informing CEPP Implementation* - results of monitoring a project component may inform next phase of project component construction sequencing,
2. *Inform Project Operations* - results inform project operations or system operating manuals,
3. *CEPP Adaptive Management Contingency Options* – monitoring results may suggest a need to implement additional restoration actions, called adaptive management options, pending all required and applicable coordination, policies, and permitting.

Management option summary matrices (MOMs) are provided as a quick reference to the adaptive management options and to link monitoring, triggers and thresholds, and the management options. The descriptions and summary matrices are intended to inform decision-makers, CEPP partner agencies, and the public on potential actions to improve restoration performance. ***Implementation of adaptive management options is not automatic; the options are suggestions that capture current understanding of potential future issues and solutions. While the AM Plan and its suggested options are considered part of the CEPP recommended plan, all applicable policies, permitting, and coordination requirements apply to implementing AM Options.***

The monitoring identified in this plan is considered part of the adaptive management strategies, as per the 2003 Programmatic Regulations for the Comprehensive Everglades Restoration Plan, the CERP Guidance Memorandum #56 (CGM 56), and the USACE CERP Adaptive Management Integration Guide (RECOVER 2011b), in accordance with WRDA 2007 and its subsequent implementation guidance. The monitoring is specific to uncertainties raised during CEPP planning which require refined data to address, and which will inform feasible options to adjust CEPP as identified in the CEPP Adaptive Management Plan. Per USACE planning guidance ER-1105-2-100 Appendix E, the intent of focusing on the uncertainties is to address questions and reduce the uncertainties. For CEPP in particular, doing so helps to ensure that CEPP water infrastructure investments continue to be good investments over the long time span of the project, potentially avoid expending funds if detailed data collection shows reductions in construction needs, and helps to avoid exceeding Section 902 cost increases by incorporating the best new knowledge into design, construction, and operations.

The adjustments and options identified in this adaptive management plan are part of the recommended plan, except for the few "future opportunities" suggestions noted above that may apply to future restoration projects. These would require separate authorization and they are demarcated in the AM Plan. The suggestions are provided to capture the best current understanding of measures that may be needed to achieve Everglades restoration beyond CEPP, with recognition that CEPP provides a significant increment but not complete restoration.

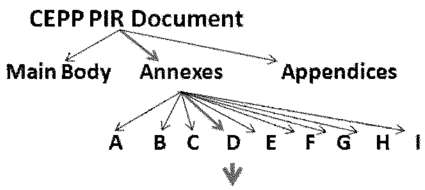
Part 2: Water Quality Monitoring Plan – Contains the necessary monitoring to ensure CEPP implementation complies with all applicable State water quality standards.

Part 3: Hydrometeorological Monitoring – Identifies the necessary hydrologic and meterologic monitoring needed to operate CEPP project structures.

Part 4: Ecological Monitoring Plan – The primary purpose of the CEPP Ecological Monitoring Plan is to identify the monitoring necessary to inform decision-makers, CEPP partner agencies, and the public on CEPP's achievement of its project objectives, i.e. its achievement of success. This monitoring will be leveraged as much as possible to contribute to CEPP adaptive management. However, given the scope and scale of CEPP, the ecological monitoring and the monitoring identified in the adaptive management plan are not one-and-the-same because the ecological monitoring plan focuses on CEPP's success at meeting project objectives (per WRDA 2007 guidance) while the monitoring specified in the adaptive management plan focuses on addressing project uncertainties (per WRDA 2007 and subsequent guidance) that may be more specific in their location and/or scale than the overall project objectives. Also, the adaptive management plan focuses on project adjustments that could be made relatively easily to improve project performance, and the monitoring described in that plan will inform such adjustments. Whereas monitoring for overall project success for a project as large as CEPP may not provide the level of detail needed to answer the specific adaptive management questions to inform location-specific adjustments. In summary, since the project objectives and the uncertainties are not redundant then neither is the monitoring, but the plans have been designed to work together and inform each other as much as possible and it is encouraged that any future refinements of these plans include continual improvements of the streamlining between plans.

The ecological monitoring plan will also contain the monitoring required under the U.S. Fish and Wildlife Biological opinion and other agency permits required to protect and conserve natural resources.

The Quality Assurance Systems Requirements (QASR) (SFWMD and USACE, 2009) manual will be followed to ensure all monitoring data collected adheres to appropriate quality assurance and control standards for CERP. All of the plans in this annex are based on CEPP goals, objectives, and constraints, described in Section 1.3.1 of the CEPP PIR document. **Figure D.1.1** below is intended to help readers navigate the parts of the CEPP Adaptive Management and Monitoring Plan Annex. The parts are 'linked' in that monitoring specified in Parts 2-4 may be referred to and used for CEPP's adaptive management. It may be possible to improve the linkages; therefore it is suggested that any future refinements of CEPP monitoring should continually seek to further coordinate with multiple monitoring plans and programs. The plans will support achievement of CERP and CEPP goals and objectives and remain within constraints by providing the data necessary to detect changes expected due to CEPP.



Annex D: Monitoring and Adaptive Management Plan.

Introduction

Part 1: Adaptive Management Plan (AM Plan). Will include AM-relevant uncertainties, strategies, and management options. Will refer to other monitoring where possible.

Part 2: Water Quality Monitoring

Part 3: Hydrometeorological Monitoring

Part 4: Ecological Monitoring

Figure D.1.1: Organization of Annex D.
This figure is intended to help readers navigate the four parts of the CEPP Adaptive Management and Monitoring Plan Annex. The parts are 'linked' in that monitoring specified in Parts 2-4, and in the CEPP Invasive and Nuisance Species Management Plan, may be referred to and used in the Adaptive Management Plan.

ANNEX D

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Part 1. CEPP Adaptive Management Plan

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D.0 CEPP ADAPTIVE MANAGEMENT PLAN EXECUTIVE SUMMARY

CEPP's planning process and recommended plan were based on extensive existing scientific knowledge of the Everglades and associated estuaries, understanding of the problems and opportunities, and the evaluation of alternatives and estimation of the potential project restoration performance. While the CEPP PIR is based on this wealth of knowledge, this adaptive management plan is provided to help address uncertainty that exists as in every natural resource management and restoration effort. Several sources of agency guidance exist regarding such uncertainties, including the U.S. Army Corps of Engineers ER-1105-2-100 Section 3-5 and Appendix E, WRDA 2007 Section 2039 and its implementation guidance, the 2003 Programmatic Regulations for the Comprehensive Everglades Restoration Plan, and its subsequent guidance including CERP Guidance Memorandum 56 (CGM 56) and the Adaptive Management Integration Guide (RECOVER 2011b). Per these sources, the concerns and uncertainties of coordinating agencies and stakeholders were taken into consideration throughout CEPP planning. The uncertainties were addressed by several means that are part of the USACE planning process, and some that could not be fully resolved during planning are described in this adaptive management plan. This plan specifies strategies and appropriate timing to address the uncertainties.

The adaptive management plan provides a screened and prioritized summary of specific uncertainties that can be addressed with efficiently structured approaches. The adaptive management plan describes the approaches (called strategies) and suggests management options for future consideration if needed. The adaptive management plan is a culmination of input from well-developed USACE planning procedures, extensive scientific and local knowledge that has developed over decades of experience, and input from the CEPP PDT during planning and the CEPP Value Engineering and Cost Risk Analysis workshop.

Every CEPP uncertainty in the adaptive management plan was screened with criteria described in Section 1.2 of this document to ensure their applicability to CEPP and to adaptive management as it is described in the 2003 Programmatic Regulations for the Comprehensive Everglades Restoration Plan and its subsequent CERP guidance. The screening criteria were based on CGM 56 and criteria provided in the CERP Adaptive Management Integration Guide (RECOVER 2011b). Each uncertainty needed to: (1) potentially affect CEPP's ability to meet its goals and objectives and remain within its constraints; (2) be at an appropriate CEPP-scale spatially and temporally; (3) have options for adaptive management actions such as potential project adjustments; and (4) have a combination of high importance to CEPP and high uncertainty that could be reduced by practical adaptive management means. As a result of the screening, some topics were routed to more appropriate venues for consideration, such as CEPP's operating plan, the work plan for CERP's interagency system-wide science group (RECOVER), and/or the interagency modeling group that supports CERP.

The screened uncertainties were then considered by six subteams who provided strategies and options for addressing them. Suggestions for informing future increments of CERP that were discussed by the subteams have been included, but demarcated as "future opportunities" that may apply to future restoration projects. These are clearly demarcated in the plan and would require separate authorization if they are pursued. These suggestions of future opportunities are provided to capture the best current understanding (i.e. to capture institutional knowledge) of measures that may be needed to achieve Everglades restoration beyond CEPP, with recognition that CEPP provides a significant increment but not complete restoration. These suggestions are also summarized in the CEPP PIR Section 6.9.1, Incremental Restoration and Future Opportunities. Per CERP's adaptive management guidance, the management options included in this adaptive management plan can be described as the following:

1. *Informing CEPP Implementation* - results of monitoring a project component may inform design, construction, and/or operation of subsequent project components,

2. *Informing Project Operations* - results inform project operations and/or system operating manuals,

3. *CEPP Adaptive Management Contingency Options* - monitoring results may suggest a need to implement additional restoration actions, called adaptive management options, pending all required and applicable coordination, policies, and permitting..

The strategies and management options comprise the bulk of this adaptive management plan. The adaptive management plan also describes how adaptive management will be incorporated in the next steps of CEPP, e.g., scheduling, design, construction, and throughout the life of CEPP (CGM 56, RECOVER 2011b).

Adaptive management activities will be implemented during the coming phases of CEPP, and the adaptive management plan will be updated accordingly. At such time, more baseline data and lessons learned will be available from other monitoring programs and restoration projects. Given the new knowledge and answers to key questions the adaptive management strategies and options proposed in this Plan may need refinement. Therefore, items included in this plan are not guaranteed to be funded as-is, but will be considered again when CEPP is closer to being implemented and as appropriate, and funding decisions will be made commensurate with available funding at that time.

It should be noted that cost estimates in this plan were provided using the best available information at the time of writing, and were provided before the CEPP project-wide contingency of ~44% was added to the project cost estimate. Therefore several detailed estimates provided in this AM and monitoring plan may be lower than the amounts shown in the cost summary tables that include the contingency (Table 6-9 in Section 6, and Table D.1.1 in Annex D intro). The contingency percentage was based on a project-wide analysis and therefore it should not be assumed that the additional contingency amounts shown in the summary cost tables will be available specifically to fund monitoring.

D.1 CEPP Adaptive Management Plan Background

CEPP's planning and tentatively selected plan were based extensively on scientific knowledge of the Everglades ecosystem and associated estuaries, from understanding the problems and opportunities to evaluating alternatives and estimating potential project restoration performance (Davis and Ogden 1994; Department of Defense 2003; RECOVER 2004; Ogden 2005; RECOVER 2009; McVoy, et al. 2011; and RECOVER 2011a; CEPP PIR Appendix H) and U.S. Army Corps of Engineers and CERP guidance. However, uncertainty exists in every natural resource management and restoration effort due to the fact that many processes in the ecosystem are not linear, they work synergistically together, and they will unfold in a future climate that is likely different than the one used to formulate the CEPP plan. The CEPP Adaptive Management Plan will address the key uncertainties identified during CEPP's planning that relate to achieving restoration success and making adjustments in CEPP if determined to be necessary to improve performance.

Congress understood that there were uncertainties in the Comprehensive Everglades Restoration Plan and therefore required CERP to include adaptive management for its individual projects (WRDA 2000). The 2003 programmatic regulations (Pro Regs) outlined an adaptive management program that would provide the tools needed to gather new information from the RECOVER monitoring and assessment plan (MAP- RECOVER 2009) and incorporate these so that CERP could be adjusted to ensure restoration success. The National Research Council's Committee on the Independent Scientific Review of Everglades Restoration Progress (CISRERP) endorsed the CERP adaptive management program (NRC 2007) and concluded that "uncertainties remain about the degree to which a resilient, self-sustaining ecosystem can be restored under the dramatically changed environment of South Florida" (NRC 2008). The CISRERP noted that adaptive management is essential for "...designing management strategies for dealing with complex ecosystem projects for which probable ecosystem responses are poorly known and hence, difficult to predict" (NRC 2007). The CISRERP further reinforced its view regarding the essentialness of adaptive management in CERP project planning and implementation by stating that, "Given the enormous scope and complexity of the restoration effort, the success of the CERP depends on strategic, high-quality, responsive, and sustained science and an effective adaptive management framework" (NRC 2010).

Per the 2003 Pro Regs, CERP produced guidance for project teams to develop adaptive management plans and integrate adaptive management activities into all phases of a project lifecycle, e.g., planning, design, construction, and operations (USACE and SFWMD, 2011; RECOVER, 2011b). These are appropriate to the large scale and complexity of CERP and its projects, with its changing context of new non-CERP water infrastructure projects, and the shifting nature of its ecosystems. The intent of the detailed guidance is to improve restoration performance and reduce costs by increasing certainty throughout project implementation. The CERP guidance is consistent with the Everglades adaptive management WRDA 2000 authorization, as well as follows the more general 2009 adaptive management guidance from U.S. Army Corps of Engineers (USACE) Headquarters on implementing Section 2039 of WRDA 2007.

In summary, there is extensive knowledge about the Everglades and there are uncertainties that arise during project planning that need to be addressed. Rather than delaying planning for the sake of further data collection or model development, the adaptive management plan provides a mechanism to systematically address uncertainties during CEPP's implementation in order to confirm that project performance is on the right trajectory, to detect early if an adjustment is needed, and to provide sound data to inform operations and implementation decisions. The adaptive management plan identifies which areas to monitor to detect performance, and options for adjusting CEPP if needed to remain on track with performance expectations, as well as suggesting future CERP options to meet overall CERP restoration goals. The suggestions for future CERP options are not expected to be authorized as part of the CEPP Plan. Rather, these are described to capture the best current understanding of needs that may be considered in the future to further improve restoration beyond CEPP. These suggestions are summarized in the CEPP PIR Section 6.10.1, Incremental Restoration and Future Opportunities.

Definitions that will help the reader in understanding the CEPP Adaptive Management Plan include the following. Additional definitions, specific to the adaptive management strategies that make up the bulk of this adaptive management plan, can be found in **Table D.1.1 CEPP Adaptive Management Uncertainties and Strategies Template and Definitions.** The concepts and definitions are described in more detail in CGM 56 (2010) and in the CERP Adaptive Management Integration Guide (RECOVER 2011b).

- **Adaptive Management** – A scientific process for continually improving management policies and practices by learning from their outcomes; Adaptive Management links science to decision making to improve restoration performance, efficiency, and probability of success. In the context of Everglades restoration, adaptive management is a structured approach for addressing uncertainties by testing for best project designs and operations to achieve restoration goals and objectives, linking science to decision making, and adjusting implementation, as necessary, to improve the probability of restoration success.
- **Uncertainty** – A question faced during planning or implementation regarding the best actions to achieve desired goals and objectives within constraints, which cannot be fully answered with available data or modeling.
- **Management Options** – Potential structural, non-structural, and/or operational alternatives to be undertaken to improve restoration performance. Adaptive management plans contain potential management actions "options" to improve performance in meeting project/program goals and objectives.
- **Strategies** – A plan to address one or more uncertainties identified in the adaptive management plan. The adaptive management strategies fit into the following approaches:
  - *Active Adaptive Management* (See **Figure D.1.1**) – Multiple pilot projects or design tests are implemented to determine the most efficient and effective way to achieve desired goals and objectives. Each design or operational action is monitored, assessed, and results are used to inform implementation of the best design for a project component or operations. Pilot projects or design tests are usually conducted before implementing the full project component that they are intended to inform.

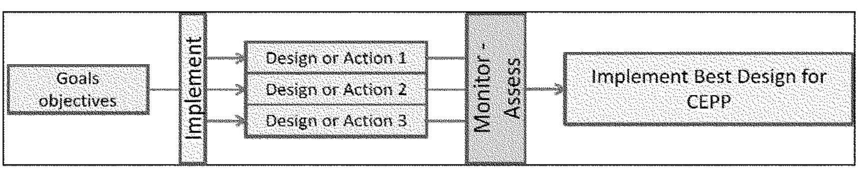


Figure D.1.1: Active Adaptive Management.
Project goals and objectives are used to determine multiple, alternate designs or management actions that could achieve the goals and objectives. These are tested by implementing them with associated monitoring. Assessment of the results indicates the best design of a particular component to move forward.

- *Passive Adaptive Management* (see **Figure D.1.2**) – Most of the CEPP adaptive management plan strategies are considered passive adaptive management approaches. One project component or set of operational criteria is implemented to test its ability to achieve desired goals and objectives. Results are monitored, assessed, and communicated to the appropriate participating agencies to determine how best to adjust project component designs, operations, CEPP contingency options, or inform future CERP projects.

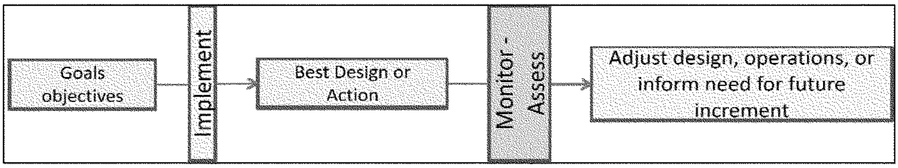


Figure D.1.2: Passive Adaptive Management.
Diagram illustrates that in Passive Adaptive Management, a design or management action is implemented to achieve project goals and objectives. Then, the associated monitoring and assessment produce documentation of successes and (potentially) shortcomings, that can be used as positive or negative lessons-learned to adjust other project component designs, adjust operations, and/or inform a future restoration increment.

Adaptive management activities will be implemented during the coming phases of CEPP, and the adaptive management plan will be updated accordingly. At such time, more baseline data and lessons learned will be available from other monitoring programs and restoration projects. Given the new knowledge and answers to key questions the adaptive management options proposed in this Plan may need refinement. Therefore, items included in this plan are not guaranteed to be funded as-is, but will be considered again when CEPP is closer to being implemented and as appropriate, and funding decisions will be made commensurate with available funding at that time.

D.2 How the CEPP Adaptive Management Plan was Developed: Identification, Screening, and Prioritization of CEPP Uncertainties

The CEPP Adaptive Management plan development consisted of the following activities, consistent with the USACE planning guidance and CERP adaptive management guidance:

- PDT and stakeholder involvement;
- USACE planning and adaptive management principles were applied in the screening of project features that were used to create alternative plans and the recommended plan in order to increase confidence that CEPP's components would have sufficient flexibility to continue to be good investments in a shifting environment (Section 1.5.5 of this adaptive management plan);
- Identification and prioritization of key CEPP adaptive management uncertainties, also referred to simply as "uncertainties" throughout this AM Plan (Section 1.3 of this adaptive management plan) related to achieving CEPP goals and objectives and avoiding constraints (Section 1 of PIR);
- Development of adaptive management strategies to address the uncertainties during CEPP design, construction, and operations that consider existing Everglades conceptual ecological models, hypotheses, performance measures, and monitoring (Section 1.3 of this adaptive management plan);

- Identification of monitoring thresholds and/or triggers and associated management options to adjust, if necessary, based on feedback from assessments (Section 1.3 of this adaptive management plan);
- Development of an adaptive management implementation process to carryout adaptive management activities during design, construction, operations related to baseline and post-project construction monitoring, tests, analyses, and the process for communicating scientific findings to decision-makers, restoration partners, and the public (Section 1.5 of this adaptive management plan).

The identification of CEPP uncertainties to be considered for inclusion in the CEPP Adaptive Management Plan began with input from the CEPP PDT, uncertainties already identified in the Decompartmentalization and Sheetflow Enhancement of Water Conservation Area 3 project ("Decomp") documentation report (USACE and SFWMD, 2012), and the prioritized list of CERP scientific restoration uncertainties identified by RECOVER in 2011. The outcome of this early effort, along with uncertainties identified through a multi-agency PDT process, produced a large list of CEPP-related uncertainties to be considered for inclusion in the CEPP Adaptive Management Plan.

The large list of uncertainties was screened using the following criteria:

1. Must be directly related to CEPP goals, objectives, or 'constraints'. The constraints included but were not limited to the legal/USACE definition of constraints; they also included important considerations identified during CEPP PDT and planning discussions.
2. Must be at project-scale. Although CEPP is large, it is not system-wide scale. System-wide uncertainties were routed to appropriate groups.
3. Must have adaptive management options, i.e., ability to be addressed during implementation, improved by adjusting CEPP. In some cases additional ability to address the uncertainty with a future increment of restoration was noted as a "future opportunity", but this feature was not sufficient in itself to pass this CEPP AM criteria.
4. Must be an uncertainty. Don't include items that are already known. For example, don't ask "What are the effects of reduced fresh water discharges on oysters in the northern estuaries?" which is known. Instead ask, "Will CEPP's reduction of fresh water peak discharges in the northern estuaries improve salinity conditions in x, y, z locations (specific locations related to CEPP) enough to significantly improve conditions for oysters?"
5. The uncertainty needs at least one attribute that is measurable that will provide information to resolve the uncertainty, i.e. the attribute must be a trait able to change in the timeframe of the adaptive management plan, and one that is distinct from the 'background noise' of natural variability. Long-term changes need a faster responding surrogate-measure for the adaptive management plan.
6. Some items remained on the uncertainties list to "Keep them in view". Some examples suggested by the team include: a) remaining watchful for CEPP effects on Lake Okeechobee's (LO) littoral zone, and to balance the ecological needs of the Lake and the northern estuaries; b) observing effects of flow in Shark River Slough on peat dynamics, which is important but hard to link to management options; c) remaining watchful of the potential for CEPP to cause hydrologic changes in the Pennsuco wetlands east of the project area. Due to the need to keep these important topics in view, they passed this criterion.

Once a short-list of screened uncertainties was identified, the following criteria were used to prioritize them:

Risk: What is the risk (high, medium, low) of not meeting CEPP restoration goals if this uncertainty is not addressed?

- Low risk means that even if the uncertainty isn't addressed, it doesn't pose much risk to achieving CEPP goals and objectives.
- Medium risk means that if the uncertainty isn't addressed it may or may not affect achievement of a goal/objective.
- High risk means that without addressing this uncertainty, there is a high risk to achieve CEPP goals and objectives.

Knowledge: What is the level of (high, medium, low) understanding of this uncertainty (i.e., how much is known about this uncertainty)?

- Low understanding means little is known about the question/issue or how to address it;
- Medium understanding means some information is known in some geographical areas, but not all;
- High understanding means a lot is known about addressing this question in multiple geographical areas.

Relevance to Adaptive Management for CEPP: What is the level of confidence (high, medium, low) that anything could be done to address the uncertainty? The team's preliminary identification of management options helped to determine this.

- Low confidence means that even if this uncertainty is addressed, CEPP or operations will not be able to be modified given the results of CEPP implementation.
- Medium confidence means if this question is addressed, a connection to future CERP project implementation is established/documented but future adjustments to the CEPP increment 1 may or may not be limited, especially if indicator response is longer than 10 years and is more relevant to RECOVER system-wide monitoring.
- High confidence means if this question is addressed, CEPP design, implementation, and/or operations can be modified to improve restoration results.

The identification, screening, and prioritization process resulted in a final prioritized list of uncertainties. This list was used to develop strategies, management options, and costs in order to develop the Adaptive Management Plan.

D.3 CEPP Adaptive Management Uncertainties, Strategies, and Management Options

The CEPP uncertainties in this section consist of prioritized needs and opportunities to learn in order to make scientifically sound recommendations to refine CEPP design, construction, and operations; the strategies and management options provided to address each uncertainty are intended to guide CEPP performance in the face of inevitable uncertainties, with existing knowledge and knowledge that will be gained through monitoring and assessment. The strategies are focused on CEPP, but where possible they are designed to contribute to future increments of CERP restoration as well in order to maximize 'return on investment' for resources invested in pursuing the adaptive management activities. Suggestions of future increments of CERP that may be useful are the best current understanding of needs that may be considered in the future to further improve restoration beyond CEPP, and are not intended to be authorized as part of the CEPP Plan. These suggestions are summarized in the CEPP PIR Section 6.9.1, Incremental Restoration and Future Opportunities. As with the other monitoring plans in Annex D, the monitoring proposed in the adaptive management strategies was guided in part by two objectives: to be complete from a CEPP perspective by providing the monitoring required to address CEPP-specific uncertainties; and to integrate with other Everglades monitoring to take advantage of existing monitoring efforts, knowledge, and information and thereby leverage dollars committed and spent elsewhere to avoid redundancies and insure cost-effectiveness. *Where possible, the CEPP adaptive management strategies rely on existing monitoring resources such as physical instrumentation, stations, locations, servicing, and analysis efforts funded by RECOVER, CERP sponsors, and partner agencies. Therefore the manitoring requirements described here are limited to the additional, marginal increase in monitoring resources and analysis efforts needed to address CEPP-specific adaptive management questions.* This point is discussed in the CEPP Adaptive Management Implementation section of this plan, and a table is provided to show leveraged monitoring. In addition, it should be noted that the timing of the strategies is staggered throughout the design and implementation of CEPP. Please see Section 1.5 Implementation of CEPP Adaptive Management and the associated Figures and Tables for more detail on the estimated start- and stop-times for each adaptive management strategy.

The uncertainties, their strategies, and management options are organized in this Plan by geographic region: CEPP-wide, Lake Okeechobee/Northern Estuaries, Greater Everglades, Southern Coastal Systems, and Lower East Coast.

The uncertainties, their identification numbers (ID#), and the CEPP project objective and/or constraint are listed here for reference. The project objectives and constraints are described in detail in CEPP PIR Section 1 (Introduction). A list of uncertainties that were screened out is provided in the final section of this adaptive management plan to show the array of ideas that were considered and brief notes from the screening process. As the CEPP Project Team learns from CEPP implementation, the list of CEPP adaptive management uncertainties will be updated to identify which have been addressed and where the risks to achieving CEPP restoration success have been lowered.

The remainder of this section of the adaptive management plan (Section 1.3) provides strategies for addressing the following screened uncertainties.

Note: the uncertainty ID numbers below refer to the ID numbers assigned to each uncertainty during AM screening, and therefore may not appear sequential since those that did not pass screening are no longer included. The ID numbers were maintained for organizational purposes; future refinements of the CEPP AM Plan may include re-numbering of the uncertainties.

CEPP-wide

- How will CEPP influence the introduction and growth of non-native invasive and native nuisance species populations within the project area, and will the species influence the predicted landscape and performance of CEPP? (ID#59/66; CEPP Objective 1)

Lake Okeechobee

- Do CEPP's operational refinements for Lake Okeechobee, which include class limit adjustments beyond the operational flexibility available under the LORS 2008 Regulation Schedule and which reduce the duration and number of high volume fresh water discharge events to the northern estuaries, affect the Lake Okeechobee littoral and nearshore vegetation coverage? (ID#3, CEPP Objective 3)

Flow Equalization Basin (A-2 FEB)

- How can we most effectively learn from the A-1 FEB to integrate A-1 FEB and the A-2 FEB and to optimize their operations to maximize flows to the Everglades via the FEBs while balancing the related needs of Lake Okeechobee and the northern Everglades? (ID#4; CEPP Objectives 1, 2, 5, and constraints related to water quality)

Northern Estuaries

- St. Lucie Estuary
  - Do reductions of high volume fresh water discharges (high flows) result in measurable increases in submerged aquatic vegetation (SAV) coverage in St. Lucie Estuary (SLE)? (ID#1; CEPP Objective 3)
  - To what extent will the reduction in the frequency and magnitude of high flows to the SLE stabilize conditions enough to improve benthic habitat in the SLE in the south fork? (ID#46; CEPP Objectives 4, 5)
  - To what extent will the reduction in the frequency and magnitude of high flows to the SLE help reestablish historic oyster beds on the South Fork SLE? (ID#45; CEPP Objectives 3, 5)
- Caloosahatchee Estuary
  - Do reductions of high volume fresh water discharges result in measurable increases in SAV coverage and oyster acreage and health in the Caloosahatchee estuary? (ID#2; CEPP Objective 3)
  - Will the reduction in low flow violations in the Caloosahatchee estuary help re-establish persistent *Vallisneria* beds in the upper Caloosahatchee estuary? (ID#49; CEPP Objectives 4, 5)

Greater Everglades

- Are the flow velocities, flow direction, volumes of fresh water, and water depth improvements from CEPP sufficient to reestablish historic ridge and slough landscapes? (ID#73; CEPP Objectives 1, 2, 5)
- Can CEPP create hydrology favorable for tree island elevation requirements? (ID#76; CEPP Objectives 1, 2, 5)
- Are inundation and hydroperiod sufficient to reduce current high rates of soil oxidation and peat fires? (ID#5; CEPP Objective 2)
- How much will CEPP improve alligator relative density and body condition in northern WCA 3A, WCA 3B and northeast Shark River Slough (NESRS)? (ID#10; CEPP Objectives 4, 5)
- How much will hydrologic restoration and vegetation management result in increases in prey densities (aquatic fauna)? (ID#9; CEPP Objective 1)
- How much will hydrologic restoration and vegetation management result in increases in wading bird foraging conditions and increased nest number and success of Wood Storks and Roseate Spoonbills? (ID#75; CEPP Objective 1)

Greater Everglades/ Lower East Coast

- Will the full suite of CEPP recommended plan structures be required in WCA 3B to create the Blue Shanty Flowway? (ID#77; CEPP Objectives 1,2,4,5 and Constraints related to water supply, flood risk management, and water quality)

Everglades National Park (ENP)/ Southern Coastal Systems

- Will there be downstream biogeochemical effects associated with modifying inflows and hydrologic conditions in ENP, including effects on nutrient movement, availability, and ecological responses? This includes consideration of hydrologic effects on nutrient loading, nutrient release from soils, transport, and water-quality related ecological indicators, such as periphyton tissue nutrients, cattail expansion, and algal bloom events, especially in eastern Florida Bay where nitrogen levels are relatively high? (ID#63; CEPP Objective 1)
- Will increased flows to northeastern Shark River Slough yield natural distribution of waters toward the southeastern Everglades (Taylor Slough and lower C-111 basin) and northeast Florida Bay without operation of the SFWMD Canal System east of the L30, L31-N, and L31-W? (ID#61; CEPP Objective 1)
- Will CEPP improve flows to Florida Bay and the Lower Southwest coast resulting in more natural salinity patterns (magnitude, spatial distribution and timing)? Will results be consistent with the expectations from the CEPP scenario model predictions? (ID#67; CEPP Objective 2)
- Will predicted CEPP flows mitigate saltwater intrusion and associated coastal wetland vegetation, soil stability, and nutrient retention or release? (ID#64; CEPP Objective 2)
- If salinity is affected by overland flow increases through ENP to Florida Bay, how much benefit is generated for SAV, sportfish, prey, coastal wading birds, and crocodiles? Can operations be adjusted to improve estuarine performance in Florida Bay? (ID#65; CEPP Objectives 2,4,5)

Lower East Coast

- Will the constructed and operational features of CEPP maintain flood risk management (WS/FRM) level of service east of the L-30, L-31N, L-31W, and C-111 without reducing quantity or quality of groundwater in water supply wellfields compared to existing conditions? (ID#35; CEPP water supply and flood risk management constraints)
- Will the constructed and operational features of CEPP reduce surface and/or groundwater base flows and wetland/groundwater recharge to the east of the L-30 and L31-N in areas such as the Pennsuco Wetlands, south Miami-Dade wetlands, and Biscayne Bay? (ID#62; CEPP Savings Assurances constraints)

Adaptive management strategies are provided in this section to describe and address each CEPP adaptive management uncertainty and inform CEPP implementation based on the body of existing scientific knowledge in Everglades restoration. This section comprises the bulk of the CEPP Adaptive Management Plan. It provides 1-2 page strategy descriptions for each uncertainty (sometimes combined, where appropriate) and summary tables of suggested management actions to improve restoration performance, as illustrated in **Table D.1.1.** The 1-2 page strategy write-ups include information on drivers of the uncertainty, restoration targets and CEPP targets for particular attributes of the ecosystem associated with the uncertainty (such as a key species or ecological features), how these attributes will be monitored to track progress toward the targets, the timeframe in which changes in these attributes will be measurable, and identification of a trigger or threshold that would give early warning that CEPP performance is veering from restoration expectations. The "timeframe in which changes will be measurable" does not imply that changes will be *complete* in that timeframe; rather, the timeframes provide an estimate of time needed to *begin* to be able to distinguish CEPP effects. For practicality, the CEPP AM Plan screening criteria included the need to have attributes measurable within the time of the AM Plan, which in some cases necessitated a 'proxy' attribute to be measured that would represent expected changes on a longer time scale. In addition, the triggers and thresholds were identified with the best available information, but the AM team recognizes that they should be updated to keep current with best available science. Second, following the strategies, tables of suggested management options are provided, called management option matrices (MOMs). These provide suggestions of paths forward and adjustments that can be made in order to keep CEPP progressing toward the targets, based on specific decision-criteria, e.g., a trigger or threshold is crossed (reflecting unintended effects related to a constraint) or is not crossed (reflecting lack of restoration progress towards restoration goals and objectives). The purpose of the two formats is to provide A) background and detail of each strategy in the 1-2 page write-ups and B) a table reference summary and crosswalk that relates monitoring to specific decision-criteria and potential actions for multiple strategies in a specific area. The detailed write-up descriptions are referred to as the "strategies" and the summary tables are referred to as "management options matrices" (MOMs) (**Table D.1.1**).

The reader will notice that the amount of information provided in this section to address the uncertainties varies; this is due to some features of CEPP being new in CERP, such as the Flow Equalization Basin, while others have years of familiarity and previous knowledge, such as the salinity effects of fresh water discharges from Lake Okeechobee to the northern estuaries. The strategies and MOMs provide synopses of the best available information, which in some cases is sparse and will need to be developed further as CEPP moves toward implementation and the adaptive management plan is updated based on new information gained about the best project design and operations to achieve restoration goals.

Adaptive management activities will be implemented during the coming phases of CEPP, and the Adaptive Management Plan will be updated accordingly. At such time, more baseline data and lessons learned will be available from other monitoring programs and restoration projects. Given the new knowledge and answers to key questions the adaptive management options proposed in this Plan may need refinement. Therefore, items included in this plan are not guaranteed to be funded as-is, but will be considered again when CEPP is closer to being implemented and as appropriate, and funding decisions will be made commensurate with available funding at that time.

Table D.1.1: CEPP Adaptive Management Strategies: Template and Definitions.
The CEPP adaptive management uncertainties and the strategies to address them are provided in the format shown here. The uncertainties and strategies are presented by region, and each region's set is followed by an 11x17 pull-out table of suggested management options that can support CEPP and potentially CERP refinement (Management Option Matrices, or MOMs). Please see further explanation in Section 1.3 above.

CEPP AM Uncertainty and ID#. *The uncertainty is a question faced during planning or implementation regarding the best restoration actions to achieve desired goals and objectives within constraints, which cannot be fully answered with available data or modeling. Uncertainties were screened and prioritized to determine which to include in the AM Plan.*

CEPP Objective or Constraint: *Uncertainties needed to related to CEPP objectives or constraints, among other criteria, to be included in the AM Plan. This rule helped to focus the scope of the AM Plan.*
Region(s). *Area of CEPP footprint to which the uncertainty and strategy pertain.*
Associated CEPP features: *Structures or measures to which the uncertainty and strategy pertain.*
Driver or uncertainty type: *Unlike most AM Plans, not all CEPP AM uncertainties and strategies are ecological. Types such as Engineering and Operations are identified.*

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? *Why the uncertainty needs to be addressed in CEPP.*

Expectations or hypotheses to be tested to address the uncertainty, and attribute(s) that will be measured to test each. *A scientific approach begins with a well-informed, pointed, detailed statement that will be tested. For the purposes of CEPP's AM Plan the statement can be referred to as an expectation or hypothesis. Approaching uncertainties scientifically is efficient because it is targeted; a properly identified hypothesis statement is the most important step to lead to effective, efficient methodology to address an uncertainty. It leads to proper identification of what to measure, how, how often, how to analyze, etc.*

More Information on attributes to be measured:

- **What is expected to be learned by measuring this attribute, i.e.,** ***how will CEPP benefit from knowledge gained about this attribute?***
- **What is the time frame in which changes to this attribute are expected to be measurable?**
- **Is this attribute complimented by other monitoring programs within and/or outside of CEPP? If so, provide reference to other monitoring. Note the monitoring paid for by others in the CEPP AM budget spreadsheet.**
- **When during CEPP's life cycle should this monitoring begin and end?**

Methodology for testing each expectation or hypothesis (including frequency of monitoring) and for reporting: *More information on what to measure, how, how often, how to analyze, and when and how to report results. PLEASE NOTE: the CEPP AM Plan varies in the level of methodology detail provided; in several cases the details will be formed during CEPP's detailed design phase. In ALL cases, methodology will be reviewed, updated and adjusted if needed by agency subject experts, before initiation, to best meet the intent of the AM Plan.*

Triggers/thresholds that indicate good CEPP performance or need for adaptive management action. *Triggers or thresholds are a point, range, or limit that signifies when restoration performance is veering away from expectations and is trending toward an unintended outcome. Triggers/thresholds should be described per attribute to be monitored because each should result in an outcome that informs management decisions.*

Management options that may be chosen based on test results. *Management Options are provided in case a performance trigger or threshold is crossed, which would indicate that CEPP performance needs to be adjusted. The Management Options are suggested paths forward and adjustments that can be made to keep CEPP progressing toward objectives and within constraints. The Management Options are summarized in 11x17 pull-out tables after each region's strategies.*

D.3.1 CEPP-Wide Restoration Uncertainty and Strategy: Invasive and Nuisance Species

D.3.1.1 Invasive and Nuisance Species in the CEPP Footprint

The introduction and expansion of invasive and nuisance plant and animal species has the potential to alter the predicted CEPP restoration landscape pattern and species composition. Such species can alter plant community structure, species composition, fire frequency and intensity, habitat quality, compete with and displace native species, threaten endangered species, and alter trophic dynamics and food webs. The high profile floral and faunal invasives (e.g. *Melaleuca*, Brazilian Pepper, Burmese python) and their impacts to the landscape are well documented. However, these species are but a fraction of the invasive and nuisance species in the Everglades ecosystem. Many of the other species' life histories and responses to disturbance and treatments are insufficiently understood.

The CEPP adaptive management invasive species strategy described here focuses on consolidating species data that is existing and proposed to be collected, in order to improve CEPP's ability to target species management resources most effectively in the specific conditions that will be created by CEPP and thereby prevent invasive and nuisance species impacts on the performance of CEPP. This adaptive management strategy has been coordinated with the CEPP Invasive and Nuisance Species Management Plan (INSMP).

This topic is included in the Adaptive Management Plan because of its level of uncertainty and risk to CEPP outcomes, its ability to be addressed through management options, and to ensure that it remains part of CEPP discussions as lessons are learned throughout the implementation of the project.

CEPP adaptive management Uncertainty #59/66: How will CEPP influence the introduction and growth of non-native invasive and native nuisance species populations within the project area, and will the species influence the predicted landscape and performance of CEPP? (Driver or type: Ecological)

This uncertainty is related to CEPP objective of restoring a natural mosaic of wetland and upland habitat in the Everglades system, and relates to all regions and features of CEPP.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? It is anticipated that addressing this uncertainty will improve the understanding and ability to predict how invasive and nuisance species influence the ecosystem function and structure within the footprint of CEPP, and potentially influence the outcome of CEPP's restoration activities. Improved species profiles and prediction/risk assessment abilities can help target resources to the most effective species management activities, and can inform future design and operations of CEPP and other restoration projects to avoid expensive trial-and-error attempts to reduce the impacts of invasive and nuisance species. The proposed activities will reduce the possibility of invasive and nuisance species hindering CEPP from achieving its restoration objectives.

Expectations and hypotheses to be tested to address uncertainty, and attribute(s) that will be measured to test each. No new monitoring is proposed in this adaptive management strategy to improve predictions and risk assessment, rather, data from the CEPP INSMP and Ecological Monitoring Plan, RECOVER MAP, other CERP INSMPs and ecological monitoring plans, historic and current databases, and aerial photos may be used to develop and/or refine risk assessment tools to direct species management decisions. Before CEPP implementation this data should be consolidated in CERPZone to develop the needed species profiles and tools.

It is recommended that the causal relationship between invasive or nuisance species to restoration activities and outcomes should be investigated as the data is consolidated. For example, the following CEPP-specific questions may be pursued: Does backfilling of canals increase or reduce abundance of invasive fish? Does removal of levees reduce spread of terrestrial invasive species that use levees as primary corridors? Do spoil mounds provide stepping stones for invasive and nuisance species that can travel through the marsh? As CEPP Adaptive Management Plan implementation approaches, the invasive and nuisance species experts among the agencies and interested stakeholders should be consulted to identify the most relevant species and questions to investigate and methods to follow. Species should be chosen based in part on their ability to represent a broader group of species in order to maximize the knowledge gained from monitoring their responses.

Methodology for testing each expectation or hypothesis. No new monitoring is proposed as part of the CEPP Adaptive Management Plan to address this uncertainty; please see the CEPP INSMP for details about species and surveillance methodology. In addition, the CEPP Ecological Monitoring Plan to monitor project success includes vegetation change monitoring. During this monitoring plant species will be documented in locations that will be deemed sentinel sites by invasive and nuisance species agency experts for measuring CEPP's restoration success. If invasive or nuisance plant species are found at these sites the CEPP vegetation management teams at the implementing agencies will be notified and will address the presence of the species as specified in the INSMP. Regarding fauna, USACE contracts include a requirement to report invasive or nuisance animal species to the project's environmental lead and the Invasive Species Management Branch. A similar requirement will be pursued for CERP project and program level monitoring.

Consolidation of existing information and refinement or development of Invasive Risk Assessment Tools are suggested prior to CEPP implementation to better define triggers for when management actions should be taken and avoid expensive negative impacts through a reactive management approach.

How results will be reported, and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action: Lessons learned will be provided as feedback to the next stages of CEPP design, construction, and implementation by the invasive and nuisance species agency experts during interactions with CEPP Design Team, Operations, and others as appropriate. There are currently several forums for sharing this information and we anticipate similar forums in the future. The INSMP is a living document that will also be updated with lessons learned.

Management options that may be chosen to reduce the impacts of invasive species. Feedback to CEPP management could include informing project decisions such as timing of delivering water, or routing water through an area slightly differently than originally specified, in addition to informing the invasive and nuisance species management team actions. Suggested adaptive management options listed below are not in any particular order and can be implemented simultaneously, as appropriate.

- Refinement or development of Invasive Risk Assessment Tools.
- Implementation of Invasive and Nuisance Species Management Plan to immediately identify and eradicate new opportunistic/highly mobile invasive exotic species in areas of concern (e.g. active construction sites).
- Implementation of Invasive and Nuisance Species Management Plan for a regional approach to suppress, control, and/or eradicate slow-growing/less mobile species.
- Suppression of established invasive species to the lowest feasible level such that ecosystem impacts are minimized.

- Redesign of existing or planned features, as appropriate and based on lessons learned, to make them less supportive of invasive exotic species proliferation/movement.

D.4 CEPP's Flow Equalization basin, Lake Okeechobee, and the Northern Estuaries

A clear relationship between the health of the northern estuaries habitats and the volume and timing of fresh water discharges from Lake Okeechobee and the estuarine watersheds has been established (Doering and Chamberlain, 1999; Barnes, 2005; Sime, 2005). Discharges change salinity in the estuaries, which affects the health, reproduction, and survival of key species. These species have an ideal range of salinity, and can tolerate some variations; their range of salinity is referred to as the "salinity envelop". Likewise, key species in LO represent LO's ecological health (Havens and Gawlik, 2005). These species have an ideal range of water depth in LO and can also tolerate some variations; their ideal water depth range can be referred to as a "stage envelop". In CEPP's planning, great care was taken to determine operations that balance the stage needs of LO and the salinity needs of the northern estuaries while routing as much water as possible south, through the FEB and stormwater treatment area (STA) and beyond to the Everglades. The adaptive management questions in this northern region of CEPP focus on achieving the balance among these closely related systems using the deep level of knowledge about the needs of the estuarine and lake habitats, as well as water quantity and quality needs of the Greater Everglades.

D.4.1.1 CEPP Flow Equalization Basin (A-2 FEB)

The CEPP Flow Equalization Basin (called the A-2 FEB) will be integrated with the State's A-1 FEB and operations will be optimized to maximize the water quantity and quality performance based on information gained from implementing the State's Restoration Strategies and learning from the State's Science Plan. Flow Equalization Basins are used to attenuate high flows from upstream of STAs and then to regulate flows of water to be treated by the STA to improve their overall performance. The A-2 FEB is the CEPP project component that will be operationally integrated with the State's water quality treatment features (A-1 FEB, STA2 and STA 3/4) to meet the water quality-based effluent limit (WQBEL) requirements for delivering the CEPP water to WCA3A. Together, the integrated A-1 FEB and the A-2 FEB unit will store and then manage the delivery of water to STA2 and STA 3/4 for treatment prior to making deliveries to WCA3A as part of CEPP plan. The majority of the new CEPP flows to the central Everglades system will be made primarily during the dry season when the natural system needs it the most. However, there are potential water quality compliance risks associated with treatment of CEPP flows using the existing conveyance features and A-1 FEB, STA 2 and STA 3/4 capacity.

Storage and deliveries from the integrated A-1 FEB and A-2 FEB unit to the STA 2 and STA 3/4 will be different than the A-1 FEB project alone. It is anticipated that once the A-2 FEB comes online the Restoration Strategies Plan will have been operated, monitored and optimized for several years. As such, there should be sufficient time and information to evaluate system performance and initiate structural and/or operational modifications to the CEPP plan if needed prior to finalizing the design of the A-2 FEB features. In addition, the State's Science Plan will have been refined over time and updated with information that can be used to refine the CEPP Adaptive Management Plan with more detail on methods, measures, targets, management options, and logistics and to include integration of the A-2 FEB.

CEPP Adaptive Management Uncertainty #4: How can we most effectively learn from the A-1 FEB to integrate A-1 FEB and the A-2 FEB, to optimize their operations to maximize flows to the Everglades

via the FEBs while balancing the related needs of Lake Okeechobee and the northern Everglades? (Driver or uncertainty type: Structural operations)

This uncertainty is related to CEPP objectives for delivering treated water to restore natural hydroperiods and freshwater distribution, improving surface water depths and durations, and reducing high volume discharges from Lake O to the northern estuaries. It relates to the CEPP area that is north of WCA 3A (north of the "redline"). The associated CEPP and non-CEPP features are Lake Okeechobee operations, existing conveyance features, A-1 FEB, the A-2 FEB, STA2 and STA3/4.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? A significant portion of the restoration anticipated from CEPP relies on the integrated performance of A-1 FEB, the A-2 FEB, and STA 2 and STA 3/4. Addressing uncertainty #4 will inform efforts to optimize performance to meet the necessary water quality compliance requirements, while delivering water into WCA 3A mostly during the dry season.

Expectations and hypotheses to be tested to address uncertainty #4, and attributes that will be measured to test each: Based on modeling conducted during CEPP planning, it is anticipated that integrated A-2 FEB and A-1 FEB operations working together with STA2 and STA 3/4 will meet water quality requirements and deliver an estimated additional flow of approximately 210,000 acre-feet per year (long-term annual average) to WCA 3A to improve Everglades hydroperiods, freshwater distribution, surface water depths and durations, and to reduce the number of high volume discharges from Lake O to the northern estuaries. It is also expected that integrated the A-2 FEB and A-1 FEB in-flow, out-flow, and operations will be controlled by several factors: 1) volume of water and nutrient load coming into and out of the integrated A-1 FEB and the A-2 FEB unit; 2) STA 2 and STA 3/4 capacity to accept additional quantities of water; and 3) ability to meet the WQBEL and 4) down-stream (WCA 3A) recession rate constraints. *The specific tests that may be needed for CEPP's adaptive management to address uncertainty #4 are TBD after implementation and observations of the State's Restoration Strategies performance. During the writing this CEPP AM Plan, the State's A-1 Adaptive Operations and Management Plan (AOMP) for the A-1 FEB was developed. It is recommended that future refinement of the CEPP AM for the A-2 FEB be coordinated with the A-1 AOMP for efficiency and consistency.*

Attributes to be measured: Together, the integrated A-1 FEB and the A-2 FEB units will store and then manage the delivery of water to STA2 and STA 3/4 for treatment prior to making water deliveries to WCA3A as part of CEPP plan. The CEPP adaptive management strategy for the A-2 FEB uncertainties are to learn from design, construction, operations of state of Florida's A-1 FEB project that is part of the state water quality strategies. A-1 FEB uncertainties will be addressed as part of the State Water Quality Science Plan. Additional information will likely be needed when the A-2 FEB is constructed and integrated with A-1 FEB by CEPP; this monitoring should build upon and be complimentary to that of the Restoration Strategies project. The attributes to be measured are to be determined, but are likely to include the quality and quantity of fresh water delivered into and out of the integrated A-1 FEB and the A-2 FEB units, STA 2 and STA 3/4, water into WCA 3A. This information will most likely be needed for defining operating protocols and ensuring water quality compliance is met. Time frame in which changes are expected to be measurable: Beginning during the first dry season after the A-2 FEB and A-1 FEB, and monitoring may continue for up to 10 years after initiating integrated operations.

Time frame in which changes are expected to be measurable: Beginning during the first dry season after the A-2 FEB implementation; throughout the life of CEPP.

Methodology for testing each expectation or hypothesis. Locations, frequency, and detailed methodology for monitoring should be developed during the design of the A-2 FEB when more information is available from implementation and operations of Restoration Strategies. Thresholds and criteria to optimize operations will be developed during design based on information from State Water Quality Science Plan results. When the A-1 FEB monitoring program is in place and the operational testing period begins, the CEPP adaptive management plan can be updated to include what might be necessary for the A-2 FEB. Specific monitoring requirements associated with those thresholds are unknown at this point but will be estimated based on the A-1 FEB monitoring costs. Once details are developed, monitoring and reporting should be coordinated and combined as much as possible with the CEPP Water Quality and Hydrometeorological Monitoring Plans (this Annex).

A. During detailed design of the A-2 FEB, inflow and outflow estimates will need to be developed for the A-1 FEB and A-2 FEB unit, STA2 and STA3/4. Once constructed and operational, the CEPP project components can then be monitored during commissioning and operations in real time to check, optimize and validate performance.

How results will be reported and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action. Thresholds and criteria to optimize operations will be developed during design based on information gained from implementation and operation of the State's Restoration Strategies and results of the State's Science Plan. Once the Restoration Strategies monitoring program is in place and the operational testing period is completed, the CEPP adaptive management plan can be updated to include information gained and what might be necessary for integration of the A-1 FEB and A-2 FEB unit. Specific monitoring requirements associated with those thresholds are unknown at this time but will be derived based on the Restoration Strategies implementation, operations and monitoring.

Management options that may be chosen based on test results. Management options will be informed by the results from Restoration Strategies implementation and the associated State Water Quality Science Plan findings and may include structural and operational modifications and/or physical adjustments.

CEPP adaptive management Uncertainty #4: How can we most effectively learn from the A-1 FEB to integrate A-1 FEB and the A-2 FEB, to optimize their operations to maximize flows to the Everglades via the FEBs while balancing the related needs of Lake Okeechobee and the northern Everglades? (Driver or uncertainty type: Structural operations)

This uncertainty is related to CEPP objectives for water quality, restoring natural hydroperiods and freshwater distribution, improving surface water depths and durations, and reducing high volume discharges from Lake O to the northern estuaries. It relates to the CEPP area that is north of WCA 3A (north of the "redline"). The associated CEPP and non-CEPP features are Lake Okeechobee operations, existing conveyance features, A-1 FEB, A-2 FEB, STA2 and STA3/4.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? A significant portion of the restoration anticipated from CEPP relies on the integrated performance of A-1 FEB, A-2 FEB, and STA 2 and STA3/4. Addressing uncertainty #4 will inform efforts to optimize performance to meet the necessary water quality compliance requirements, while delivering water into WCA 3A mostly during the dry season.

Expectations and hypotheses to be tested to address uncertainty #4, and attributes that will be measured to test each: Based on modeling conducted during CEPP planning, it is anticipated that integrated A-2 FEB and A-1 FEB operations working together with STA2 and STA3/4 will meet water quality requirements and deliver an estimated additional flow of ~210,000 acre-feet per year (long-term annual average) to WCA 3A to improve Everglades hydroperiods, freshwater distribution, surface water depths and durations, and to reduce the number of high volume discharges from Lake O to the northern estuaries. It is also expected that integrated A-2 FEB and A-1 FEB in-flow, out-flow, and operations will be controlled by several factors: 1) volume of water and nutrient load coming into and out of the integrated A-1 FEB and A-2 FEB unit; 2) STA 2 and STA 3/4 capacity to accept additional quantities of water; and 3) ability to meet the WQBEL and 4) down-stream (WCA 3A) recession rate constraints. *The specific tests that may be needed for CEPP's adaptive management to address uncertainty #4 are TBD after implementation and observations of the State's Restoration Strategies performance.*

Attributes to be measured: Together, the integrated A-1 FEB and A-2 FEB units will store and then manage the delivery of water to STA2 and STA 3/4 for treatment prior to making water deliveries to WCA3A as part of CEPP plan. The CEPP adaptive management strategy for the A-2 FEB uncertainties are to learn from design, construction, operations of state of Florida's A-1 FEB project that is part of the state water quality strategies. A-1 FEB uncertainties will be addressed as part of the State Water Quality Science Plan. Additional information will likely be needed when the A-2 FEB is constructed and integrated with A-1 FEB by CEPP; this monitoring should build upon and be complimentary to that of the Restoration Strategies project. The attributes to be measured are TBD, but are likely to include the quality and quantity of fresh water delivered into and out of the integrated A-1 FEB and A-2 FEB units, STA 2 and STA 3/4, water into WCA 3A and at WQBEL monitoring compliance locations. This information will most likely be needed for defining operating protocols and ensuring water quality compliance is met. Time frame in which changes are expected to be measurable: Beginning during the first dry season after A-2 FEB and A-1 FEB integration and CEPP operation; throughout the life of CEPP.

Time frame in which changes are expected to be measurable: Beginning during the first dry season after A-2 FEB implementation; throughout the life of CEPP.

Methodology for testing each expectation or hypothesis. Locations, frequency, and detailed methodology for monitoring should be developed during the design of the A-2 FEB when more information is available from implementation and operations of Restoration Strategies. Thresholds and criteria to optimize operations will be developed during design based on information from State Water Quality Science Plan results. When the A-1 FEB monitoring program is in place and the operational testing period begins, the CEPP adaptive management plan can be updated to include what might be necessary for the A-2 FEB. Specific monitoring requirements associated with those thresholds are unknown at this point but will be estimated based on the A-1 FEB monitoring costs. Once details are developed, monitoring and reporting should be coordinated and combined as much as possible with the CEPP Water Quality and Hydrometeorological Monitoring Plans (this Annex).

A. During detailed design of the A-2 FEB, inflow and outflow estimates will need to be developed for the A-1 FEB and A-2 FEB unit, STA2 and STA3/4. Once constructed and operational, the CEPP project components can then be monitored during commissioning and operations in real time to check, optimize and validate performance. Ultimately, meeting the necessary water quality compliance standards will be the major contributing factor in the ability to deliver approximately 210,000 acre-feet of restorative flows per year on a long-term annual average to WCA 3A.

How results will be reported and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action. Thresholds and criteria to optimize operations will be developed during design based on information gained from implementation and operation of the State's Restoration Strategies and results of the State's Science Plan. Once the Restoration Strategies monitoring program is in place and the operational testing period is completed, the CEPP adaptive management plan can be updated to include information gained and what might be necessary for integration of the A-1 FEB and A-2 FEB unit. Specific monitoring requirements associated with those thresholds are unknown at this time but will be derived based on the Restoration Strategies implementation, operations and monitoring.

Management options that may be chosen based on test results. Management options will be informed by the results from the State's Restoration Strategies implementation and the associated Science Plan findings and may include structural and operational modifications and/or physical adjustments.

D.4.1.2 Lake Okeechobee's Balance with Northern Estuaries and the CEPP FEB

This CEPP adaptive management uncertainty highlights the balance needed between maintaining Lake Okeechobee (Lake) at ecologically beneficial, water supply and flood risk management appropriate lake stages, the ecological performance in the northern estuaries, and the need to send water from LO to the FEB. The strategy proposes analysis of data, from existing monitoring programs that would be continued during CEPP's implementation, to determine if CEPP's operations affect LO's littoral and nearshore vegetation while CEPP also attempts to improve conditions in the estuaries and deliver water south to the Everglades during the dry season. The hypothesis, monitoring, and data analysis in this strategy focus on LO. FEB and estuarine monitoring are described separately.

Modeling of the hydrology of LO-estuaries-FEB shows that the estuaries will receive fewer high-flow events that violate the salinity envelopes of the northern estuaries, and LO will at times have higher stages (while remaining within the current operation schedule), which has the potential to affect LO's vegetation. The critical issue will be what time of year and for what duration Lake stages are higher. High lake stage allows wind-driven waves to uproot emergent and submergent plants in the nearshore region. It may also result in re-suspension or transport of suspended solids in or to the nearshore and littoral regions, reducing water clarity and light penetration, resulting in less submerged aquatic vegetation growth. Another issue is if stage reversals occur during the spring recession, bird species such as snail kites or ground nesters could be adversely affected by flooding of nests. Small stage reversals (*e.g.*, < 6") may also flood apple snail egg masses, even though it may take larger stage reversals to cause detectable changes to vegetation in the lake. Vegetation impacts would also probably not be detectable if a stage increase is of short duration; *i.e.*, 1-3 months. In conclusion, we expect that higher water levels resulting from CEPP should be infrequent and of short enough duration to prevent significant reductions in the littoral and near shore vegetation under higher lake stages (*e.g.*, >15 ft NGVD)(for more detail see the interagency scientists' review of CEPP, Annex E). This adaptive management plan was designed to verify that expectation and to inform potential future decisions if Lake Managers need to address unintended CEPP influences on LO.

CEPP adaptive management Uncertainty #3: Do CEPP's operational refinements for Lake Okeechobee, which include class limit adjustments beyond the operational flexibility available under the LORS 2008 Regulation Schedule and which reduce the duration and number of high volume fresh water discharge events for the northern estuaries, affect LO Okeechobee littoral and nearshore vegetation coverage?

Driver or uncertainty type: Ecological and operational; balancing multiple objectives (water supply, flood control, and ecological health of the lake and estuaries).

This uncertainty is related to the CEPP constraint of remaining within the approved operating schedule of Lake Okeechobee and doing no ecological harm to LO. It focuses on the ecological effects in Lake Okeechobee of operations in the region that will balance the needs of LO, the northern estuaries, and will optimize the volume and timing of water to send south to the Everglades. The associated CEPP and non-CEPP features are Lake Okeechobee operations, A-1 FEB, A-2 FEB, STAs 3/4, C-44 Reservoir, C-43 Reservoir, storage of additional water north of LO, and Indian River Lagoon-South Project.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? CEPP was designed to not negatively impact LO ecosystem, which is represented here by the relationship between vegetation and lake stage. The purpose of this adaptive management item is to detect unintended negative effects early and provide reliable data analysis for subsequent discussions of Lake Okeechobee regulation schedule modifications that could be needed.

Expectations and hypotheses to be tested to address uncertainty #3, and attribute(s) that will be measured to test each. During CEPP planning, the conclusion of model evaluation of Alts 1-4 indicated that CEPP had a low potential to impact vegetation (CEPP PIR, **Annex E** - RECOVER System-wide Evaluation of CEPP) because stage differentials between the recommended plan and the FWO were typically small, intermittent and had sufficient recovery time between them. Therefore, the expectations to be checked are that there usually will be no discernible negative littoral or near shore vegetation impacts in the lake resulting from CEPP's operational changes, which will hold additional water in the lake compared to current operations. (Note: the additional water held in the lake remains within the current LORS 2008 requirements.) The modeling runs evaluated by RECOVER suggest that the timing, duration, and return frequency of events evaluated with Lake Okeechobee performance measures will usually not decrease the lake's vegetation.

Attributes to be measured to examine the potential impacts of additional lake stages resulting from CEPP include quantifying the additional water held in LO and associated change in lake stages, and associated changes in littoral and nearshore vegetation areal coverage. Lake stages and vegetation coverage are currently monitored by the SFWMD. SFWMD tracks lake stages and provides weekly updates and a weekly stage hydrograph. If this tracking continues then pre-CEPP and post-CEPP lake stage data would be available. These data would show if the CEPP is holding the lake >6 inches above the ecological performance measure stage envelope, for durations greater than 1 month. If such incidents occur, they will be tracked and compared with the vegetation data (described next). Existing meteorological data in conjunction with water control structure data will be analyzed to determine whether changes are due to CEPP or due to Climatic Changes (e.g., period of increased rainfall), as Lake Okeechobee monthly stages are significantly correlated to prior two years watershed rainfall (RECOVER, 2009).

Currently the SFWMD Lake and River Ecosystem Section conducts monitoring of LO's nearshore submerged aquatic vegetation (SAV) and littoral emergent vegetation via aerial photography and ground-truthing, to estimate vegetation coverage. The EAV and SAV monitoring is anticipated to continue so that changes in vegetation coverage over time can be detected. If lake stages are held significantly higher with CEPP, then the vegetation data can be analyzed for changes associated with the additional lake stages. No additional monitoring is currently suggested for this uncertainty. Instead, CEPP-specific data analysis and reporting is proposed to address: if and when the lake stages are held slightly higher, due to CEPP, are the higher stages affecting the littoral and near shore vegetation?

More Information on Attributes to be measured:
For each attribute, specify the following.

- **What is expected to be learned by measuring this attribute, i.e., how will CEPP benefit from knowledge gained about this attribute?** Data on the lake's stages and the vegetation coverage are needed to test whether CEPP affects the lake vegetation.
- **What is the time frame in which changes to this attribute are expected to be measurable?** Within 1 year of operating CEPP, when additional water is stored in the lake, resulting from CEPP operations.
- **When during CEPP's life cycle should this monitoring begin?** Since monitoring programs currently exist, they will not need to be initiated but should instead be continued in order to collect legitimate pre- and post-CEPP data. Conversely, if the current level of monitoring is decreased, then baseline monitoring will need to begin 3 to 5 years prior to the CEPP A-2 FEB becoming operational.

Methodology for testing each expectation or hypothesis (include frequency of monitoring). No new monitoring is proposed to address this uncertainty; instead, existing monitoring programs should be maintained to gather the needed data. CEPP-specific analysis would be needed to determine if CEPP operations affect vegetation coverage. A total of four weeks per year of additional data analysis and reporting has been proposed in the CEPP adaptive management budget for addressing this uncertainty, when significant increases in lake stage occur due to additional water storage resulting from CEPP.

How results will be reported and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action. There are several forums in which potential effects of CEPP on the lake can be reported, ranging from weekly Operations and Periodic Scientist calls, the annual SFER and multiple-year System Status Reports. The trigger or threshold that signifies action needed: Significant decrease in littoral or near shore vegetation coverage, *i.e.*, a reduction in vegetation coverage of >10% which persists for one growing season (Spring to Fall) that is causally linked to instances of withholding more water in the lake resulting from CEPP. A more refined threshold that identifies optimal species distribution and composition may be developed, and could be informed by the following existing sources of information:

- Spatial extents in acres of marginal and optimal habitat are provided in the 2008 LORS Biological Opinion. However, the distribution of habitat types has significantly changed with dry years since 2008; updated information should be used to make accurate assessments of CEPP's effects.
- Lake Okeechobee Regulation Schedule thresholds for littoral vegetation from Endangered Species Act (ESA) consultation (Snail Kite critical habitat).
- There is no completed RECOVER performance measure for Lake Okeechobee littoral zone emergent vegetation, but the 2012 System Status Report update contains information on when the draft PM guidelines have been met or not met (SSR 2012).
- Current data indicates that some plant species respond to changes in hydroperiod in the course of less than a year, which helps to inform the hypothesis provided below.
- An SAV model for the lake has recently been developed by K.R. Jin at the SFWMD. If approved by the USACE, it could be used to refine our expectations of lake stage effects on vegetation.

- Additional modeling efforts may be able to further quantify lake stage – vegetation relationships and the potential ecological benefits of building additional water storage in the watershed.
- The Florida Fish and Wildlife Commission also conducts lake monitoring, focused on fish species. It is to be determined if or how the fish monitoring could contribute to addressing the adaptive management Uncertainty described here about the ecological effect of refinements to Lake Okeechobee operations.
- The USACE is funding apple snail and snail kite monitoring on the lake as required by the BO for the 2008 LORS. It is to be determined if or how this monitoring could contribute to addressing this CEPP uncertainty.
- Other, as yet untested methods that may be developed in the intervening 15+ years until A2 FEB comes on-line.
- A revision of the nearshore SAV PM, from the amount of total areal coverage, to the amount of potentially colonizable habitat that contains SAV, may be used to determine nearshore SAV health.

Management options that may be chosen based on test results are included in the Management Options Matrices (MOM) for Lake Okeechobee, the CEPP FEB, and the northern estuaries, which are all linked to each other.

Table D.1.2: Lake Okeechobee (LO) balance with Northern Estuaries Management Options Matrix.

The Management Option Matrix (MOM) shown here, and those throughout the adaptive management plan, help link monitoring identified in specific adaptive management strategies to decision criteria and suggested management options to consider for adjusting CEPP if monitoring reveals performance issues related to CEPP operations. For the CEPP adaptive management plan, nearshore and littoral zone vegetation represents the lake's ecology. Currently no alternate explanations for changes in vegetation are included, such as increased fish populations. After authorization of CEPP and before implementation of the CEPP Adaptive Management Plan, it is recommended that such possibilities be considered and accounted for in this and other CEPP adaptive management strategies to the extent possible. *The "timeframe to detect changes…" does not imply that changes will be complete in that timeframe; rather, they provide an estimate of time needed to begin to be able to distinguish effects of CEPP. These time frames are indications of response speeds, not limits on how long the monitoring will be conducted.

Uncertainty tracking ID#	Timeframe to detect change of attributes*	Attribute or indicator	Specific Property to be Measured and Frequency	Decision Criteria: Trigger(s) for Management Action	Management Action Options Suggestions
#3	<1 year	Native vegetation in LO littoral and nearshore zones	Acres of native vegetation Vegetation species composition	Significant decrease(>10%) in littoral or near shore vegetation coverage, which persists for one growing season (Spring to Fall) and causally linked to instances of withholding more water in LO resulting from CEPP	• Adjust operations to hold more water in LO at times when less likely to impact vegetation, • Adjust operations to send more base-flow water to the estuaries, if flow won't impact salinity envelopes, • Adjust operations to move more water to the FEB during periods of ecologically harmful high LO stages to prevent additional ecological damage in LO and estuaries. • Adjust operations to share the balance of extra water between LO and the estuaries until increased capacity and storage are available, i.e., this could include alternating between sending water to the estuaries or keeping it in LO during times of excess water. (This information will better inform the weekly operations call discussions and increase the options that are discussed) **Potential considerations for future CERP and non-CERP restoration projects:** More storage reservoirs, particularly north of LO; Increased canal capacity between LO and the FEBs to improve ability to move water quickly to the FEBs when needed to avoid discharging it to the estuaries or holding LO levels high; Refer to the SFWMD Restoration Strategies for lessons learned on measures that could relieve burden on the STAs, which are the bottleneck that control the movement of water from LO to the Everglades; If a discussion ensues about LO schedule it is suggested that streamlined modeling can show effects of lake changes on LO vegetation.

D.4.1.3 St. Lucie Estuary

The CEPP FEB and Lake Okeechobee (LO) operational adjustments combined with Indian River Lagoon South operations are intended to help reduce high flows from the LO and basin runoff to the northern estuaries. Uncertainty exists in whether the FEB will improve LO high flow releases during the wet season to the degree necessary to reduce low salinity events in the south fork portion of the St. Lucie that stress both benthic, SAV and oysters. In addition, uncertainty exists regarding the recovery of SAV in the estuary if additional measures are not taken to improve water clarity and sediment problems, such as removal of mucky sediments and further Best Management Practices (BMPs) in the watershed that will be needed to improve water quality.

CEPP Adaptive Management Uncertainties: There is a group of closely-related ecological uncertainties in the SLE.

- Do reductions of high volume fresh water discharges (high flows) result in measurable increases in submerged aquatic vegetation (SAV) coverage in SLE? (ID#1)
- To what extent will the reduction in the frequency and magnitude of high flows to the SLE help reestablish historic oyster beds on the South Fork SLE? (ID#45)
- To what extent will the reduction in the frequency and magnitude of high flows to the SLE stabilize conditions enough to improve benthic habitat in the SLE in the south fork? (ID#46)

This group of uncertainties is related to the CEPP objective of reducing high volume discharges from Lake Okeechobee to the northern estuaries. The region is Lake O – northern estuaries. The associated CEPP and non-CEPP features are Lake O operations, the FEBs, the Indian River Lagoon-South project and C-44 reservoir, and S-80.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? CEPP benefits to the St. Lucie Estuary can be optimized if sufficient information about the on-the-ground effects of CEPP on the estuaries is gathered and reported.

Expectations and hypotheses to be tested to address the SLE uncertainties, and attributes that will be measured to test each. The following hypotheses and performance expectations are supported by the modeling results reported in the RECOVER System-wide Evaluation of CEPP Report (**Annex E**). The proposed monitoring may be complimented by RECOVER northern estuaries monitoring programs and by project-level monitoring. The locations of CEPP-specific monitoring proposed here will be conducted in the specific locations where CEPP planning modeling showed effects from CEPP.

A. High Flow Salinity (pertains to uncertainties #1, 45, 46)

- CEPP will result in a greater percentage of time that the preferred salinity range of 12-20 psu is met (32.4% to 43%), based on planning modeling results.
- CEPP will result in fewer high flows to SLE, based on planning model results that showed reduction from 30% to 17% in the number of high flow discharge violations (151 to 86 high flow >2000cfs at St. Lucie Structures over 41-year period of record).

B. Benthic habitat (pertains to uncertainty #46)

- CEPP will result in an improvement in benthic habitat that will result in Marine Biotic Index (MAMBI) score improvement in the south fork and potentially the middle estuary due to improve salinities. Expected improvement by one benthic MAMBI score in the south fork monitoring sites M4 and M5; expected to move from Moderate (orange) to Good (green) at site M4 and Good (green) to High (blue) at site M5.

- Alternatively, CEPP may not result in an increase in benthic habitat due to poor sediment and water quality in the SLE.

C. Submerged Aquatic Vegetation (SAV) (pertains to uncertainty #1)

- CEPP will increase SAV bed density (# shoots/acre) of manatee grass by 20%, measured at Boy Scout Island. This is based on planning modeling that showed a decrease in die-off events and increase in *Halodule* acreage, shoot density, and blade length in the area directly outside of the mouth of the SLE at Boy Scout Island from 1,873,297 shoots per acre to 2,249,388 shoots per acre.
- CEPP will improve seagrass shoot density in other areas where seagrass already exists, where salinity range is met.

D. Oysters (pertains to uncertainty #45).

- CEPP will increase the density of oysters (# oysters/acre) by 9% in existing beds measured at Roosevelt Bridge to 594,737 to 650,890. This is based on planning modeling that showed a 10.9% increase in oyster density at the oyster beds located in the middle SLE.
- CEPP will increase density of oysters at historical beds, where salinity range is met.
- CEPP may impact oyster mortality due to increased predation and/or disease due to low flow violations.

More Information on Attributes to be measured:

- **What is expected to be learned by measuring this attribute, i.e., how will CEPP benefit from knowledge gained about this attribute?** The attributes have been identified as indicators of ecological health in the St. Lucie estuary and indicators of restoration performance. They are the minimal efficient attributes to monitor CEPP performance in the St. Lucie.
- **What is the time frame in which changes to this attribute are expected to be measurable?** See triggers and thresholds below.
- **Is this attribute complimented by other monitoring programs (within and/or outside of CEPP)?** The monitoring is complimented by RECOVER MAP and restoration project monitoring. The locations for CEPP monitoring are focused in areas where CEPP modeling showed the most likelihood to achieve restoration benefits in the St. Lucie estuary.
- **When during CEPP's life cycle should this monitoring begin?** If pre-CEPP estuarine monitoring can be used for baseline comparison, this monitoring should begin when CEPP changes flows to the estuaries by routing water to the FEB complex and Everglades rather than discharging it to the estuaries.

Methodology for testing each expectation or hypothesis (include frequency of monitoring). The above hypotheses will be tested by monitoring restoration performance related to improved salinities in the SLE due to reduction of high flows at S-80, after implementing the A-2 FEB. Three primary indicators (benthic invertebrate community health, SAV, oysters) will be used as multiple lines of evidence to verify ecological restoration response to improve salinities. Information will feed back into improved operations of the A-2 FEB in coordination with Lake Okeechobee and IRL-S, as well as future CERP increments related to storage, to further reduce high flow discharges to the estuaries. In addition, the monitoring will confirm whether water quality (nutrients) and/or sedimentation (total suspended solids) may be affecting restoration performance, which would need to be addressed by IRL-S implementation and/or future CERP increments and State water quality best management practices.

IRL-S is an important CERP project that works synergistically with CEPP to improve high freshwater flows from the basin and also addresses associated sediment and nutrient inputs from the basin, thus reducing stress on the both benthic invertebrates, SAV, and oysters. If that project is not implemented, the benefits to SAV (acreage and shoot density), benthic invertebrates (improved community health index scores), and oysters (increased density per acre) associated with CEPP may not be realized. If the IRL-S C-44 reservoir is operational before the A-2 FEB, then CEPP baseline monitoring in the northern estuaries will document the changes due to that project to differentiate from changes resulting from CEPP.

How results will be reported, and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action. The associated thresholds identified in the statement of hypotheses on page D.1-21 combined with the following monitoring parameters and timing are identified to help determine in the future whether adjustments to CEPP operations are needed, and they may additionally inform future restoration projects by providing lessons learned.

- *Flows and Salinity*: High flows and low flows are compared to rainfall, and expected to show changes compare to baseline in a minimum of 2 years, as well as comparable water years in the modeling period of record. If no changes are observed, then operational adjustments would be the next action. Rainfall will be measured from National Weather Service data in the basin. Existing monitoring of flow and salinity will be used with the exception of adding a salinity recorder at the Palm City Bridge. Flows are measured by continuous recorders at the salinity control structures in the SLE (S-80, S-49, S-48, and Gordy Road). Salinity can be measured at Roosevelt (US1) Bridge (existing monitoring by SFWMD) and Palm City Bridge (needs to be added).
- *Water Quality*: Existing water quality monitoring at 10 stations in the SLE will be used to detect water quality conditions to determine if they have changed from the baseline. Nutrients may be a confounding factor to investigate if salinity goals are met, but ecological indicators did not respond.
- *Benthic*: A minimum of 2 years is needed to detect progress in the MAMBI benthic community index score, after achieving the right flows and salinity. The RECOVER monitoring should be used to inform CEPP restoration progress. Particularly in the South Fork estuary, sites M4 and M5 can be compared to the middle estuary and IRL-S sites to determine if the change is due to improvements in reducing high flows from the S-80.
- *SAV*: A minimum of a 4 year period to compare to baseline and look for incremental progress towards CEPP performance expectation for both indicators. RECOVER monitoring and sampling protocol will be used. Additional resolution is needed in South Fork, North Fork, and 2-3 years in the middle to outer estuary. RECOVER does not monitor St. Lucie only IRL and outer point at St. Lucie (Willoughby Cove). In addition, mapping of SAV in St. Lucie every 2-3 years is needed to detect additional areas that may have improved seagrass coverage (*Halophila* and *Halodule* seagrass species). The quadzilla mapping technique or cheaper option should be used to quantify change in SAV acreage in areas where salinity is expected to have improved resulting in increased chance of SAV expansion.
- *Oysters*: A minimum 4 year period to compare to baseline and look for incremental progress towards CEPP performance expectation for oyster density and oyster health. RECOVER monitoring can be used to monitoring oysters in the north and south forks of the St Lucie Estuary and in 2 areas in the middle estuary. Current RECOVER sampling protocol samples live-dead counts two times a year. It is recommended to increase live-dead counts to four times a year (April, June, October, January) to be able to analyze potential increase in oyster density related to CEPP by teasing out inter-annual variation due to climatic changes. In addition, high flow or low flow event driven monitoring should be conducted. RECOVER monitoring that measures recruitment, growth,

predation, disease in existing locations can be used to understand how flow performance measure violations may be impacting salinity issues that affect these oyster parameters.

Management options that may be chosen based on monitoring results. One key assumption to be considered before determining whether management options should be implemented for SLE is whether the A-2 FEB is meeting its expected 210,000 average acre-ft per year delivery of water south to the Greater Everglades, which means it is accepting water from Lake Okeechobee. As described in the strategy above to address the A-2 FEB uncertainties, the methods of measuring the FEB performance and output are TBD until more is learned from the State's Science Plan and lessons are learned from A-1 FEB. If the FEB is unable to accept much lake water and the lake stages are not held slightly higher within the LO regulation schedule as planned in CEPP, then we would not expect many CEPP benefits in the SLE. Operations of the lake and FEB will be optimized to meet the average volume delivery goal, and where possible, to get additional reduction of high-flow discharge events beyond what was estimated in the modeling, as well as minimize low flow exceedence events.
The following options are consistent with CERP SAV, benthic invertebrates, and oyster indicators:

- **If there is an issue with flows:** Optimize flows between IRL-South, Lake Okeechobee, and CEPP; consider increasing water storage capabilities in the next increment of CERP (see CEPP PIR section, "Future Opportunities").
- **If there is an issue with sediment**: Evaluate benthic monitoring results as first indicator of issues with sediment. If results suggest that despite salinity improvements the ecological restoration is hindered by undesired sediment (potentially high organic, anoxic, high sulfide muck) then muck removal may be needed. Muck removal is not part of the CEPP recommended plan nor has it been evaluated during CEPP planning; it is provided here as a suggestion for parties to consider for a future effort if needed. The suggested methods include identifying suitable salinity areas given CEPP and other project results, then removing muck in those areas as described in Indian River Lagoon South project document.
- **The following options are specific to SAV and oysters**:
  - SAV- If there is an issue with water quality: provide the results as feedback to the implementing agencies to further optimize water quality using IRL-South Stormwater Treatment Areas, water quality features and State water quality projects/BMPs. If there is an issue with lack of seed source: Implement seagrass plantings, which may be a non-implementing agency restoration effort.
  - Oysters - If there is an issue with lack of oyster substrate: Add suitable substrate such as oyster cultch (material such as oyster shells or concrete laid down on oyster areas to provide mobile oyster spat with places to attach), or add mature oysters to increase spat production as described in the Indian River Lagoon South project.

D.4.1.4 Caloosahatchee Estuary

After implementing the CEPP A-2 FEB, restoration performance will be monitored related to improved salinities in the Caloosahatchee Estuary due to reduction of high flows at S-77 (from LO) and S-79, which is the main structure that discharges into the Caloosahatchee River and Estuary (CRE). We are uncertain that the FEB will improve LO high flow releases during the wet season to the degree necessary to reduce low salinity events in the middle and lower estuaries that stress both SAV and oysters in the Caloosahatchee. In addition, we are uncertain about whether water quality and sedimentation in the Caloosahatchee will improve from existing LO flows that stress SAV photosynthesis.

Two primary indicators (SAV, oysters) will be used as multiple lines of evidence to verify ecological restoration response to improve salinities. Information will feedback into improved operations of the A-2 FEB in coordination LO and C-43 project, as well as future CERP increments related to storage to further reduce high flows. In addition, the monitoring will confirm whether water quality (nutrients) and/or sedimentation (total suspended solids) may be affecting restoration performance, which would need to be addressed by future CERP increments and State water quality best management practices. While it is possible that other factors could affect the estuaries and would not be identified by monitoring SAV and oysters there is a need to focus on a relatively small number of ecological indicators in order to be able to set targets and track change efficiently; therefore the valued ecosystem component (VEC) concept is used. For the uncertainties addressed in this adaptive management plan the VECs are SAV and oysters, which have long been recognized as supporting estuarine habitat in these estuaries and have extensive historical data sets. Salinity is a primary indicator of the effects of fresh water flow changes, which help mediate extreme salinity fluctuations for oysters and SAV.

C-43 is an important CERP project that works synergistically with CEPP to improve high and low freshwater flows from the basin and Lake Okeechobee, and also addresses associated sediment and nutrient inputs from the basin, thus reducing stress on both SAV, and oysters. If that project is not implemented, the benefits to SAV (acreage and shoot density) and oysters (increased density per acre) associated with CEPP may not be realized. If C-43 reservoir is operational before the A-2 FEB, then RECOVER and CEPP baseline monitoring would document the changes due to that project to differentiate from changes resulting from CEPP.

CEPP Adaptive Management Uncertainties in the Caloosahatchee Estuary: There is a group of closely-related ecological uncertainties in the Caloosahatchee Estuary.

- Do reductions of high volume fresh water discharges result in measurable increases in SAV coverage and oyster acreage and health in the Caloosahatchee estuary? (ID#2)
- Will the reduction in low flow violations in the Caloosahatchee estuary help re-establish persistent *Vallisneria* beds in the upper Caloosahatchee estuary? (ID#49)

This group of uncertainties is related to the CEPP objective of reducing high volume discharges from Lake Okeechobee to the northern estuaries. The region is LO – northern estuaries. The associated CEPP and non-CEPP features are LO operations, the FEBs, S-77, and S-79.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? CEPP benefits to the Caloosahatchee estuary can be optimized if sufficient information about the on-the-ground effects of CEPP on the estuaries is gathered and reported.

Expectations and hypotheses to be tested to address the Caloosahatchee Estuary uncertainties, and attributes that will be measured to test each. The following hypotheses and performance expectations are supported by the modeling results reported in the RECOVER System-wide Evaluation of CEPP Report (**Annex E**). The proposed monitoring will leverage and compliment RECOVER northern estuaries monitoring and other project-level monitoring. The locations of CEPP-specific monitoring proposed here will be conducted in the specific locations where CEPP planning modeling showed effects from CEPP.

A. Flows (pertains to uncertainty #49)

- High flow reduction (>2800 cfs): 16.4% chance to 13.8% chance over existing conditions (94 to 68 high flow >2800cfs at S-79 over 41 year period of record).

- Low flow exceedence reduction (<450cfs): From 23.5 % chance to 5.3% chance over existing conditions (116 to 26 months of flows lower than 450 cfs over a 41 year period of record).

B. Salinity (pertains to uncertainty #2)

- CEPP will result in a greater percentage of time that the preferred salinity range of 16-28 psu at Cape Coral is met (increase from 37.7% to 45.3%), based on planning modeling results.
- CEPP will result in a greater percentage of time that the preferred salinity range of 16-28 psu at Shell Point is met (increase from 57.4% to 66%).

C. Submerged Aquatic Vegetation (SAV) (pertains to uncertainties #2, 49)

- Increase # of shoots per acre density in middle to lower estuary measured by Shell Point from 1,165,536 shoots per acre to 1,250,523 shoots per acre or 15.3% increase.
- CEPP will result in a decrease number of die off events and increase in Tape Grass acreage, shoot density, and blade length in upper estuary as indicated at Ft. Myers.

E. Oysters (pertains to uncertainty #2, 49).

- CEPP will result in an increase in oyster density at Shell Point by 4.4% from (3,893,214 oysters per square meter to 4,063,168).
- CEPP will result in an increase in oyster density at Cape Coral by 7.1% from (2,671,020 to 2,861,229 oyster per square meter).

More Information on Attributes to be measured:

- **What is expected to be learned by measuring this attribute, i.e., how will CEPP benefit from knowledge gained about this attribute?** The attributes have been identified as indicators of ecological health in the northern estuaries and indicators of restoration performance. They are the minimal efficient attributes to monitor CEPP performance in the estuaries.
- **What is the time frame in which changes to this attribute are expected to be measurable?** See triggers and thresholds below.
- **Is this attribute complimented by other monitoring programs (within and/or outside of CEPP)?** The monitoring is complimented by RECOVER MAP and restoration project monitoring. The locations for CEPP monitoring are focused in areas where CEPP modeling showed the most likelihood to achieve restoration benefits in the Caloosahatchee Estuary.
- **When during CEPP's life cycle should this monitoring begin?** If pre-CEPP estuarine monitoring can be used for baseline comparison, this monitoring should begin when CEPP changes flows to the estuaries by routing water to the FEB complex and Everglades rather than discharging it to the estuaries.

Methodology for testing each expectation or hypothesis (include frequency of monitoring). Hypotheses will be tested by measuring a reduction in high flows at S-79, after implementing the A-2 FEB and LO CEPP operations changes; some reviewers have noted that this may be the primary CEPP adaptive management indicator to monitor in the Caloosahatchee Estuary. Restoration performance related to two species of SAV and oysters will be measured to provide multiple lines of evidence of ecological response due reduction of high flows (oysters, manatee grass, and *Halodule* in middle to lower estuary) and reduction in low flow exceedences (*Vallisneria*). Baseline monitoring will be compared to monitoring when the A-2 FEB and LO operations are fully implemented. Information will feed back into improved operations of the A-2 FEB in coordination with Lake O and C-43, as well as future CERP increments related to storage to further reduce high flows. In addition, the monitoring will confirm whether water quality (nutrients) by future CERP increments and state water quality best management practices.

How results will be reported, and the triggers/thresholds that indicate good CEPP performance or need for adaptive management. Flows and Hydrology: Basin, Lake Okeechobee and S-79 flows will be measured to confirm progress towards expected CEPP performance. Rainfall in Kissimmee, LO, and C-43 basin will need to be considered to determine whether two consecutive water years are similar to baseline water years to compare performance improvements against. In addition, baseline monitoring (before project implementation) will be compared to flows achieved 2 years after CEPP and Lake O operations are implemented. Flows will be measured at S-79 and S-77. Salinity at Ft Myers, Shell Point, and Cape Coral will be monitored using existing networks.

SAV and Oysters: SAV and oysters will be measured after a minimum 4 year period of flows and salinity expected performance being achieved. Results will be compared to baseline and analyzed for incremental progress towards CEPP expected performance for both indicators (SAV and oysters). RECOVER SAV monitoring will be used (same protocol for quadzilla mapping at stations 1 and 2 for *Vallisneria*). The CEPP target indicates the first area downstream of S-79 where *Vallisneria* is most likely to reestablish is from 15 to 19 miles upstream from Shell Point. RECOVER oyster monitoring at Iona Cove, Cattle Dock, Bird Island, and Kitchel Key will be used. CEPP should increase frequency of oyster sampling from 2 to 4 times per year to better understand annual and inter-annual variation. RECOVER should continue predation and disease monitoring to better understand when oyster die-off events may be occurring to inform operations (to reduce disease and predation). Nutrients and total suspended solids will be compared in the same 4 year period to ensure these factors did not get worse from baseline. If salinity expectations are met with CEPP but SAV and oyster performance is not, there could be an issue with nutrients or total suspended solids preventing proliferation of these species, which would clarify needs and opportunities for future projects and thus prevent misdirection of future efforts.

Management options that may be chosen based on results. The following management options may be considered if expected flow and salinity performance and the subsequent ecological benefits are not realized:

- **If there is an issue with flows:** Optimize flows between C-43, Lake Okeechobee, the FEB complex, other projects as appropriate, and CEPP.
- **If there is an issue with sediment**: The CEPP Plan may reduce sediment loads to the estuaries by reducing water discharge volumes. However, CEPP does not otherwise include provisions to improve estuarine substrate that is an important aspect of estuarine habitat. Evaluate benthic monitoring results as first indicator of issues with sediment. If results suggest that despite salinity improvements the ecological restoration is hindered by undesired sediment (potentially high organic, anoxic, high sulfide muck) then muck removal may be needed. Muck removal is not part of the CEPP Plan nor has it been evaluated during CEPP planning; it is provided here as a suggestion for parties to consider for a future effort if needed. The suggested methods include identifying suitable salinity areas given CEPP and other project results and then removing muck in those areas, as described in Indian River Lagoon South project document.
- **The following options are specific to SAV and oysters**:
    - SAV- If there is an issue with water quality: provide the results as feedback to the implementing agencies to further optimize water quality using water quality features and State water quality projects/BMPs.

- Oysters - If there is an issue with lack of oyster substrate see suggestions for future restoration projects included in the management options matrix (**Table D.1.3**).

Table D.1.3: St. Lucie Estuary Management Option Matrix. See Table D.1.3 caption for further explanation.

Uncertainty ID	Time until changes are measurable*	Indicator or Attribute	Specific property to be Monitored, and Frequency	Decision Criteria: Confirmation of CEPP Performance or Trigger(s) for Management Action	Management Action Options
1, 45, 46	5 year	Flows	• Total flows into the SLE at S-80, 49, 48, and Gordy Road	• After 5 years of operation, evaluate the 5 years of flow data to determine if monthly average flows exceedences that were >2000 cfs were fewer (17% of time vs. 30%) (5 year snapshot until target is recognized)	Within approved Lake O schedule, and utilizing IRL-S, the FEB capacities, and other projects as appropriate, examine whether adjustments can be made to further optimize flows and meet low flow needs and reduce high flows. **Potential considerations for future CERP and non-CERP restoration projects:** Increase water storage capability to continue to restore lower volumes of fresh water discharges to the estuaries; muck removal to improve substrate; if there is an issue with lack of SAV seed source implement seagrass plantings (may be non-implementing agency effort); if there is inadequate amounts of oyster substrate add suitable substrate such as oyster cultch (material such as oyster shells or concrete laid down on oyster areas to provide mobile oyster spat with places to attach); add mature oysters to increase spat production as described in the Indian River Lagoon South project.
1, 45, 46	5 year	Salinity	• Salinity at US 1 bridge	• After 5 years of operation, evaluate the 5 years of flow data and see if % of time within 12 – 20 psu increased from 32-36%, and % of time below 12 psu decreased from 50 to 40 %.	
46	5 years	Benthic	• Benthic fauna at total 14 stations compared to 2 south fork stations (M-4 and M-5)	• After 5 years of operation and evidence of ideal flows and salinities met, Marine Benthic Index should move from Moderate (orange) to Good (green) at site M4; and Good (green) to High (blue) at site M5	
45	5 years	Oysters	• Oyster live-dead counts to four times a year (April, June, October, January); monthly monitoring samples for recruitment, growth, predation, and disease at existing locations.	• After 5 years of operation and evidence of ideal flows and salinities met, oyster density per acre should increase by 14% (574,674 to 655,614). If not, • Check for decreasing oyster recruitment, growth, predation, and disease trends	
1	5 years	SAV	• 4 or 5 stations same as RECOVER technique, SAV shoot density and species. Compare North to South Fork and Mid estuary. • Mapping of SAV acreage in St. Lucie every 2-3 years. • Continue monitoring and assessment of water quality data	• After 5 years of operation and evidence of ideal flows and salinities met, SAV shoot density per acre should increase by 20.1% (1,873,761 to 2,250,132). • If flows and salinity expectations are met but SAV does not improve, then check water quality results that may impact SAV growth and recruitment.	

***The "timeframe to detect changes…" does not imply that changes will be complete in that timeframe; rather, they provide an estimate of time needed to begin to be able to distinguish effects of CEPP. These time frames are indications of response speeds, not limits on how long the monitoring will be conducted.**

Table D.1.4: Northern Estuaries – Caloosahatchee Management Options Matrix. See Table D.1.3 caption for further explanation.

Uncertainty ID	Time until changes are measurable*	Indicator or Attribute	Specific Property to be Monitored, Location, Frequency	Decision Criteria: Confirmation of CEPP Performance or Trigger(s) for Management Action	Management Action Option
#2, 49	5 years	Flows	• Structure flows into the CRE at S-79	• After 5 years of operation, evaluate the 5 years of flow data to determine if average monthly low flows (<450cfs) decreased from 23% to 5% of time (5 year snapshot until target is recognized).	Within approved LO schedule and utilizing C-43 and the FEB capacities, and other projects as appropriate, examine whether adjustments can be made to improve flows. **Potential considerations for future CERP and non-CERP restoration projects:** Same as those for the SLE.
#2 and 49	5 years	Salinity	• Salinity (PSU) at Shell Point (*Halodule* and oysters), Ft. Myers (*Vallisneria*, and Cape Coral (15 minute sampling)	• After 5 years of operation, the desired range of salinity (16-28 psu) should be met 66% of the time (9% improvement over existing conditions) at Shell Point, and 45% of the time (8% improvement over existing conditions) at Cape Coral.	
#2 and 49	5 years	Oysters	• RECOVER oyster monitoring sites at Iona Cove, Cattle Dock, Bird Island, and Kitchel Key. Oyster density per square meter, oyster growth, disease and predation. Quarterly sampling.	• After 5 years of operation, oyster shoot density per meter squared should increase by 4.4% at Shell Point and 7.1% at Cape Coral. If not, examine oyster disease, predation monitoring.	
#2 and 49	5 years	SAV	• RECOVER SAV monitoring for seagrass shoot density and species coverage. • SAV acreage mapping every 5 years	• After 5 years of operation, increase seagrass shoot density (*Halodule*) per acre by 15.3% at Shell Point. • After 5 years of operation, reestablish *Vallisneria* beds 15 to 19 miles upstream of Shell Point. • If flows and salinity expectations are met but SAV does not improve, then check water quality results that may impact SAV growth and recruitment.	

***The "timeframe to detect changes…" does not imply that changes will be complete in that timeframe; rather, they provide an estimate of time needed to begin to be able to distinguish effects of CEPP. These time frames are indications of response speeds, not limits on how long the monitoring will be conducted.**

D.4.2 Greater Everglades Strategies and Management Options

A large portion of CEPP's area consists of the central Greater Everglades, including Water Conservation Area 3A (WCA 3A), Water Conservation Area 3B (WCA 3B), and the inland portion of Everglades National Park (ENP). The hypotheses, questions, uncertainties and management options below focus on CEPP's expected improvement of the ecological condition of the Everglades in terms of geo-morphological features, water flow, peat depths, vegetation, fire reduction, and fundamental prey and predator interactions. Over 15 years of scientific work, interagency collaboration, and public involvement have elevated these Everglades features to the forefront based on ecological and social values. The CEPP-specific questions were identified based on expected improvements from CEPP features and operations. Several topics were honed during the development of the Adaptive Management Plan based on the availability of information to create a detailed adaptive management strategy, for example, while several bird species are important in the Everglades the focus in this Adaptive Management Plan is on Spoonbills and Wood Storks due to the availability of nest success performance measures for these species; other species' performance measures focus on nest numbers which is not as informative for the needs of this Adaptive Management Plan. It should be noted that several of the questions below begin with "How much..." and these topics were also honed to focus on indicators or species for which there is enough scientific understanding to estimate a target with upper and lower bounds. The estimations are described in each "Adaptive Management Strategy". It is recognized that some estimations need refinement as data is collected and understanding of the Everglades ecosystems continually improves.

As noted above, adaptive management will be reiterated in the coming phases of CEPP, and the Adaptive Management Plan will be revisited. At such time, more baseline data and lessons learned will be available from other monitoring programs and restoration projects. Given the new knowledge, key questions and adaptive management options proposed in this Plan may need refinement. Therefore, items included in this plan are not guaranteed to be included or funded as-is, but will be considered again when CEPP is closer to being implemented.

D.4.2.1 Scope of Greater Everglades Adaptive Management Monitoring Plan

This scope is summarized in the following five figures (**Figure D.1.3-Figure D.1.7**).

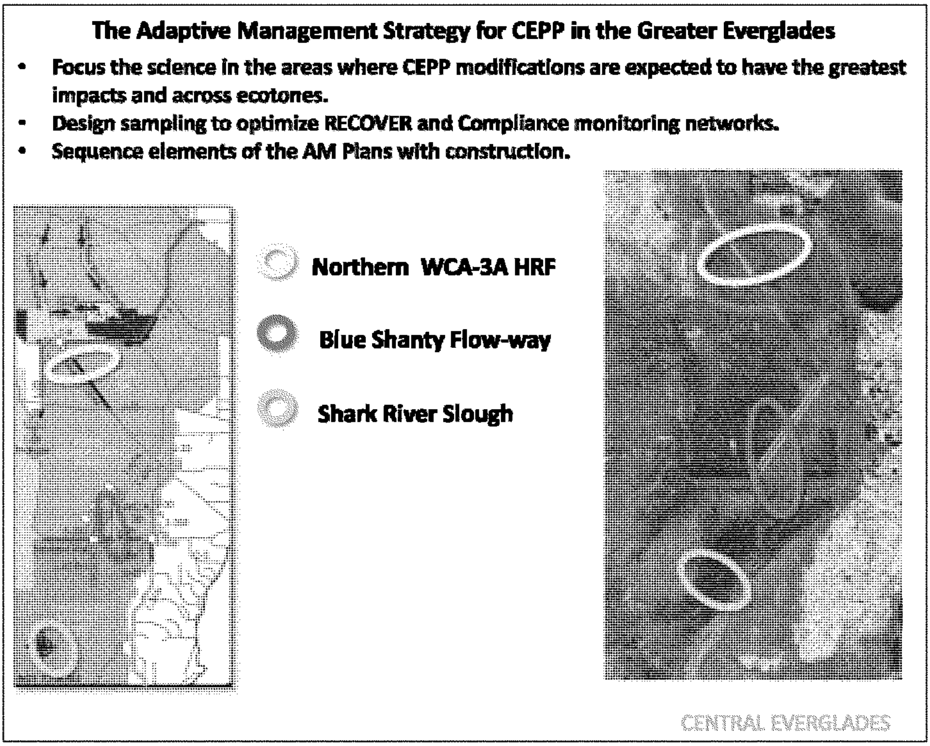
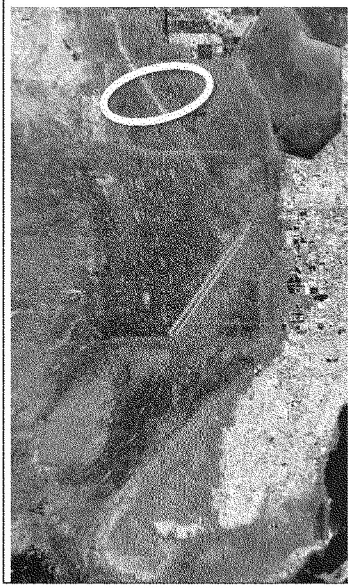


Figure D.1.3: The scope of the Greater Everglades adaptive management plan is focused on regions where the most hydrologic alterations are expected, and each major element of this Adaptive Management Plan can be summarized into four figures (See below). Circled areas are illustrative; not to scale.

Figure D.1.4-Figure D.1.6 **below summarizes the "Direct-Effects" adaptive management program downstream of each of the three major control structures associated with CEPP; 1) The NW-WCA-3A Hydropattern Restoration Feature (HRF), 2) The Blue Shanty Flowway and 3) The Tamiami Trail Bridges (Central SRS). Figure D.1.5 summarizes the "Indirect-Effects" adaptive management program in regions with relatively long lag times and/or are regions far removed from the direct impacts of major new structures within the Greater Everglades.** *Although exact sampling protocols and frequencies will be developed during CEPP's detailed design phase, the costs associated with these adaptive management strategies are relatively correct, are indicative of the proportional efforts that will be expended to address attribute specific methodologies, and most importantly, assumes that all hydrologic and ecological monitoring associated with RECOVER, USGS and the ENP remain at current (i.e., FY2013) funding levels.*

The GE Adaptive Management Strategy for CEPP

Northern WCA-3A HRF – $485,000



# - Uncertainty	Attributes to be Monitored	1-yr Costs
#5 - Will CEPP reduce soil oxidation and peat fires?	*Soil Moisture Content; Peat Accretion; Fire mapping; Community Structure; Radiometric Dating; Soil Decomposition; Weather; Hydrology*	$100,000.00
#63 & #76 - Will CEPP hydrology and biogeochemical response reestablish ridge, slough and tree islands?	*Tree islands, Canals and Marsh: Soil dynamics, Periphyton, WQ, Vegetation Mapping*	$250,000.00
#9 - How much will hydrologic restoration and vegetation management in result in increases in prey densities (aquatic fauna).	Aquatic fauna density; Large fish density	$50,000
#10 & #75 - How much will CEPP improve terrestrial wildlife and alligators?	Alligator relative density and body condition; Deer abundance; Terrestrial animal diversity	$85,000

Figure D.1.4: Elements of the Hydrologic Restoration Feature (HRF) will focus the Adaptive Management monitoring in the NW section of WCA-3A. Some of the uncertainties have been combined for tabular simplicity. The uncertainties are mostly related to the complete lack of ridge and slough vegetation, microtopography, fish and wading birds in this region. Here the question is: Can the construction, operation and potentially vegetation management of the HRF structure and flow area facilitate a healthier landscape that will support a return of typical Everglades foodwebs? This wetland is strongly sloped from west to east and flows will need to be re-directed more north to south as part of CEPP. Adaptive Management options that create preferential flows paths, scour out deeper sloughs, remove cattail or that thin out dense willow plains will be considered for evaluation. **Dollar amounts shown here have not been updated with CEPP project-wide contingency amounts; they are provided only to show relative allocation among monitoring efforts. Circled areas are illustrative; not to scale.**

The GE Adaptive Management Strategy for CEPP

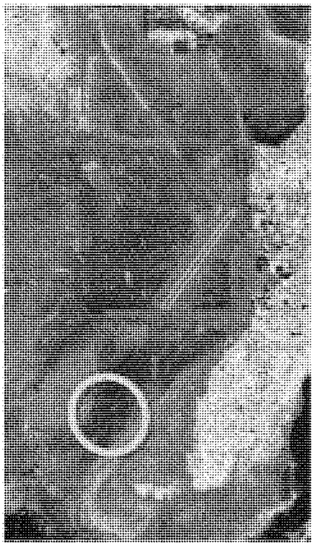
Blue Shanty Flow-way – $515,000

# - Uncertainty	Attributes to be Monitored	1-yr Costs
#5 - Will CEPP reduce soil oxidation and peat fires?	*Soil Moisture Content; Peat Accretion; Fire mapping; Community Structure; Radiometric Dating; Soil Decomposition; Weather; Hydrology*	$50,000
#63 & #76 - Will CEPP hydrology and biogeochemical response reestablish ridge, slough and tree islands?	*Tree islands, Canals and Marsh: Soil dynamics, Periphyton, WQ, Vegetation Mapping*	$425,000
#9 - How much will hydrologic restoration and vegetation management in result in increases in prey densities (aquatic fauna).	Aquatic fauna density; Large fish density	$25,000
#10 - How much will CEPP improve alligator relative density and body condition?	Alligator relative density; Alligator body condition	$15,000

Figure D.1.5: Elements of the control structures on the L-67A levee, the removal of some of the L-29 levee and the 2.5 Mile Bridge on Tamiami Trail in WCA-3B will determine the focus of the Blue Shanty Flowway Adaptive Management monitoring. Some of the uncertainties have been combined here for tabular simplicity. The uncertainties are mostly related to flow rates needed to create ecological connectivity, while restoring tree islands, slough vegetation and microtopography. Here the question is: How well will the operations of the L-67A structures reconnect WCA-3A to ENP, rehydrate WCA-3B and create a healthy ridge & slough landscape? Adaptive Management options that create preferential flows paths, scour out deeper sloughs, and pulse flow velocities across the flowway are all available for evaluation. **Dollar amounts have not been update with CEPP project-wide contingency amounts; they are provided only to show relative allocation among monitoring efforts. Circled areas are illustrative; not to scale.**

The GE Adaptive Management Strategy for CEPP

Shark River Slough – $360,000



# - Uncertainty	Attributes to be Monitored	1-yr Costs
#5 - Will CEPP reduce soil oxidation and peat fires?	*Soil Moisture Content; Peat Accretion; Fire mapping; Community Structure; Radiometric Dating; Soil Decomposition; Weather; Hydrology*	$100,000
#63 - Will Biogeochemical response be altered by changes in the timing and distribution of CEPP hydrology?	*Tree islands, Canals and Marsh: Soil dynamics, Periphyton, WQ, Vegetation Mapping*	$150,000
#9 - How much will hydrologic restoration and vegetation management in result in increases in prey densities (aquatic fauna).	Aquatic fauna density; Large fish density	$20,000
#10 - How much will CEPP improve alligator relative density and body condition?	Alligator relative density; Alligator body condition	$15,000
#61; #73 & #76 - Will CEPP hydroperiods, depths and flow velocities reestablish ridge and slough landscapes, including tree islands?	Tree Island Attributes (Peat Accretion, Soil Nutrients, Community Structure, GW flows); Ridge & Slough Attributes (Community Structure, Floc analysis, periphyton, sediment movement, flow velocities)	$75,000

Figure D.1.6: Management of features along Tamiami Trail (S-333, S-356, and the divide structure) will be the focus of the Adaptive Management monitoring plan for Shark River Slough (SRS). Some of the uncertainties have been combined for tabular simplicity. The uncertainties are mostly related to the hydrologic connectivity of SRS to adjacent habitats (e.g., Rocky Glades), tree islands, wading birds and Florida Bay. Here the question is: How will the distribution of flow in Northeast SRS (i.e., the 1-mile bridge vs. the 2.5 mile bridge) restore tree islands, prevent soil oxidation, and enhance fish densities for wading birds? The hydrology of SRS can affect the ecology of adjacent habitats (i.e., Rocky Glades, the wet prairies of the Cape Sable Seaside Sparrow (CSSS) and Florida Bay). Therefore the Adaptive Management options that expand the SRS habitat, increase hydroperiods where wading bird are expected to forage, and reduce Florida Bay salinities, while allowing wet prairie habitat to be maintained or transition to new areas, will be considered for evaluation. Dollar amounts have not been update with CEPP project-wide contingency amounts; they are provided only to show relative allocation among monitoring efforts. Circled areas are illustrative; not to scale.

The GE Adaptive Management Strategy for CEPP

Far afield – $370,000

# - Uncertainty	Attributes to be Monitored	1-yr Costs
#63 & #64 - Will CEPP mitigate saltwater intrusion effects on coastal wetland vegetation , soil, and nutrient retention or release?	*Changes in saltwater intrusion extent, salinity, vegetation, soil nutrient and carbon dynamics (SRS, Taylor Slough, Mangrove wetland, nearshore Fl Bay)*	$175,000
#61 and #67 - Will CEPP improve coastal salinity patterns, resulting in improved habitat and food webs	*Coastal wetland and nearshore food web analysis and modeling (SRS, Taylor Slough, Mangrove wetland, nearshore Fl Bay)*	$75,000
#65 & #75 - How much will hydrologic restoration and vegetation management result in increases in wading bird foraging conditions?	Prey availability, model refinement Northern WCA-3A, Blue Shanty, WCA-3B, SRS, Fl Bay	$120,000

Figure D.1.7: The combination of all three GE Adaptive Management Strategies will indirectly impact habitats and foodwebs far from the new structures in CEPP.

These far-afield uncertainties have the potential to influence decision-making, management options and CEPP II design. The overriding uncertainty is the degree of restored water volumes and its adequacy in terms of large scale, landscape restoration. Here the question is: How close to full scale CERP restoration does the additional 210,000 acre-ft associated with CEPP bring the Everglades? Adaptive Management options are all those associated with the NW-WCA-3A HRF, the Blue Shanty Flowway and the Tamiami Trail Bridges. Some of the uncertainties have been combined for tabular simplicity. **Dollar amounts have not been update with CEPP project-wide contingency amounts; they are provided only to show relative allocation among monitoring efforts. Circled areas are illustrative; not to scale.**

D.4.2.2 Flow Velocity for Ridge and Slough

CEPP Adaptive Management Uncertainty #73: Are the flow velocities, flow direction, volumes of fresh water, and water depth improvements from CEPP sufficient to reestablish historic ridge and slough landscapes? (Driver or uncertainty type: Hydro-ecological)

This uncertainty is related to the CEPP objective of restoring a natural mosaic of wetland habitats in the Everglades system, and relates to all regions and features of CEPP, but is most specific to regions immediately downstream of major restoration features. These features include the HRF Spreader Canal in NW WCA 3A, the Blue Shanty flowway in WCA 3B and project features and operations that move water under the two Tamiami Trail bridges.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty?
This critical uncertainty directly impacts the sustainability of the ridge/slough landscape and the ability of CEPP to redistribute sediments, alter peat oxidation rates, prevent peat fires, produce microtopography and create the diversity of habitats needed by the plant and animal communities of the Everglades. The flow velocities in the direction of historic sloughs and ridges, water volumes, and water depths downstream of new CEPP inflow structures are expected to enhance the transport of slough bed particles, periphyton-derived particles, and water column-derived particles. According to the ecological theory of Dynamic Equilibrium, the creation of historic transport conditions will restore historic depths of sloughs and elevation of ridges.

Expectations and hypotheses to be tested to address uncertainty, and attribute(s) that will be measured: Central to this uncertainty is the hypothesis that historic flow velocities, directionality, and volumes will restore historic depths of sloughs and elevation of ridges. This uncertainty will be evaluated in three separate regions of the Greater Everglades (NW WCA 3A, Blue Shanty Flowway and central SRS), but not at the same time. As a result, findings from the region that is restored first will impact adaptive management strategies to follow. Also, sediment transport models such as RASCAL (Ridge and Slough Cellular Automata Landscape) (Larsen and Harvey 2010) will provide insight for future refinement of modeling needs. Specific attributes and expectations include:

Hydrology:
- Velocity – Pulsed velocities reaching 2.5 cm/second or greater in downstream marsh of HRF, L-67, and Tamiami Trail Bridge structures for a total of 4 weeks during average and wet years.
- Direction: Mimic historic slough and tree island directionality.
- Volume: 210,000 acre-ft (long-term annual average) of additional water delivered to Northern WCA 3A.
- Depth – Decrease in the times that water depths go negative (i.e., below ground surface) by 120 days per year, on average in NWCA 3A, by 160 days per year, on average in WCA 3B, and by 210 days per year, on average in Northeast Shark River Slough.

Sediment:
- Organic – sediments will accumulate quicker in regions with long hydroperiods and will be redistribution in regions with periodic high flow velocities to create preferential flow paths and historic slough landscapes.

Vegetation:
- Northwestern WCA 3A – woody herbaceous vegetation will restore to ridges of sawgrass and sloughs with water lily south of HRF feature and along the backfilled Miami Canal.
- In SRS – expansion of ridge and slough pattern along the edges of SRS.
- WCA 3B – sawgrass meadows will transition to sawgrass ridges and water lily sloughs, while maintaining tree islands.

Quantification of the distribution, subsidence, accretion and movement of sediments, floc and peat is required to understand the role of flow velocities, direction, volumes, and water depth on the restoration and maintenance of healthy sloughs and ridges. The flow velocities, direction, volume, and water depth will be measurable immediately upon implementation of the CEPP structures; entrainment and transport of particles should also be measurable quickly. Re-creation of slough-ridge patterns that can be validated by surveys of peat elevations and vegetation structure will take at least 5-10 years to measure but will have some early indicators via measurements of water and sediment movements.

Methodology for testing each expectation or hypothesis: A BACI (Before-After-Control-Impact) methodology will be used for testing expectation everywhere in the Greater Everglades and for all hypotheses. In this approach, the before period is defined by measurements made 2-3 years prior to the impact (e.g., operation of the Blue Shanty gated culverts) and the after as the period during and following pulsed flow events. Control and impact reflect the regions not influenced and influenced by the structures and features, respectively. The monitoring will use a multidisciplinary approach that directly couples the monitoring of hydrology, sediment transport, vegetation, and wildlife (and, thus multiple hypotheses). The central focal points of the monitoring will be the detailed description of the hydrologic flow fields in the region of the structures and features, and the environmental conditions of the downstream communities. Monitoring shall use well-established vegetation and biogeochemical methods and state-of-the art tracer technologies when appropriate. The detailed plans for these measurements and QA/QC protocols will be described in more detail after CEPP authorization. Further evaluation will be gained by integrating field results with simulation (e.g., Ribbon and Lattice-Boltzmann) and hydrologic models (e.g., SFWMM). Based on lessons learned from RECOVER Monitoring and Assessment Plan and Decomp Physical Model landscape monitoring, attribute-specific methodologies will include:

- Hydrology: Hydraulic gradient will be expressed as "flow fields" that describe the movement of surface flows. Surface-water flow fields will be defined using a grid of continuous measurements of water level (e.g., stage gages and pressure transducers), a selected number of continuous velocity measurements, and point velocity measurements (e.g., Acoustic Doppler Velocimeter, ADV). Stage (water depth) data will be operated and maintained using USGS and/or SFWMD-established protocols. The large-scale hydrodynamics of surface water flows will primarily be investigated using an SF_6 tracer methodology modified for the low-gradient Everglades. Concomitantly, dye tracer releases will be made to visually assess local flow patterns. The results of the tracer tests, in combination with aerial photography to delineate spatial features, will be integrated with a Lattice-Boltzmann modeling procedure to develop fine-scale simulations of flow dynamics within the ridge & slough landscape, including vegetation interactions.
- Vegetation: The hydrologic monitoring process will serve as a framework for conducting a large number of location-specific measurements on particle sources, physical characteristics of particles, particle mass-balance relationships, and associated vegetation characterizations. It is anticipated that novel or state-of-the art technologies will be employed to characterize these phenomena. It is expected that methodologies will differ between the canal and marsh studies. Relationships between the hydrological attributes and the slough-ridge sediment and vegetation will be determined by measuring peat depths, elevations, soil nutrients and vegetation productivity along north-south transects in WCA-3 and west-east gradients in SRS within GRTS sampling units. The Generalized Random-Tesselation Stratified approach (GRTS) of Stevens and Olsen (2004)), drawn from a tiling of the Ridge and Slough and sawgrass prairie areas into 2km * 5km cells oriented along the directions of ridges, is a probability design, allowing design-based estimates of regional means. It provides spatial balance for inferences about gradients of change, and for model-based inferences (spatial interpolation) of regional means. It supports varying spatial and temporal measurement intensity for different attributes while maintaining co-location for inferences about causal pathways. Thus, it maximizes the flexibility of subsequent analyses of the resultant monitoring data. Changes over time will include comparisons with historic aerial photographs. The detailed plans for these measurements and protocols will be described in more detail after CEPP authorization.

How results will be reported and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action: The BACI statistical design will be used to formulate conclusions, address the uncertainties and make recommendations. Results will be provided on an annual basis to CEPP Project Managers, agency leads and the general public as part of the SFER (South Florida Environmental Report). Conclusions and recommendations for adaptive management actions will be provided every 2-3 years after integration with monitoring results from RECOVER, CEPP (non-adaptive management), and other agencies (non-CEPP) such as USGS, EPA, FWS, etc. This integration, reported by RECOVER, will evaluate the triggers/thresholds that indicate good CEPP performance based upon established and approved RECOVER Performance Measures. Examples include; 1) timing and amplitude of water depth fluctuations, 2) water flow direction and magnitude, 3) sediment transport patterns, 4) ridge and slough functionality, connectivity and aligned with ridges.

The process to establish and recommend an adaptive management action will be more complicated than simply reporting because it will be constrained by: 1) requirements of the BACI approach, 2) the size of the downstream testing environment, 3) the size of the new CEPP hydrologic structure, 4) the resilience of the downstream habitats (i.e., their ability or inability to change), 5) weather patterns, and 6) CEPP sequencing. RECOVER is designed to have the scientific and organization framework to manage this degree of complexity. With appropriate staffing, RECOVER will review the detailed adaptive management strategies, including but not limited to refined methods, frequencies, and logistics, for each of the three adaptive management downstream study areas (i.e., northeast WCA 3A, Blue Shanty Flowway and central SRS), for scientific focus, engineering practicality, field logistics and restoration relevance. Once an adaptive management study is implemented, and at least two years of post-construction data has been reviewed, RECOVER will evaluate results and may recommend staying with the methods or modifying them, or may suggest a new management action.

Management options that may be chosen to improve performance and assess the role of flow for ridge and slough restoration: Feedback to CEPP management could inform project decisions on timing, pulsing, or routing of water deliveries through an area differently than originally specified but within the approved CEPP Plan. Suggested adaptive management options listed below are not in any particular order and can be implemented simultaneously, as appropriate.

- Implement vegetation management downstream of flow structures to restore landscape patterns and create preferential flow paths. This may include concurrent or series testing of vegetation management options (e.g., fire, harvesting, herbicide, physical stress) downstream of the NW-WCA 3A HRF and the 67A conveyance features to create preferential flow paths along historic flow paths. This could be implemented to minimize easterly flow patterns, if such flow patterns occur. The design would involve vegetation management downstream of one section of the HRF compared to another section of the HRF without vegetation management, and another area south of L-5 not receiving hydrologic restoration or vegetation management. Goal is to determine whether such management actions significantly improve rate of restoration of ridge-slough directionality, topography, and hydrologic functions, to determine whether such actions should be undertaken with other CEPP features such as the L-67 flow structures and in the western WCA 3B flowway.
- Increase operational flexibility to maximize flow velocities in the Blue Shanty flowway including; 1) hydrological pulsing, 2) fill, plug, or gap ditches and agricultural canals, 3) implement rest of L-67A conveyance features to test additional flow, 4) Spoil mound removal and vegetation clearing, 5) Backfill Blue Shanty North-South Canal.
- Incremental increases in inflows to WCA-3B to create sloughs.

- Adjust operations along the northern boundary of WCA 3A by redistributing water into the S8 or into a new HRF east of the Miami Canal.

D.4.2.3 Restoring Tree Island Hydrology

CEPP Adaptive Management Uncertainty #76: Can CEPP create hydrology favorable for tree island elevation requirements? (Driver or Uncertainty type: hydro-ecological)

This uncertainty is related to the CEPP objective of restoring a natural mosaic of wetland habitats in the Everglades system, and relates to the potential for longer hydroperiods throughout the Greater Everglades, but especially downstream of new control structures. Addressing this uncertainty should reverse processes of peat subsidence and habitat (vegetation) diversity loss on tree islands.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? The CEPP adaptive management monitoring plan expects to unravel the mechanisms of tree island restoration and sustainability in order to a) manage hydrological parameters (i.e., depth, hydroperiod, flow) downstream of major operational structures and b) promote ecological processes such as, peat accumulation and decomposition rates, vegetation diversity, seedling recruitment and tree growth rates. Expectations are very similar to those associated with the flow uncertainty above. That is, this uncertainty will evaluate the sustainability of the ridge/slough landscape and the ability of CEPP to redistribute sediments, decrease peat oxidation rates, prevent peat fires, produce microtopography and create the diversity of habitats needed by all plant and animal communities. According to the ecological theory of Dynamic Equilibrium, the creation of historic water depths and hydroperiods will restore historic tree island peat depths and plant diversities.

Expectations and hypotheses to be tested to address uncertainty, and attribute(s) that will be measured: Central to this uncertainty is the hypothesis that historic hydroperiods and water depths on pre-drainage tree islands created a dynamic steady state where islands were able to maintain elevations of 2-3 feet above the surrounding sloughs, had a diverse population of wetland hardwoods and were refugia for nesting and foraging wildlife during high water conditions. This uncertainty will be evaluated in three separate regions of the Greater Everglades (NW WCA-3A, Blue Shanty Flowway and central SRS), but not at the same time. As a result, findings from the region that is restored first will impact adaptive management strategies to follow. Specific attributes and expectations include:

- Hydrology:
  - Water Depth: Maximum annual water depths for tree islands with high soil oxidation rates, and as a result, low elevations, might increase by 100%. However, stress associated with high waters will be minimized if hydroperiods do not exceed 11 months.
- Sediments:
  - Peat: Accretion rates are expected to exceed soil decomposition and subsidence rates, causing entire islands to increase in elevation.
  - Biogeochemistry: Restoration will enhance the accumulation of phosphorus in tree island sediments.
- Vegetation:
  - Marsh vegetation: Increased density of herbaceous species, especially in the lower elevation tails.
  - Trees: Increased recruitment of woody vegetation everywhere, but especially on the higher elevation heads.

Methodology for testing each expectation or hypothesis: A BACI (Before-After-Control-Impact) methodology will be used for testing expectation everywhere in the Greater Everglades and for all hypotheses. In this approach, the before period is defined by measurements made 2-3years prior to the impact (e.g., operation of the Blue Shanty gated culverts) and the after as the period during and following pulsed flow events. Control and impact reflect the regions not influenced and influenced by the structures and features, respectively. The monitoring will use a multidisciplinary approach that directly couples the monitoring of hydrology, sediment characteristics, vegetation, and wildlife (and, thus multiple hypotheses). The central focal points of the monitoring will be the detailed description of the peat accretion rates and tree root development on tree islands downstream of new water control structures. Monitoring shall use well-established vegetation and biogeochemical methods. The detailed plans for these measurements and QA/QC protocols will be described in more detail after CEPP authorization. Attribute-specific methodologies will include:

- Geomorphology and Hydrology: Tree island soil characteristics, pore water chemistry, and elevation changes will be monitored in such a way as to relate tree island hydrology, soil moisture and surficial flow patterns to peat accretion, community structure, root production and pore-water nutrients. Islands downstream of control structures will outfitted across transects with Surface Elevation Tables (SETs), feldspar marker horizons, and shallow groundwater wells to monitor peat accretion rates, soil elevations, groundwater movement, and pore-water nutrients. Changes over time will include comparisons with historic aerial photographs.
- Vegetation: Relationships between the hydrological attributes and the slough-ridge sediment and vegetation will be determined by measuring peat depths, elevations, soil nutrients and vegetation productivity along north-south transects in WCA-3 and west-east gradients in SRS within GRTS sampling units. The Generalized Random-Tesselation Stratified approach (GRTS) of Stevens and Olsen (2004)), drawn from a tiling of the Ridge and Slough and sawgrass prairie areas into 2km * 5km cells oriented along the directions of ridges, is a probability design, allowing design-based estimates of regional means. It provides spatial balance for inferences about gradients of change, and for model-based inferences (spatial interpolation) of regional means. It supports varying spatial and temporal measurement intensity for different attributes while maintaining co-location for inferences about causal pathways. Thus, it maximizes the flexibility of subsequent analyses of the resultant monitoring data. The detailed plans for these measurements and protocols will be described in more detail after CEPP authorization.

How results will be reported, and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action: The BACI statistical design will be used to formulate conclusions, address the uncertainties and make recommendations. Results will be provided on an annual basis to CEPP Project Managers, agency leads and the general public as part of the SFER (South Florida Environmental Report). Conclusions and recommendations for adaptive management actions will be provided every 2-3 years after integration with monitoring results from RECOVER, CEPP (non-adaptive management), and other agencies (non-CEPP) such as USGS, EPA, FWS, etc. This integration, reported by RECOVER, will evaluate the triggers/thresholds that indicate good CEPP performance. For tree islands, this will require the creation of a new suite of RECOVER Tree Island Performance Measures. Examples include; 1) timing and amplitude of water depth fluctuations, 2) soil accumulation rates, and 3) canopy cover and density.

The process to establish and recommend an adaptive management action will be more complicated than simply reporting because it will be constrained by: 1) requirements of the BACI approach, 2) the size and number of tree islands in the downstream testing environment, 3) the resilience of the downstream tree islands (i.e., their ability or inability to change), and 4) CEPP sequencing. RECOVER was designed to have the scientific and organization framework to manage this degree of complexity. With appropriate staffing, RECOVER will review the methodologies for each of the three adaptive management downstream study areas (I.e., NE-WCA-3A, Blue Shanty Flowway and central SRS), for scientific focus, engineering practicality, field logistics and restoration relevance. Once an adaptive management study is implemented, and at least two years of post-construction data has been reviewed, RECOVER will evaluate results and may recommend staying with the methods or modifying them, or may suggest a new management action.

Management options that may be chosen to improve performance and assess the role of hydrology for tree island restoration: Feedback to CEPP management could include informing project decisions such as timing of delivering water, pulsing of delivery water, managing FEB/STA water to either enhance or reduce tree island hydroperiods, or routing water through an area slightly differently than originally specified. Suggested adaptive management options for tree islands downstream of CEPP water control structures listed below are not in any particular order and can be implemented simultaneously, as appropriate. Some options that would need additional authorization to improve restoration beyond CEPP are presented in the management options matrix.

- Create moat-like sloughs around tree islands using vegetation management options (e.g., fire, harvesting, herbicide, physical stress) as tested in the Loxahatchee Impounded Landscape Assessment (LILA) Everglades ecological experiments.
- Increase operational flexibility to maximize flow velocities in the Blue Shanty flowway including; 1) hydrological pulsing, 2) implement rest of L-67A conveyance features for additional flow as described in the CEPP Plan, 3) vegetation clearing or management.
- Incremental increases to WCA-3B hydroperiods to create more resilient tree islands with higher elevations in anticipation of a future increment of CERP.
- Adjust operations along the northern boundary of WCA 3A by redistributing water into the S8.

D.4.2.4 Reducing Soil Oxidation and Fire

CEPP Adaptive Management Uncertainty #5: Are inundation and hydroperiod sufficient to reduce current high rates of soil oxidation and peat fires? (Driver or Uncertainty type: hydro-ecological)

This uncertainty is related to the CEPP objective to improve sheet flow patterns and surface water depths and duration in order to increase soil moisture to minimize muck fire events and loss of peat soils in the Everglades system. Furthermore, the hydrological restoration in CEPP will prevent peat fires in all regions and all habitats, and will reverse processes of subsidence, especially in Northeast WCA 3A, WCA 3B, the Rocky Glades, and eastern margin of SRS.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? Deep-burning peat fires generally occur during periods of extended drought when extreme burning conditions are generally occurring at a landscape level. Therefore, greater understanding of the effect surface water depth and duration on the combustion potential in organic soils will provide a useful tool for informing managers how to allocate more efficiently and effectively limited resources during periods of greatest demand. Thus, by addressing this uncertainty CEPP will help to reduce the frequency and intensity of muck fire events that will help to decrease soil oxidation and reduce potential damage to the plant community, in general, and woody trees in particular. Similarly, reduction of fire events will decrease the potential of shift in community composition from forested ecosystems to marshes as it has been observed in the ENP.

Expectations and hypotheses to be tested to address uncertainty, and attribute(s) that will be measured: Central to this uncertainty is the hypothesis that organic soil loss and accumulation is maintained in a state of dynamic equilibrium as a function of surface water depth and duration, water table and fire events. This hypothesis will be tested in three separate regions of the Everglades, including NW WCA-3A, WCB-3B and Central Shark River Slough. Specific attributes and expectations include:

Attributes:

a) Hydroperiod, flow velocity and direction, and water table depth;
b) Soil accretion rates by using sediment elevation tables (SETs) to document peat accretion rates on natural and created tree islands-link to tree islands (Note that SETs are only on tree islands, which is why SETs are associated with this uncertainty. Ridge and slough elevation changes will be measured in association with GRTS panels for other adaptive management uncertainties);
c) Belowground production and decomposition rates (standardized peat from different areas in the Everglades Protection Area will be used to decompose naturally at different rates due to the different organic matter matrices).
d) Soil moisture and soil bulk density;
e) Organic matter content of peat and percent organic carbon;
f) Microtopography peat depths and pore-water nutrients across landscape units. Porewater nutrients will be monitored to evaluate the stability of the total phosphorus concentrations and the potential for invasive/nuisance species to decline or increase with restoration.

Expectations:

a) Decrease frequencies and durations of dry outs leading to decrease rates of organic soil loss through oxidation and/or peat fires.
b) Increasing peat accumulation due to improving sheet flow.
c) Timing and distribution of water will reduce soil oxidation and fire events.
d) NW WCA 3A: fire frequencies should be reduced.
e) NE WCA 3A: HRF may not be sufficient to eliminate soil oxidation and threat of peat fires within NE 3A.
f) WCA 3B: peat fires will not occur within the Blue Shanty area but within northern 3B it is expected that fires will decrease by 20%.
g) Rocky glades: Fire will continue to occur as CEPP hydroperiods are not sufficient to reduce potential threat of fire and soil oxidation.

Methodology for testing each expectation or hypothesis: A BACI (Before-After-Control-Impact) methodology will be used for testing expectation everywhere in the Greater Everglades and for all hypotheses. In this approach, the before period is defined by measurements made 2-3 years prior to the impact (e.g., operation of the Blue Shanty gated culverts) and the after as the period during and following pulsed flow events. Control and impact reflect the regions not influenced and influenced by the structures and features, respectively. The monitoring will use a multidisciplinary approach that directly couples the monitoring of hydrology, sediment characteristics, and vegetation. The central focal points of the monitoring will be the detailed description of spatial and temporal patterns of soil moisture, soil bulk density and organic matter content that are directly associated with water table depths. Monitoring shall use well-established soil moisture and soil accretion methods. The detailed plans for these measurements and QA/QC protocols will be described in a Science Work plan, which will be developed after CEPP authorization. Attribute-specific methodologies will include:

- Hydrology: Soil characteristics, including soil moisture, organic matter content, and bulk density along with water table depths will be monitored in such a way as to relate hydrology and surficial flow patterns to frequency of dry downs
- Soil: Relationships between the hydrological attributes and soil and vegetation processes will be determined by measuring peat depths, elevations, soil nutrients and vegetation productivity along north-south transects in WCA-3 and west-east gradients in SRS within GRTS sampling units. The Generalized Random-Tesselation Stratified approach (GRTS) of Stevens and Olsen (2004)), drawn from a tiling of the Ridge and Slough and sawgrass prairie areas into 2km * 5km cells oriented along the directions of ridges, is a probability design, allowing design-based estimates of regional means. It provides spatial balance for inferences about gradients of change, and for model-based inferences (spatial interpolation) of regional means. It supports differing spatial and temporal intensity of measurement for different attributes while maintaining co-location for inferences about causal pathways. Thus, it maximizes the flexibility of subsequent analyses of the resultant monitoring data. The detailed plans for these measurements and protocols will be described in a Science Work plan, which will be developed after CEPP authorization.

How results will be reported and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action: The BACI statistical design will be used to formulate conclusions, address the uncertainties and make recommendations. Results will be provided on an annual basis to CEPP Project Managers, agency leads and the general public as part of the SFER (South Florida Environmental Report). Conclusions and recommendations for adaptive management actions will be provided every 2-3 years after integration with monitoring results from RECOVER, CEPP (non-adaptive management), and other agencies (non-CEPP) such as USGS, EPA, FWS, etc. This integration, reported by RECOVER, will evaluate the triggers/thresholds that indicate good CEPP performance. For tree islands, this will require the creation of a new suite of RECOVER Tree Island Performance Measures. Examples include; 1) timing and amplitude of water depth fluctuations, 2) soil moisture, and 3) sediment accumulation rates.

The process to establish and recommend an adaptive management action will be more complicated than simply reporting because it will be constrained by: 1) limitations of the BACI approach, 2) the soil properties in the downstream testing environment, 3) the resilience of the downstream soil and vegetation (i.e., their inability to change), and 4) CEPP sequencing. RECOVER was designed to have the scientific and organization framework to manage this degree of complexity. With appropriate staffing, RECOVER will review the detailed strategies for each of the three adaptive management downstream study areas (i.e., NE-WCA-3A, Blue Shanty Flowway and central SRS), to include but not be limited to detailed methods, scientific focus, engineering practicality, field logistics and restoration relevance. Once an adaptive management study is implemented, and at least two years of post-construction data has been reviewed, RECOVER will evaluate results and may recommend staying with the methods or modifying them, or may suggest a new management action.

Management options that may be chosen to improve performance and assess the role of surface water depth and duration on soil organic content, moisture and bulk density for reducing soil oxidation and frequency of fire events: While effects of muck fire events are broadly accepted as negative, an improved understanding of these events in their local ecological context will increase the ability of managers to adopt appropriate strategies to efficiently and ecologically control them. Thus, feedback to CEPP management could include informing project decisions such as timing of delivering water, pulsing of delivery water, managing FEB/STA water to rise water tables to enhance or increase soil moisture in areas where surface water depth and duration has been lowered than originally specified. Suggested adaptive management options for regions of CEPP water control structures listed below are not in any particular order and can be implemented simultaneously, as appropriate. Options that may be considered for a future increment of CERP are suggested in the management options matrix.

- Increase operational flexibility to minimize frequency of muck fires in areas where organic soils experience extreme dry conditions.
- Incremental increases to WCA-3B hydroperiods increase soil moisture and diminish fire events to create more resilient environment in anticipation of a future increment of CERP.
- Adjust operations along the northern boundary of WCA-3A by redistributing water into the S8.

D.4.2.5 Everglades Predators: Alligators

CEPP Adaptive Management Uncertainty #10: How much will CEPP improve alligator relative density and body condition in northern WCA 3A, WCA 3B and northeast Shark River Slough (NESRS)? (Driver or Uncertainty type: hydro-ecological)

This uncertainty is related to the CEPP objectives of: 1) restoring more natural water level responses to rainfall to promote plant and animal diversity and habitat function and 2) reducing water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization. It relates to all regions and features of CEPP, but the greatest opportunities for learning are immediately downstream of major restoration features. These features include the HRF Spreader Canal in NW WCA-3A, the Blue Shanty Flowway in WCA-3B and the two Tamiami Trail bridges.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? Addressing this uncertainty provides information that will enhance the ability of CEPP to improve and restore a key ecological attribute of the Everglades. Alligators play a key ecological role in the Everglades by improving ecological diversity and function through creation of alligator holes, trails, and nests. However, in many areas such as northwestern Water Conservation Area 3, conditions are too dry to support alligator populations at targeted levels; thus, these other ecological benefits and functions are not occurring. The CEPP adaptive management monitoring plan will provide a way to determine more specifically the values of hydrological parameters (hydroperiod, depth, frequency of dry downs) that are necessary to maintain healthy alligators and alligator populations at targeted levels. Resolving this uncertainty will contribute to our understanding of how much water is needed for a restored Everglades.

Expectations and hypotheses to be tested to address uncertainty, and attribute(s) that will be measured: Our hypothesis is that more natural hydrologic patterns with dry downs no more frequent than once every 3-5 years (creating multi-year hydroperiods) will improve both alligator body condition and relative density of alligators. This uncertainty will be evaluated in three separate regions of the Greater Everglades (NW WCA-3A, Blue Shanty Flowway and central SRS), but not at the same time. As a result, findings from the region that is restored first will impact adaptive management strategies to follow. The Alligator Production Suitability Index Model (Shinde et al. 2013) will be used to provide input for guiding strategies and determining expectations based on expected hydrologic improvements. Specific attributes and expectations include:

- Alligator Body Condition: Longer hydroperiods and less frequent dry downs will result in alligator body condition that is less variable from spring to fall and higher than pre-project.

- Alligator Relative Density: Longer hydroperiods and less frequent dry downs will result in an increase in relative density of alligators. Maximum relative densities will be achieved if dry downs are on average once every 3-5 years.

Methodology for testing each expectation or hypothesis: The testing of this hypothesis will be done in conjunction with the BACI (Before-After-Control-Impact) methodology used for uncertainties related to restoring hydrology for ridge and slough and tree island elevation everywhere in the Greater Everglades. In this approach, the before period is defined by measurements made 2-3 years prior to the impact (e.g., operation of the Blue Shanty gated culverts) and the after as the period during and following feature completion. Control and impact reflect the regions not influenced and influenced by the structures and features, respectively. The monitoring will use a multidisciplinary approach that directly couples the monitoring of hydrology, and wildlife. For this hypothesis attribute-specific methodologies will include:

Alligator Body Condition: Fifteen alligators will be captured in spring and fall in areas downstream of features and in control areas following protocols developed for RECOVER MAP (Mazzotti et al. 2010). Alligators will be measured, weighed, marked, gender determined and released at their site of capture. Body condition will be calculated using the Fulton's K body condition index. EDEN data will be used to describe prior and current hydrologic variables including hydroperiod, average water depths at various time steps prior to capture and yearly water depth amplitude prior to capture.

Alligator Relative Density: Night-time spotlight counts will be conducted in spring and fall in areas downstream of features and in control areas along designated survey routes following protocols developed for RECOVER MAP (Mazzotti et al. 2010). Environmental data will be taken at the beginning and end of each survey and location and size estimate of all alligators observed will be recorded. A minimum of two transects conducted twice each season will be used. Hydrology data from key USGS gauges as well as data from EDEN will be used to describe both hydrologic conditions at the time of the surveys and hydrologic conditions (hydroperiod, depths, and amplitude) in the 1-5 years prior to the surveys.

How results will be reported, and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action: Results will be reported in the context of what is expected given the improvements to hydrology (estimated using The Alligator Production Suitability Index Model (Shinde et al. 2013)) and in comparison to established targets (Mazzotti et al. 2009). Results will be provided on an annual basis to CEPP Project Managers, agency leads and the general public as part of the SFER (South Florida Environmental Report). Conclusions and recommendations for adaptive management actions will be provided every 2-3 years after integration with monitoring results from RECOVER, CEPP (non-adaptive management), and other agencies (non-CEPP) such as USGS, EPA, FWS, etc. This integration, reported by RECOVER, will evaluate the triggers/thresholds that indicate good CEPP performance (see Mazzotti et al. 2009).

Management options that may be chosen to improve performance and assess the role of hydroperiods and depths for improving alligator body condition and relative density: Feedback to CEPP management will include providing information that can inform project decisions such as timing of delivering water, or routing water through an area slightly differently than originally specified. Suggested adaptive management options listed below are not in any particular order and can be implemented simultaneously, as appropriate. Options that may be considered for a future increment of CERP are suggested in the management option matrix.

- Incremental increases in flows through WCA 3B to recreate historic slough paths.
- Adjust operations along the northern boundary of WCA 3A by redistributing water into the S8.

D.4.2.6 Prey Densities

CEPP Adaptive Management Uncertainty #9: How much will hydrologic restoration and vegetation management result in increases in prey densities (aquatic fauna)? (Driver or Uncertainty type: hydro-ecological)

This uncertainty is related to the CEPP objectives of: 1) restoring more natural water level responses to rainfall to promote plant and animal diversity and habitat function and 2) reducing water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization. It relates to all regions and features of CEPP, but the greatest opportunities for learning are immediately downstream of major restoration features. These features include the HRF Spreader Canal in NW WCA-3A, the Blue Shanty Flowway in WCA-3B and the two Tamiami Trail bridges.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? Addressing this uncertainty provides information that will enhance the ability of CEPP to improve and restore the availability of critical, food-web fish and invertebrates. Changes in the densities, availability and spatial distributions of aquatic prey are needed to restore historic food-web interactions, especially for wading birds. However, in many areas such as northwestern Water Conservation Area 3, WCA-3B and SRS, conditions are too dry or recession rates are too fast, to support prey populations at significant levels. The CEPP adaptive management plan will provide a way to determine more specifically the values of hydrological parameters (hydroperiod, depth, frequency of dry downs) that are necessary to restore and sustain a healthy prey-base throughout the Greater Everglades, but especially in regions that were once known for supporting wading bird supercolonies.

Expectations and hypotheses to be tested to address uncertainty, and attribute(s) that will be measured: Central to this uncertainty is the hypothesis that restoration of multi-year hydroperiods to northern WCA 3A, WCA 3B, and NESRS will result in increased density of aquatic fauna and large fish. More specifically, will infrequent dry downs (i.e., no more frequent than once every 5 years) significantly improve density of small and large fish, and will this translate into a more resilient and available food base for wading birds and other large predators? This uncertainty will be evaluated in three separate regions of the Greater Everglades (NW WCA-3A, Blue Shanty Flowway and central SRS), but not at the same time. As a result, findings from the region that is restored first will impact adaptive management strategies to follow. The Fish Habitat Suitability Index Model (Trexler et al. 2003) will be used to provide input for guiding strategies and determining expectations based on expected hydrologic improvements. Specific attributes and expectations include:

- Aquatic Prey: The density of small fish (8 cm or less standard length) and prey invertebrates such as, grass shrimp and crayfish will significantly increase downstream of the new water control structures, in NE WCA-3A where hydroperiods are expected to increase by 35%, and along the edges of SRS.
- Large Fish: The distribution, movement and density of large fish (>8 cm standard length) will expand and increase into areas with annual average hydroperiods in excess of 11 months.

Methodology for testing each expectation or hypothesis: The testing of this hypothesis will be done in conjunction with the BACI (Before-After-Control-Impact) methodology used for uncertainties related to restoring hydrology for ridge and slough and tree island elevation everywhere in the Greater Everglades. In this approach, the "before" period is defined by measurements made 2-3 years prior to the initiation of CEPP operations that will affect the area (e.g., operation of the Blue Shanty gated culverts) and the after as the period during and following feature completion. Control and impact reflect the regions not influenced and influenced by the structures and features, respectively. The monitoring will use a multidisciplinary approach that directly couples the monitoring of hydrology and aquatic fauna. Detailed methodology for assessment of fish performance is available in the DECOMP Performance Measure Documentation Sheet for Prey-Based Freshwater Fish Density. This monitoring will include presence/absence monitoring for invasive and nuisance fish species and will be coordinated with the INSMP team to consolidate monitoring trips and reduce costs. Attribute-specific methodologies will include:

- Aquatic Prey: Aquatic prey populations are monitored using one square meter throw traps. Throw trap samples will be collected in primary sampling units in areas that were identified as feasible for throw-trap sampling. Selection of primary sampling units will be based on a spatially balanced recursive tessellation design. Throw trap locations within a primary sampling unit are three fixed coordinates within a ten meter by ten meter cell drawn randomly from the habitat that can be sampled. Landscape estimates for standing crops of prey populations are interpolated via standard kriging across the sampling domain.
- Large Fish: Same as above for small fish plus wet season satellite tracking.

How results will be reported, and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action: The BACI statistical design will be used to formulate conclusions, address the uncertainties and make recommendations. Results will be provided on an annual basis to CEPP Project Managers, agency leads and the general public as part of the SFER (South Florida Environmental Report). Conclusions and recommendations for adaptive management actions will be provided every 2-3 years after integration with monitoring results from RECOVER, CEPP (non-adaptive management), and other agencies (non-CEPP) such as USGS, EPA, FWS, etc. This integration, reported by RECOVER, will evaluate the triggers/thresholds that indicate good CEPP performance based upon established and approved RECOVER Performance Measures. Specifically, the distribution and density of small fish will trigger an adaptive management action if any of the following are true: if one year is at least three standard errors above or below the limits of an objective interval; if two out of three years are at least two standard errors above or below the limits of an objective interval; or if four out of five consecutive years are at least 1.5 standard errors above or below the limits of an objective interval.

Management options that may be chosen to improve performance and assess the role of extended hydroperiods and flow for the restoration of aquatic prey densities. Feedback to CEPP management will include providing information that can inform project decisions such as timing of delivering water, or routing water through an area slightly differently than originally specified. Suggested adaptive management options listed below are not in any particular order and can be implemented simultaneously, as appropriate.

- Concurrent or series testing of vegetation management options (e.g., fire, harvesting, herbicide, physical stress) downstream of the NW WCA 3A HRF and the 67A conveyance features to create preferential flow paths in historic flow path locations.

- Increase operational flexibility to maximize flow velocities in the Blue Shanty flowway including; 1) hydrological pulsing, 2) Implement rest of L-67A conveyance features for additional flow as described in the CEPP Plan, 3) vegetation management or clearing.
- Incremental increases in flows through WCA 3B to re-create slough paths.
- Adjust operations along the northern boundary of WCA 3A by redistributing water into the S8.

D.4.2.7 Wading Bird Foraging Conditions and Nesting

CEPP Adaptive Management Uncertainty #75: How much will hydrologic restoration and vegetation management result in increases in wading bird foraging conditions and increased nest number and success of Wood Storks and Roseate Spoonbills? (Driver or Uncertainty type: hydro-ecological)

This uncertainty is related to the CEPP objectives of: 1) restoring more natural water level responses to rainfall to promote plant and animal diversity and habitat function and 2) reducing water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization. It relates to all regions and features of CEPP, but the greatest opportunities for learning are immediately downstream of the HRF Spreader Canal in NW WCA-3A, in SRS downstream of the two Tamiami Trail bridges, and in Florida Bay downstream of Taylor Slough. By addressing this uncertainty in combination with the one above (Aquatic Prey Density), this CEPP adaptive management plan is expected to increase GE wading bird populations everywhere in the Everglades, but mostly in ENP.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? Addressing this uncertainty provides information that will enhance the ability of CEPP to restore critical, keystone populations of egrets, ibis, herons, storks, cranes and spoonbills in terms of their abundance, spatial distributions and reproductive viability. Wading birds are not utilizing the ENP for foraging or nesting as they did 100 years ago. The CEPP adaptive management monitoring plan will provide a way to determine more specifically the values of hydrological parameters (hydroperiod, depth, frequency of dry down) and ecological parameters (prey density, vegetation, exotics) that are necessary to restore and sustain wading bird populations throughout the Greater Everglades, but especially in regions that were once known for supporting wading bird super colonies.

Expectations and hypotheses to be tested to address uncertainty, and attribute(s) that will be measured: Central to this uncertainty is the hypothesis that 1) restoration of more natural ridge and slough patterns coupled with appropriate recession rates will result in an increase in wading bird foraging conditions, 2) restoration of multi-year hydroperiods to northern WCA 3A, WCA 3B, and NE Shark River Slough will result in increased density of aquatic prey, earlier nesting and increased fledgling success, and 3) restoration of short hydroperiod wetlands will increase dry season prey availability, and promote earlier nest initiation (November/December) and nest success of Wood Storks and Roseate Spoonbills in the southern Everglades. This uncertainty will be evaluated in four separate regions of the Greater Everglades (Northern WCA-3A, WCA-3B, central SRS and Florida Bay). A Wading Bird Habitat Suitability Index (HSI) Model (Beerens et al. 2012), a Wood Stork HSI (LoGalbo, et al., 2012) and a Spoonbill HSI will be calibrated to provide input for guiding strategies and determining project performance expectations based on expected hydrologic improvements. Specific attributes and expectations include:

- Wading Birds: Increase in foraging conditions within short hydroperiod wetlands along flanks of SRS, and a shift in timing of nest initiation to November/December
- Wood Storks and Roseate Spoonbills: Increase in nesting success in southern Everglades due to earlier fledging dates and a decrease in nest abandonment and nest predation.

- All: Overall net gain in foraging conditions throughout the project area; 20% increase over baseline of foraging conditions in short hydroperiod wetlands.

Methodology for testing each expectation or hypothesis: The testing of these hypotheses will be done in conjunction with the BACI (Before-After-Control-Impact) methodology used for uncertainties related to restoring hydrology for ridge and slough, salinities in Florida Bay and prey densities in the regions of historic super colonies. In this approach, the before period is defined by measurements made 24 months prior to the impact (e.g., operation of the Blue Shanty gated culverts) and the after as the period during and following feature completion. Control and impact reflect the regions not influenced and influenced by the structures and features, respectively. The monitoring will use a multidisciplinary approach that directly couples the monitoring of hydrology, aquatic fauna, water quality, wading bird foraging and nesting success. Detailed methodology for assessment of Wading Bird performance (including Wood Storks and Spoonbills) is available in the RECOVER Performance Measure Documentation Sheets (GE-21 and GE-22) for Wetland Trophic Relations and Bancroft et al. (2002). Attribute-specific methodologies will include:

- Hydrology: Hydroperiods, stage and depths across the landscape before, during and after foraging will be calculated from USGS and SFWMD stage gauges and interpolated using USGS EDEN kriging techniques.
- Aquatic Prey: Use protocols developed for RECOVER MAP to measure dry season prey availability. Aquatic prey populations will be monitored using one square meter throw traps and will be collected before and after wading bird dry season foraging events downstream of CEPP structures and features.
- Wading Birds: Bird foraging counts, nest location, nesting success and fledgling success will be conducted using bi-weekly or monthly overflights of foraging and nesting locations as per Bancroft et al. (2002)

How results will be reported, and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action: The BACI statistical design will be used to formulate conclusions, address the uncertainties and make recommendations. Results will be provided on an annual basis to CEPP Project Managers, agency leads and the general public as part of the SFER (South Florida Environmental Report). Conclusions and recommendations for adaptive management actions will be provided every 2-3 years after integration with monitoring results from RECOVER, CEPP (non-adaptive management), and other agencies (non-CEPP) such as USGS, EPA, FWS, etc. This integration, reported by RECOVER, will evaluate the triggers/thresholds that indicate good CEPP performance based upon established and approved RECOVER Performance Measures. Specifically, restoration targets for mainland nesting patterns as stipulated in the CERP Documentation Sheet GE-22 Wetland Trophic Relationships and based upon work by Ogden, Bancroft and Frederick (1997), Ogden (1994) and Gawlik et al. (2003). These include the following:

- CEPP is expected to increase wading bird nesting pair numbers in mainland colonies that move towards the minima of 4,000 pairs of Great Egrets, 10,000 to 20,000 combined pairs of Snowy Egrets and Tricolored Herons, 10,000 to 25,000 pairs of White Ibis, and 1,500 to 2,500/3,000 pairs of Wood Storks.
- Shift the timing of nesting in mainland colonies to more closely match preproject conditions. Specific recovery objectives would be for storks to initiate nesting no later than January in most years (as early as December in some years), and for ibis, egrets and herons to initiate nesting in February - March in most years (especially in ecotone colony locations).

- The return of major Wood Stork, Great Egret and ibis/small egrets and herons nesting colonies from the Everglades to the coastal areas and the headwaters ecotone of the mangrove estuary of Florida Bay and the Gulf of Mexico.
- The reestablishment of historical distribution patterns of Wood Stork nesting colonies in the region of mainland mangrove forests downstream from the Shark Slough and Taylor Slough basins. Increase the proportion of birds that nest in the southern ridge and slough marsh-mangrove ecotone (headwaters) to greater than 50% of the total for the entire Everglades basin.
- For storks, an annual reproductive productivity for all colonies combined of greater than 1.5 chicks per active nest
- An increase in the return, frequency, and size of wading bird super colonies consisting primarily of White Ibis in response to interannual variation in rainfall in the tributary headwaters of Shark River Slough and other Gulf of Mexico mangrove estuaries at a frequency of 1 to 2 events per decade.

Management options that may be chosen to improve performance and assess the role of hydrology and ecology for wading bird restoration: Feedback to CEPP management will include providing information that can inform project decisions such as timing of delivering water, or routing water through an area slightly differently than originally specified. Adaptive management options would be considered if 3-year moving averages of nesting success were not showing an increase or if after 3 years there is not an overall gain in foraging conditions throughout the project. Suggested adaptive management options listed below are not in any particular order and can be implemented simultaneously, as appropriate. Options that may be considered for a future increment of CERP are suggested in the management options matrix.

- Concurrent or series testing of vegetation management options (e.g., fire, harvesting, herbicide, physical stress) downstream of the NW-WCA 3A HRF and the 67A conveyance features to create preferential flow paths.
- Increase operational flexibility to maximize flow velocities in the Blue Shanty flowway including; 1) hydrological pulsing, 2) Implement rest of L-67A conveyance features to test additional flow as described in the CEPP Plan, 3) Vegetation management or clearing.
- Incremental increases in flows through WCA 3B to recreate historic slough paths.
- Adjust operations along the northern boundary of WCA 3A by redistributing water into the S8.

D.4.2.8 WCA 3B Structures and Blue Shanty Flowway

CEPP Adaptive Management Uncertainty #77: Will the full suite of CEPP recommended plan structures be required in WCA 3B to create the Blue Shanty Flowway? (Driver or type: Structural; informing CEPP implementation)

This CEPP Adaptive Management Uncertainty is related to all of the CEPP restoration objectives, and the constraint of maintaining level of service for flood protection and maintaining the resources of WCA 3B. The region is WCA 3B, LEC seepage management, NE SRS. The associated CEPP and non-CEPP features include the L-67A gated structures and associated L-67C gaps, S-333, S-355s, S-356, L-29.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? At times adaptive management plans can support conflict resolution by providing a plan to collect reliable data to answer outstanding questions. The strategy proposed here will inform discussions of:

1. whether three gated structures proposed in the recommended plan for the L-67A are needed to meet sheetflow, hydroperiod, flow directionality, and flow velocity goals;
2. the effects of additional flow in WCA 3B on the resources in WCA 3B, e.g., tree islands, sawgrass communities, biogeochemistry that shapes the system;
3. the direction of flow and extent of seepage when additional water enters WCA 3B through an L-67A gated structure to confirm or refute the need for the proposed Blue Shanty Levee to direct water south across the degraded portion of the L-29 Levee and under the Tamiami Trail Next Steps Bridge toward Shark River Slough, and maintain level of service for LEC flood risk management.

If restoration objectives and constraints can be accomplished with fewer structures than proposed in the recommended plan then CEPP may experience cost savings and alleviate the need to construct additional features.

Expectations and hypotheses to be tested, and attributes that will be measured to test each.

A. **Hypothesis A -** Fewer than three gated structures in L-67A may provide sufficient flow through WCA 3B to meet *interim* hydrological targets set during CEPP's planning for this area (not full CERP restoration flow targets, as described in PIR **Section E.3.4 Evaluation Criteria for Storage and Treatment Options**), which will preserve and restore tree islands and promote restoration of ridge and slough habitat in WCA 3B. Attributes to monitor when one L-67A gated structure has been installed: water depths, flow direction, flow velocity, hydroperiods, tree island vegetation, ridge vegetation, and slough floc transport in WCA 3B. More detail about monitoring tree islands and ridge and sloughs is provided in the adaptive management strategies specific to these topics.
B. **Hypothesis B -** CEPP planning models showed flow and seepage moving eastward perpendicular to historic flow patterns and current landscape features when additional water was provided through the proposed L-67A gated structures, which supported the need for the Blue Shanty Levee in the recommended plan. This adaptive management strategy will investigate whether water may move south to the S-355 outlet structures on the L-29 Levee and under the MWD and Tamiami Trail Next Steps Tamiami Trail Bridges, rather than east towards the L-30 Canal, to potentially alleviate the need for the Blue Shanty Levee. Removal of the Blue Shanty Levee from the recommended plan would require extensive engineering review and potential adjustments to the L-67C degrade in the recommended plan. The function and integrity of the C&SF flood protection system provided by the L-67 A and L-67 C levee system must be maintained following CEPP implementation, and CEPP degradation of portions of the L-67 C and L-29 levees must be offset with additional infrastructure and operational constraints that maintain the pre-project level of flood protection and account for any potential increased design risk. Attributes to monitor in addition to those listed above: pump operations related to managing WCA 3B seepage, water flow directionality from gated structures; water depth and flow volumes from WCA 3B to northeast Shark River Slough; and water depth east of the L-30 in Dade-Pennsuco Wetlands.

More Information on Attributes to be measured. For each attribute, specify the following.

- **What is expected to be learned by measuring this attribute, i.e., how will CEPP benefit from knowledge gained about this attribute?** See the Ridge and Slough CEPP adaptive management strategy for more information on several of these attributes, and others related to vegetation change.

- Water depths – need to monitor water depths to ensure that they are not too deep for conservation of WCA 3B resources. WCA 3B has experienced peat and soil loss since the C&SF canal system was installed and therefore returning the area too quickly to pre-drainage water depths is not feasible. Interim hydrologic targets were determined during CEPP planning and can guide the expectations for this attribute and are described in described in CEPP PIR **Section E.3.4 Evaluation Criteria for Storage and Treatment Options.** In addition, the following targets were provided by the FWC and will be considered: If in any year, depths in WCA3B exceed 8.5' stage at site 7-1 for more than 59 days, monitoring of tree island health should be initiated. If significant stress to trees is detected measures should be taken when possible to achieve more favorable conditions during the following water year to reduce stress on tree islands in WCA3B. If average water levels at the 62 and 63 gauges increase above 11.6', actions should be taken when possible to reduce levels as soon as possible to avoid unintended effects on WCA 3B resources.:
- Flow direction – Ideally most of the water added by CEPP to WCA 3B will flow south to Shark River Slough, which was the historic flow path in the recent centuries before drainage. Monitoring flow direction in WCA 3B will establish whether additional structures and operational refinements are needed to guide the water south. At the time of writing this adaptive management strategy it was suggested that flow directions moving 30 degrees east or more from historical flow patterns could impact restoration success; this estimate may be adjusted based on information gained from the Decomp Physical Model or other relevant sources.
- Flow velocity – Velocity of ~2.5 cm/sec for ~4 weeks per year should be sufficient, combined with supporting water depths and hydroperiods, to entrain sediments in the flow and thereby scour sloughs while building ridges. Monitoring flow velocity will indicate whether CEPP structures and operations are meeting the velocity requirement.
- Hydroperiods – The Everglades naturally vary between wetter and dryer times; monitoring WCA 3B hydroperiods will confirm that CEPP structures and operations provide the needed rotation of wetter and dryer times. Interim hydroperiod targets were set during CEPP planning and can guide the expectations for this attribute and are described in described in CEPP PIR **Section E.3.4 Evaluation Criteria for Storage and Treatment Options**. In addition, tree island ecologists have provided this guideline based on data collected in the Everglades:
    - <u>Multiple Years of Inundation</u>: It takes 3-5 years of sequential inundation of more than 120 days/yr for a WCA-3B tree island to lose more than 50% of its plant community.
- Operations related to managing WCA 3B seepage; and flow volumes from WCA 3B to northeast Shark River Slough – If the S-355 spillways sufficiently move water out of WCA 3B, the S-356 pump station can be effectively managed to prevent unintended water depths and head increases along the L-30 and L-31N Canals, and the water can be delivered to northeast Shark River Slough, it may be feasible to complete the CEPP Blue Shanty flowway through the southern end of WCA 3B, as described in the recommended plan, without constructing the Blue Shanty Levee. Prior to implementation of the CEPP partial degrade of the western L-29 Levee (proposed sequencing after the completion of the Blue Shanty Levee), operation of the S355s will be needed for this effort, although these structures do not have an operational permit at the time of writing this strategy. It is noted that there would be significant challenges

associated with creating a flowway without the levee, such as the reduced ability to control hydroperiods and stages in the portion of WCA 3B that would otherwise be east of the new levee. The potential to overdrain the eastern side of WCA 3B, to have unintended effects on seepage into the LEC, or other inadvertent hydrological effects of creating a flowway without the levee would need to be thoroughly examined before making a decision to proceed.

- **What is the time frame in which changes to this attribute are expected to be measurable?**
  - Data will be needed for a minimum of 2-3 wet and dry seasons after first gated structure is installed for minimum statistical power for all of the attributes listed.
- **Is this attribute complimented by other monitoring programs (within and/or outside of CEPP)?** The data described here will compliment and be complimented by the CEPP adaptive management tree island and ridge and slough strategies, the CEPP Ecological Monitoring Plan, the CEPP Hydrometeorological Monitoring Plan, the RECOVER MAP, and Loxahatchee Impoundment Landscape Assessment (LILA) monitoring, and the Decomp Physical Model. It may also be complimented by agency monitoring such as Fish and Wildlife Commission, South Florida Water Management District, and Broward and Miami-Dade County monitoring programs.
- **When during CEPP's life cycle should this monitoring begin and end?** If baseline data cannot be determined from existing programs for the attributes listed, baseline monitoring should begin 2-3 years before the first gated structure is installed in the L-67A. After constructing the north L-67A structure and associated L-67C gap, the monitoring should continue until 2-3 wet and dry seasons of data have been collected to determine the results of the first gated structure. The results will inform decision makers about the need for additional structures. If structures are then constructed, it may be desired to continue the monitoring to make sure that restoration objectives are being met while constraint limits are avoided. The number of years of this monitoring may be determined by how confident parties are in the effects of the additional structures, i.e., remaining uncertainty may be resolved with commensurate monitoring.

Methodology for testing each expectation or hypothesis. Methods are partially described in the CEPP adaptive management tree island and ridge and slough strategies; more detailed methods will be determined in coordination with CEPP PED and design phases.

How results will be reported, and the triggers/thresholds that indicate good CEPP performance or need for adaptive management action. The triggers/thresholds will be based on the input provided by CERP agencies and scientists, and the hydrologic targets developed during CEPP planning described in CEPP PIR **Section E.3.4 Evaluation Criteria for Storage and Treatment Options**, which do *not* call for full-restoration hydrological stages or hydroperiods due to the present ecological condition of WCA 3B.

Management options that may be chosen based on results. The options are not mutually exclusive. Additional options may be developed as knowledge is gained during CEPP design and during the testing.

- Implementation schedule for CEPP may be adjusted, if needed, to provide time for data collection after first L-67A gates structure is operational.
- If initial gated structure flows are acceptable then proceed with discussing with the PDT options for creating a flowway in southern WCA 3B without the Blue Shanty Levee. This may be accomplished by adding another gated structure in the L-67A, potentially gapping L-67C rather than removing a portion of it (to maintain levee system function and integrity), and using the CEPP recommended plan partial degrade of the L-29 Levee to create the flowway while

maintaining flood risk management. Note the potential issues described above that could be associated with not constructing the levee.

- Determine whether filling agricultural ditches in the flowway is needed to improve southerly flow conveyance to the L-29 Canal and to move water through Tamiami Trail Bridges. Filling the ditches may be considered a future increment of CERP.

Table D.1.5: Greater Everglades Management Options Matrix – Northern Water Conservation Area 3A. See caption for Table D.1.3 for further explanation.

Uncertainty ID	Time until changes are measurable*	Indicator or Attribute	Specific property to be Monitored	Decision Criteria: Confirmation of CEPP Performance or Trigger(s) for Management Action	Management Action Options
73, 5	3 years	• Weather • Hydrology	• Rainfall • Flow Direction and Volume • Flow Velocity • Hydroperiod	• Flow directionality improvement from current west to east flow back to north to south historic flow direction • Long-term average annual flow increase into northern Water Conservation Area 3 of 210,000 acre-ft • Hydroperiod targets based on CEPP planning targets and agency input • Pulsed velocities reaching 2.5 cm/second or greater downstream of HRF for 4 weeks or more total during average and wet rainfall years	• Adjust operations along the northern boundary of WCA 3A by redistributing water into the S8. **Potential considerations for future CERP and non-CERP restoration projects:** Gap half of the C-11 extension spoil mounds; leave remaining in place to compare slough restoration rates; Retrofit the S-336G to the L-6 Diversion to deliver more water to the HRF.
5, 73	3 -10 years	• Soil Oxidation • Peat Accretion • Fire Frequency	• Soil Moisture Content • Peat Accretion • Fire Mapping • Radiometric Dating • Soil Decomposition	• Statistically significant increase soil moisture content • Organic soil content increase • Sediment elevation increase in ridges and tree islands • Statistically significant decrease in fire frequency	
73,76	3-10 years	• Biogeochem-istry	• Water Quality • Soil Dynamics • Periphyton	• Nutrient accumulation rates no greater than baseline in sawgrass plain areas and sloughs • Nutrient concentration increases in ridges and/or tree islands compared to marsh • No statistically significant nutrient increase in periphyton biomass, nor decrease in periphyton diversity • Sediment floc mobilization in sloughs	• Adjust operations along the northern boundary of WCA-3A by redistributing water into the S8. • Improve A-1 and A-2 FEB operations to increase water quantity while decrease nutrients loads. • Concurrent or series testing of vegetation management options (e.g., fire, harvesting, herbicide, physical stress) downstream of the NW-WCA 3A HRF **Potential considerations for future CERP and non-CERP restoration projects:** Fill, plug, or gap ditches and agricultural canals; spoil mound removal and vegetation clearing; backfill Blue Shanty North-South canal; adjust operations along the northern boundary of WCA 3A by redistributing water into the S8 or into a new HRF east of the Miami Canal; retrofit the S-336G to the L-6 Diversion to deliver more water to the HRF.
73, 76	5-20 years	• Ridge and Slough and Tree Islands	• Vegetation Community Structure – Vegetation Mapping • Ridge and Slough Structure, Bimodality • Tree Island Formation	• No increase in area expansion and density of cattail • Vegetation transition in Northwest WCA from woody herbaceous vegetation to sawgrass on ridges and water lily in sloughs • Ridge and slough spatial patterning beginning to form landscape • Measurable differences in biomodality of ridges and sloughs between CEPP treated and control sites.	
9	3-5 years	• Aquatic fauna	• Crayfish and Small Fish Density • Large Fish Density	• Increased crayfish, small and large fish densities, following improved hydroperiods	
10	4-6 years	• Alligator	• Relative density • Body condition	• Decreased variability in alligator body condition • Increased relative density of alligators	
75	4-6 years	• Wading Birds	• Foraging conditions • Nesting timing, success, and area	• Increased foraging conditions (concentration of aquatic fauna [prey]) in central WCA 3A (20% increased area over baseline conditions) • Shift in timing of nesting to November/December • Decreased wood stork nesting in WCA 3A (move to SRS)	
73, 76, 77	3-5 years	• Terrestrial mammals	• Species Diversity • Deer Abundance	• No change in upland species diversity in Northeast WCA 3A • No change or increases in deer abundance in Northeast WCA 3A	• Adjust operations of HRF feature to improve stages in Northeast WCA 3A for upland species.

***The "timeframe to detect changes..." does not imply that changes will be complete in that timeframe; rather, they provide an estimate of time needed to begin to be able to distinguish effects of CEPP. These time frames are indications of response speeds, not limits on how long the monitoring will be conducted.**

Table D.1.6: Greater Everglades Management Options Matrix – Water Conservation Area 3B and Blue Shanty Flow Way. See caption for Table D.1.3 for further explanation.

Uncertainty ID	Time until changes are measurable*	Indicator or Attribute	Specific property to be Monitored	Decision Criteria: Trigger(s) for Management Acton	Management Action Options
5, 73, 77	3 years	• Weather • Hydrology	• Rainfall • Flow Direction and Volume • Flow Velocity • Hydroperiod	• Flow directionality improvement from current west to east flow back to north to south historic flow direction • Decrease by 160 days on average that water depth goes below ground primarily in Blue Shanty Flowway • Measured flow increase east of Blue Shanty Flowway without significant water depth increase in average and dry years • Pulsed velocities reaching 2.5 cm/second or greater downstream of L-67 structures for 4 weeks or more total during average and wet rainfall years	• Adjust CEPP implementation schedule to allow time to measure flow into WCA 3B as described in the text for #77, then consider options for increasing flow through WCA 3B: o implementation of additional L-67A conveyance structures described in the CEPP Plan o gapping L-67C instead of full removal o Consider need for Blue Shanty Levee • Concurrent or series testing of vegetation management options (e.g., fire, harvesting, herbicide, physical stress) downstream of the L-67A conveyance features to restore preferential flow paths • Increase operational flexibility to maximize flow velocities in the Blue Shanty flowway including; 1) hydrological pulsing, 2) implement rest of L-67A conveyance features to test additional flow as described in CEPP Plan, 3) vegetation management or clearing • Provide incremental increases in flows through WCA 3B to restore sloughs **Potential considerations for future CERP and non-CERP restoration projects:** Expansion of collector canal 0.4 miles to connect to existing agricultural ditch for improved conveyance using 355B structure; fill, plug, or gap ditches and agricultural canals; spoil mound removal and vegetation clearing; backfill Blue Shanty North-South canal.
5, 73, 77	3 -10 years	• Soil Oxidation • Peat Accretion • Fire Frequency	• Soil Moisture Content • Peat Accretion • Fire Mapping • Radiometric Dating • Soil Decomposition	• Statistically significant increase soil moisture content • Organic soil content increase and soil bulk density • Sediment elevation increase in ridges and tree islands • No peat fires west of Blue Shanty and 20% decrease in peat fire frequency east of blue shanty	• Increase operational flexibility to minimize frequency of muck fires in areas where organic soils experience extreme dry conditions. • Incremental increases to WCA-3B hydroperiods to increase soil moisture and diminish fire events to create more resilient environment and increase peat elevations.
73,76	3-10 years	• Biogeochemistry	• Water Quality • Soil Dynamics • Periphyton	• Nutrient pore water accumulation rates no greater than baseline in sawgrass plain areas and sloughs • Nutrient concentration increases in ridges and/or tree islands compared to marsh • No statistically significant TP increase in periphyton biomass, nor decrease in periphyton diversity • Increased sediment floc mobilization in sloughs	• Adjust operations to minimize nutrient load from canals vs. marsh water entering WCA 3B
73, 76	5-20 years	• Ridge and Slough and Tree Islands	• Vegetation Community Structure – Vegetation Mapping • Ridge and Slough Structure, Bimodality • Tree Island Formation	• No increase in area expansion and density of cattail • Sawgrass meadows will transition to sawgrass ridges and water lily sloughs, while maintaining tree islands • Measurable differences in bi-modality of ridges and sloughs between CEPP treated and control sites. • Tree island species diversity will be maintained • Increased in woody vegetation seedling recruitment on tree island heads • Increased density of herbaceous species, in lower elevation tree island tails	• Create moat-like sloughs around tree islands using vegetation management options (e.g., fire, harvesting, herbicide, physical stress). • Increase operational flexibility to maximize flow velocities in the Blue Shanty flowway including; 1) hydrological pulsing, 2) implement rest of L-67A conveyance features to test additional flow as described in CEPP Plan, 3) vegetation management or clearing • Incremental increases to WCA 3B hydroperiods to increase elevations and create more resilient tree islands west and east of the Blue Shanty Levee
9	3-5 years	• Aquatic fauna	• Crayfish and Small Fish Density • Large Fish Density	• Increased crayfish, small and large fish densities, following improved hydroperiods	• Incremental increases in flows through WCA-3B to restore sloughs. • Concurrent or series testing of vegetation management options (e.g., fire, harvesting, herbicide, physical stress) downstream L- 67A conveyance features to restore preferential flow paths. • Increase operational flexibility to maximize flow velocities in the Blue Shanty flowway including; 1) hydrological pulsing, 2) implement rest of L-67A conveyance features to test additional flow as described in CEPP Plan, 3) vegetation management or clearing
10	4-6 years	• Alligator	• Relative density • Body condition	• Decreased variability in alligator body condition • Increased relative density of alligators	

***The "timeframe to detect changes…" does not imply that changes will be complete in that timeframe; rather, they provide an estimate of time needed to begin to be able to distinguish effects of CEPP. These time frames are indications of response speeds, not limits on how long the monitoring will be conducted.**

Table D.1.7: Greater Everglades Management Options Matrix – Shark River Slough. See caption for Table D.1.3 for further explanation.

Uncertainty ID	Time until changes are measurable*	Indicator or Attribute	Specific property to be Monitored	Decision Criteria: Trigger(s) for Management Acton	Management Action Options
73, 5	3 years	• Weather • Hydrology	• Rainfall • Flow Direction and Volume • Flow Velocity • Hydroperiod	• Decrease by 210 days on average that water depth goes below ground primarily in Northeast Shark River Slough • Measured flow increase reaching 2.5 cm/second or greater south of Tamiami Trail Bridge structures into Shark River Slough for 4 weeks or more total during average and wet rainfall years	• Increase operational flexibility to maximize flow velocities South of Tamiami Trail structures in combination with South-Dade Conveyance operations and seepage management features: ○ L-67 A conveyance through flow way into Shark River Slough ○ S-333 conveyance ○ S-355 and S356 structure operations • Remove L67 extension levee and old Tamiami Trail as described in the Recommended Plan, but in phases that allow for analysis of effects if needed: ○ Begin with 1.5 miles of L-67 extension levee, associated canal, and adjacent section of old Tamiami trail, and/or ○ Remove most or all of L-67 extension levee and do not fill canal, and/or ○ Remove rest of L-67 extension levee and backfill canal
5, 73	3 -10 years	• Soil Oxidation • Peat Accretion • Fire Frequency	• Soil Moisture Content • Peat Accretion • Fire Mapping • Radiometric Dating • Soil Decomposition	• Statistically significant increase soil moisture content • Organic soil content increase and soil bulk density • Sediment elevation increase in ridges and tree islands • Fire frequency will not change in Rocky Glades, while peat fire frequency in northeast Shark River Slough will decrease by 20%	
73,76	3-10 years	• Biogeochemistry	• Water Quality • Soil Dynamics • Periphyton	• Nutrient pore water accumulation rates no greater than baseline in sawgrass plain areas and sloughs • Nutrient concentration increases in ridges and/or tree islands compared to marsh • No statistically significant TP increase in periphyton biomass, nor decrease in periphyton diversity • Increased sediment floc mobilization in sloughs	
73, 76	5-20 years	• Ridge and Slough and Tree Islands	• Vegetation Community Structure – Vegetation Mapping • Ridge and Slough Structure, Bimodality • Tree Island Formation	• No increase in area expansion and density of cattail • Measurable differences in bi-modality of ridges and sloughs between CEPP treated and control sites. • Expansion of ridge and slough along edges of shark river slough • Tree island species diversity will be maintained • Trend of tree island loss will decrease from 10% per decade on average to 0% • Increased in woody vegetation seedling recruitment on tree island heads • Increased density of herbaceous species, in lower elevation tree island tails	
9	3-5 years	• Aquatic fauna	• Crayfish and Small Fish Density • Large Fish Density	• Increased crayfish, small and large fish densities, following improved hydroperiods	
10	4-6 years	• Alligator	• Relative density • Body condition	• Decreased variability in alligator body condition • Increased relative density of alligators	
75	4-6 years	• Wading Birds	• Foraging conditions • Nesting timing, success, and area	• Increase in foraging condition area within short hydroperiod wetlands along flanks of SRS • Shift in timing of nest initiation to November/December • Increased Wood Storks and Roseate Spoonbills nesting success in southern Everglades due to earlier fledging dates and decreased nest abandonment and predation. • 20% increase over baseline of foraging conditions in short hydroperiod wetlands.	

***The "timeframe to detect changes…" does not imply that changes will be complete in that timeframe; rather, they provide an estimate of time needed to begin to be able to distinguish effects of CEPP. These time frames are indications of response speeds, not limits on how long the monitoring will be conducted.**

D.4.3 Southern Coastal Systems Strategies and Management Options

Historically, freshwater flowed as sheetflow south from Lake Okeechobee, through the Everglades to the southern estuaries (e.g. Florida Bay, Lower Southwest Coast, and Biscayne Bay). Water management activities such as construction of canals to serve as surface water conveyance and flood control and protection as well conversion of historic wetlands to agriculture or urban land uses over the past several decades have altered the magnitude, distribution, and timing of the historic sheetflow conditions throughout the Everglades landscape (Ogden, 2005). The changes to surface water in combination with changes in ground water volumes has altered the timing and distribution through the southern sloughs (Taylor and Shark River) which lead to estuaries located along the south Florida coastline (i.e. Lower Southwest Coast to Biscayne Bay). This change in timing and distribution has resulted in a shift from the historic mesohaline conditions to hypersaline conditions in several near shore estuarine areas. As a result of changing salinity conditions coastal wetlands and the "White" zone have shifted landward as the interface of the fresh and saline conditions has retracted. The transitional areas of the southern coastal wetlands of Florida Bay, the Lower Southwest Coast, and Biscayne Bay and the estuaries themselves, constitute some of the most ecologically productive areas in Florida, supporting a portion of Florida's tourism and fishing industry as well as being considered aesthetically amongst the most beautiful areas in Florida. The CEPP-specific questions below focus on the effects of additional fresh water and changes to the timing and distribution from CEPP to the coastal wetland and estuarine plant and animal species that represent the health of the southern end of the Everglades system.

As noted above, adaptive management will be reiterated in the coming phases of CEPP, and the Adaptive Management Plan will be revisited. At such time, more baseline data and lessons learned will be available from other monitoring programs and restoration projects. Given the new knowledge, key questions and adaptive management options proposed in this Plan may need refinement. Therefore, items included in this plan are not guaranteed to be included or funded as-is, but will be considered again when CEPP is closer to being implemented.

D.4.3.1 Avoiding Legacy Nutrients in Everglades Soils

The availability of legacy nutrients in Everglades soils, their subsequent movement through the system, and the ecological effects is dependent on a better understanding where the potential sources of nutrients are spatially distributed and their biogeochemical availability. Studies are needed prior to the completion of construction and operation of CEPP features to: 1) determine the location of legacy sources of nutrients that could be directly affected by CEPP water deliveries. Specific areas of concern include: downstream of S-12D and S-333, the L-67A and L-67C Canals, the Blue Shanty flow-way, Taylor Slough bridge, ENP lakes, and select coastal creeks into Florida Bay and the Lower Southwest coast; 2) understand the biogeochemical processes in ENP that affect the release of nutrients from the soils, and; 3) concentrations of mobilized nutrients and their downstream movement.

CEPP Uncertainty #63: Will there be downstream biogeochemical effects due to existing (legacy) conditions associated with modifying inflows and hydrologic conditions in ENP, including effects on nutrient movement, availability, and ecological responses? This includes consideration of hydrologic effects on nutrient loading, nutrient release from soils, transport, and water-quality related ecological indicators, such as periphyton tissue nutrients, cattail expansion, and algal bloom events, especially in eastern Florida Bay where nitrogen levels are relatively high?

CEPP Uncertainty #63 is focused on the effects of increased water volumes delivered past Tamiami Trail to Shark River and Taylor Sloughs on the mobilization, cycling, and transport of imported nutrients in the water column and suspension of legacy nutrients in the soils to the downstream areas of Florida Bay and the Lower Southwest Coast. The primary driver for this uncertainty is hydrology and nutrients.

The associated CEPP features are:

1. The S-12 Structures, S-333, S-335, S-334, the C-67 A and L-67C canals, L-29 Divide Structure, S-356, G-211; and
2. Blue Shanty Flow Way
3. The partial seepage barrier south of Tamiami Trail along L-31N.

The implementation of the CEPP as well as other projects and operational schemes may alter the flow and locations at which these flows enter SRS. These changes may have an impact on SRS compliance with the requirements of state law and Appendix A from the 1991 Settlement Agreement. For CEPP, the three most important aspects of Appendix A compliance assessment are as follows: (1) CEPP-related increases in flow may reduce the Long Term Limit (LTL) for TP; (2) the effect of the project implementation sequence on interim TP loads and concentrations; and (3) alteration of existing SRS inflow points and the addition of new inflow points. All of these may have some effect on Appendix compliance or the sufficiency of the compliance methodology and are currently undergoing review by a subteam assigned by the Everglades Technical Oversight Committee. Assuming the water delivered by CEPP past Tamiami Trail into the Park meets the Consent Decree water quality criteria, the increased water deliveries may result in the following due to existing (legacy) conditions: 1) the mobilization and redistribution of soil and plant tissue nutrients downstream, 2) an accelerated rate of cattail distribution expansion, and 3) an increase in the frequency, spatial extent, duration, and/or magnitude of algal blooms in Florida Bay and the Lower Southwest coast.

Nutrient Changes in Periphyton and Soil Nutrients: A baseline monitoring period of 6 years for soil nutrient content (1 every 2 years, 3 sampling events total) to measure long-term nutrient trends and 3 years of quarterly periphyton tissue nutrients in areas of concern (e.g. downstream of S-12D and S-333, the Blue Shanty flow way, Taylor Slough bridge) to measure early indication of nutrient changes is recommended to adequately establish existing conditions. Monitoring of soil nutrient content every 2 years and quarterly periphyton tissue nutrients beginning with construction of the first feature and/or operational change and carried through O/M is necessary to document any changes in nutrient distribution resulting from incremental increases in deliveries past Tamiami Trail with each constructed feature.

Cattail Expansion – Cattails are an indicator of persistent nutrient issues in the Everglades and the current rate of cattail expansion south of Tamiami Trail is not known. Analyses of historic databases and/or aerial photos may be necessary to determine the current rate of cattail expansion, setting the baseline condition for CEPP. Annual vegetation transects and landscape scale aerial vegetation mapping every 5 years in areas of concern (e.g. downstream of S-12D, the Blue Shanty flow way, Taylor Slough bridge) beginning with construction of the first feature and/or operational change and carried through O/M is necessary to document any changes to the vegetation distribution resulting from incremental increase in deliveries past Tamiami Trail with each constructed feature. The CEPP Invasive and Nuisance Species Management Plan (INSMP) acknowledges that cattail expansion may occur in the footprint of CEPP but does not investigate whether such expansion, should it happen, results from legacy nutrients in the ecosystem. If cattails expand, they may indicate a mobilization of legacy nutrients in the ecosystem and would trigger a potential need to change the timing and distribution of

CEPP's water in this area as described in the SCS management options below. In addition, the information will help the project team determine whether to dedicate resources to controlling the spread of the cattail, which would include consideration of whether project benefits are being impacted.

Coastal Creek Nutrient Loading Rates - Nutrient loading rates through coastal creeks into Florida Bay are well documented. Additional nutrient information is needed at existing Lower Southwest coastal creek flow monitoring stations to complete calculations of nutrient loading rates. A baseline monitoring period of 3 years of monthly monitoring of various water quality parameters (e.g. chlorophyll a, TP, TN) in Florida Bay, the Lower Southwest coastal estuaries and creeks is recommended to adequately establish existing conditions. To track post construction impacts on Florida Bay and Southwest coastal estuaries and creeks, as part of this adaptive management strategy monthly monitoring of various water quality parameters (e.g. chlorophyll a, TP, TN) should begin during early CEPP construction and/or operational change and continue for up to 10 years.

Water quality, soil nutrients, and ecological attributes have been selected to measure the effects of CEPP hydrologic modifications to the volume of freshwater delivery south of Tamiami Trail on the biogeochemistry of Shark River and Taylor Slough and the fate (both spatially and ecologically) of the nutrients that may be released from the soil legacy nutrient pool. The potentially affected region is bounded by Tamiami Trail to the north, L-31N and the C-111 canals to the east, and extends into the estuarine areas of Florida Bay and the Lower Southwest Coast. These attributes were selected based on existing knowledge of 1) surface/groundwater connectivity in Shark River and Taylor Sloughs and adjacent estuaries; 2) biogeochemical processes in Shark River and Taylor Sloughs; 3)potential to transport of nutrients and other materials through the region; and 4) known algal bloom dynamics in Florida Bay and the Lower Southwest Coast. Many of the attributes listed are currently monitored by other agencies or USACE projects and may provide, in part, input to the testing of this uncertainty's hypothesis. It is anticipated additional monitoring will be necessary for the Project, to be determined during Design. Costs for the additional monitoring have been included in the Monitoring Cost Table. The timeframe in which the attributes listed below will be able to measure changes as function of the Project range from a minimum of 2 months (periphyton and estuarine surface water quality) to a maximum of 5 years (soil nutrients). Estimated timeframes to begin perceiving changes are listed below in parentheses.

The attributes to be measured and time needed to begin perceiving changes are the following (these time frames are indications of speed of response, not limits on the monitoring to be conducted):

1. Periphyton (2 months)
2. Estuarine Surface Water Quality (2 months)
3. Cattail (2 years)
4. Soil Nutrients (5 years)

The full restoration target for each attribute listed above can be found in the following CERP Performance Measures:

1. RECOVER PM Greater Everglades Wetlands TP Concentrations in Surface Water
2. RECOVER PM Greater Everglades Wetlands Nutrient TN Concentrations in Surface Water
3. RECOVER PM Total Phosphorus Concentrations in Soil
4. RECOVER PM Wetland Trophic Relationships – Periphyton
5. RECOVER PM Southern Coastal Systems Water Quality

The CEPP restoration target for each attribute is listed below. These targets are based on the best professional judgment of scientists familiar with the region. Data analyses of existing conditions as referenced below may be found in the CERP RECOVER System Status Reports. Additional data analyses may need to be performed prior to any CEPP construction or operational change to determine existing conditions from pre-construction collected monitoring information.

- Increased flow will not alter current periphyton system-wide indicator report status
- Additional flows will not result in an increase in algal bloom events (frequency, spatial extent, duration, and/or magnitude) in Florida Bay and Lower Southwest coast relative to current conditions
- No acceleration in cattail distribution expansion rate relative to current conditions
- No alteration of current spatial distribution of soil and vegetation nutrient pools relative current conditions

The thresholds for the implementation of adaptive management measures for the region are listed below and constitute working hypotheses to be tested under the CEPP AM plan. Exceedence of any of the listed thresholds indicates need to consider the adaptive management measures suggested next. These threshold limits are based on the best professional judgment of scientists familiar with the region. Data analyses of existing conditions as referenced below may be found in the CERP RECOVER System Status Reports. Additional data analyses may need to be performed prior to CEPP construction or operational changes to determine existing conditions from pre-construction collected monitoring information.

- Increased frequency of yellow and/or red conditions for the periphyton nutrient content or algal bloom system-wide indicator report
- Increased rate of cattail expansion above current rate
- Movement of spatial nutrient front or increase in nutrient rate of release from soils as observed along soil and/or vegetation transect from existing conditions.

Suggested Adaptive Management Options listed below are not in any particular order and can be implemented simultaneously, as appropriate.

1. Spatial redistribution of water into less sensitive areas
2. Reduce point source discharges (e.g., S12A, S12B, S12C, S12D) and shift more water to the Blue-Shanty flowway
3. Redistribution of water to more closely match historic timing of flows to the coastal wetlands and estuaries
4. Refinement of existing hydrologic and hydrodynamic models in the southern coastal wetlands, Florida Bay, and the Lower Southwest Coast to increase ability to forecast effects of water management decisions
5. Cattail management/removal

D.4.3.2 Freshwater Flow and Florida Bay Salinity

CEPP Uncertainty #61
Will increased flows to northeastern Shark River Slough yield natural distribution of waters toward the southeastern Everglades (Taylor Slough and lower C-111 basin) and northeast Florida Bay without operation of the SFWMD Canal System east of the L30, L31-N, and L31-W?

CEPP Uncertainty #67
Will CEPP improve flows to Florida Bay and the Lower Southwest coast resulting in more natural salinity patterns (magnitude, spatial distribution and timing)? Will results be consistent with the expectations from the CEPP scenario model predictions?

CEPP Objective or Constraint:
Uncertainty #61 and 67 are related to the following CEPP objectives:

- Restore seasonal hydroperiods and freshwater distribution to support a natural mosaic of wetland and upland habitat in the Everglades System;
- Improve sheetflow patterns and surface water depths and durations in the Everglades system in order to reduce soil subsidence, the frequency of damaging peat fires, the decline of tree islands, and salt water intrusion;
- Reduce water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization; and
- Restore more natural water level responses to rainfall to promote plant and animal diversity and habitat function

Region(s).
CEPP Uncertainties #61 and 67 are focused on the connection between flows to Florida Bay improving salinities and the flexibility of CEPP and SFWMD Canal System water management operations to deliver waters to the region below Tamiami Trail (Shark and Taylor Sloughs, Florida Bay, and the Lower Southwest Coast) in a spatially and temporally balanced manner for the greatest amount of overall ecological restoration.

- **Associated CEPP features:** The L-30, L-31N, L-31W, C-111, Lower East Coast Service Area (LECSA) 2 & 3 SFWMD Canal System;
- The S-12 Structures, S-356, G-211, divide and coastal water management structures of the LECSA 2 & 3 SFWMD Canal System
- Blue Shanty Flow Way; and
- The partial seepage barrier south of Tamiami Trail along L-31N.

Driver or uncertainty type. The primary driver for this uncertainty is hydrology.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? Constructed features of CEPP are designed to yield a more natural distribution of water towards the southeastern Everglades and northeast Florida Bay. The CEPP operational plan focuses primarily on operational changes to the S-356 pump station and G-211 structure to actively move water to the west of the L-31N to compensate for seepage concerns along the L-31N and requires the integration of operations of the LECSA 2 & 3 SFWMD Canal System to achieve the predicted salinity regimes in at the Little Madeira Bay, Joe Bay, Trout Cove, Long Sound, Little Blackwater Sound, and

Barnes Sound Marine Monitoring Network stations. Operations of the LECSA 2 & 3 SFWMD Canal System can affect the flows in Taylor Slough and the lower C-111 basin and subsequently, salinities in Little Madeira Bay, Joe Bay, Trout Cove, Long Sound, Little Blackwater Sound, and Barnes Sound Marine Monitoring Network stations.

CEPP water deliveries south of Tamiami Trail are predicted to improve flows to Florida Bay and the Lower Southwest coast resulting in a more natural salinity pattern (magnitude, spatial distribution and timing). CEPP and LECSA 2 & 3 SFWMD Canal System operations and constructed features will result in: 1) a more natural flow distribution, 2) a more natural timing regime and 3) a greater magnitude of flows to Florida Bay and the lower Southwest coast.

Expectations or hypotheses to be tested to address uncertainty #, and attribute(s) that will be measured to test each.

More Information on attributes to be measured:

- ***What is expected to be learned by measuring this attribute, i.e., how will CEPP benefit from knowledge gained about this attribute?***
- ***What is the time frame in which changes to this attribute are expected to be measurable?***
- ***Is this attribute complimented by other monitoring programs (within and/or outside of CEPP)? If so, provide reference to other monitoring and make sure that monitoring paid for by others is noted in the CEPP adaptive management budget spreadsheet.***
- ***When during CEPP's life cycle should this monitoring begin and end?***

Hydrologic and water quality attributes are selected to measure the effects of CEPP operational modifications to the quantity, timing, and distribution of freshwater delivery in the region south of Tamiami Trail (Shark River and Taylor Sloughs, Florida Bay, and the Lower Southwest Coast). These attributes were selected based on existing knowledge of the surface/groundwater connectivity in Shark River and Taylor Sloughs and adjacent estuaries. Many of the attributes listed are currently monitored by other agencies or USACE projects and may provide, in part, input to the testing of this uncertainty's hypothesis. For example, the ENP Marine Monitoring Network (MMN) is a primary tool for evaluate salinity in Florida Bay and should be maintained to continue to inform decision makers on the progress and potential improvements needed with adaptive management. It is anticipated additional monitoring will be necessary for the Project, to be determined during Design. Costs for the additional monitoring have been included in the Monitoring Cost Table. The timeframe in which the attributes listed below will be able to measure changes as function of the Project range from a minimum of 7 days (wetland and canal/creek stage, surface and groundwater flow) to a maximum of 2 years (estuarine salinity). Estimated timeframes to begin perceiving changes are listed below in parentheses.

The attributes to be measured and time needed to begin perceiving changes are the following (these time frames are indications of speed of response, not limits on the monitoring to be conducted):

1. Estuarine Salinity (2 years)
2. Wetland and Canal/Creek Stage (7 days)
3. Surface and Groundwater Flow (7 days)

Methodology for testing each expectation or hypothesis (including frequency of monitoring) and for reporting: The expectation (hypothesis) is that CEPP will improve salinity ranges in Florida Bay, as evidenced by project alternative plan modeling. Real-time analyses of operational changes to the S-12 structures, S-333, and the LECSA 2 & 3 SFWMD Canal System and their subsequent affect on surface and ground water flows to the southern coastal creeks and salinity in Florida Bay and the Lower Southwest Coast prior to construction, during construction, and into O/M for CEPP should be pursued to provide feedback to water managers on operational decisions and their subsequent effect on the estuaries. Focus of the analyses are on the distribution, magnitude, and timing of surface and groundwater flows at water management structures, select wetland stage/flow gages, select coastal creek flow gages, and salinity at the Marine Monitoring Network stations. Preferably, refinement of the existing hydrologic and hydrodynamic models in the southern coastal wetlands, Florida Bay, and the Lower Southwest coast is necessary to better forecast the effects of operational changes prior to actual implementation and avoid irreversible negative impacts through a trial and error approach. This refined modeling analysis will help identify specific quantifiable hypotheses (CEPP performance expectations) to be confirmed with CEPP implementation

Triggers/thresholds that indicate good CEPP performance or need for adaptive management action. The restoration target triggers and baseline threshold for the implementation of adaptive management measures for the region are listed below. Non-attainment of any one of the restoration targets and/or exceedence of any one of the baseline thresholds necessitates the implementation of the adaptive management measures. These triggers and threshold are based on the best professional judgment of scientists familiar with the region, actual environmental monitoring data, modeled scenario data, and scientific research. Refinements or additions to the listed triggers and thresholds may occur in the future as new research and data are analyzed and incorporated by the PDT. Data analyses of existing conditions as referenced below may be found in the CERP RECOVER System Status Reports. Additional data analyses may need to be performed prior to any CEPP construction or operational change to determine existing conditions from pre-construction collected monitoring information.

CEPP Restoration Target Triggers:

- RECOVER Southern Coastal Systems Performance Measure: Salinity in Florida Bay (http://www.evergladesplan.org/pm/recover/recover_docs/perf_measures/062812_rec_pm_scs_salinity_flbay.pdf) metrics less than those predicted for the selected alternative (4R2) or exhibits a negative long-term trend at each of the 17 NPS Marine Monitoring Network stations in Florida Bay
- Stage/flow distribution inconsistent to those predicted for the selected alternative (4R2)

Baseline Thresholds:

- Salinity exceeds the 90th percentile of the recorded salinity values at the NPS Marine Monitoring Network in NE Florida Bay zone and near shore Florida Bay stations for the entire period of record for the equivalent rainfall years
- Violation of the Minimum Flows and Levels for Florida Bay

Management options that may be chosen based on test results. *Management Options are provided in case a performance trigger or threshold is crossed, which would indicate that CEPP performance needs to be adjusted. The Management Options are suggested paths forward and adjustments that can be made to keep CEPP progressing toward objectives and within constraints. The Management Options are summarized in 11x17 pull-out tables after each region's strategies.*

Suggested Adaptive Management Options listed below are not in any particular order and can be implemented simultaneously, as appropriate.

1. Adjustments to operations along Tamiami Trail and the LECSA 2 & 3 SFWMD Canal System to improve water deliveries to Florida Bay and the Lower Southwest Coast
1. Refinement of existing hydrologic and hydrodynamic models in the southern coastal wetlands, Florida Bay, and the Lower Southwest Coast

D.4.3.3 Sea Level Change

CEPP Uncertainty #64
Will predicted CEPP flows mitigate saltwater intrusion and associated coastal wetland vegetation, soil stability, and nutrient retention or release?

CEPP Objective or Constraint:

Uncertainty #64 is related to the following CEPP objectives:

- Restore seasonal hydroperiods and freshwater distribution to support a natural mosaic of wetland and upland habitat in the Everglades System;
- Improve sheetflow patterns and surface water depths and durations in the Everglades system in order to reduce soil subsidence, the frequency of damaging peat fires, the decline of tree islands, and salt water intrusion;
- Reduce water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization; and
- Restore more natural water level responses to rainfall to promote plant and animal diversity and habitat function

Region(s).

CEPP Uncertainty #64 is focused on the biogeochemical effects of sea level change/saltwater intrusion into the southern coastal wetlands (lower portions of Shark River and Taylor Sloughs) adjacent to Florida Bay and the Lower Southwest Coast, its potential mitigation by increased flows across Tamiami Trail, and its impact on soil stability and nutrient release to the estuaries. Unmitigated sea level change has the potential to impact Shark River and Taylor Sloughs miles inland of the current southern coastline.

Associated CEPP features: The associated CEPP features are:
1. The L-30, L-31N, C-111, LECSA 2 & 3 SFWMD Canal System canals;
2. The S-12 Structures, S-356, G-211, divide and coastal water management structures of LECSA 2 & 3 SFWMD Canal System
3. Blue Shanty Flow Way; and
4. The partial seepage barrier south of Tamiami Trail along L-31N.

Driver or uncertainty type: The primary driver for this uncertainty is hydrology.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? Sea level change and saltwater intrusion is of great concern in the southern coastal wetlands as it has the potential to negatively impact restoration success. Increased salinities in the southern coastal wetlands and their subsequent effect on the coastal vegetation community have been documented. Increased salinities in the coastal wetlands have the potential to negatively impact the soil elevation, amplifying the effects of sea level change. Flows delivered by CEPP to the southern coastal wetlands: 1) are sufficient to maintain or reverse the current spatial extent of surficial saltwater intrusion and associated mangrove and "white zone" expansion; 2) will influence plant growth and soil decomposition processes to increase rates of soil accretion, elevation increase, and minimize nutrient and material releases caused by peat collapse, mitigating the effects of sea level change and; 3) will minimize the inland extent of the groundwater salt wedge resulting in a decreased rate of internal phosphorus release to surface water and subsequent transport to the estuaries decreasing the probability of an algal bloom event , especially on eastern Fl Bay where nitrogen levels are relatively high.

Expectations or hypotheses to be tested to address uncertainty #, and attribute(s) that will be measured to test each.

More Information on attributes to be measured:

- ***What is expected to be learned by measuring this attribute, i.e., how will CEPP benefit from knowledge gained about this attribute?***
- ***What is the time frame in which changes to this attribute are expected to be measurable?***
- ***Is this attribute complimented by other monitoring programs (within and/or outside of CEPP)? If so, provide reference to other monitoring and make sure that monitoring paid for by others is noted in the CEPP adaptive management budget spreadsheet.***
- ***When during CEPP's life cycle should this monitoring begin and end?***

Water quality, soil nutrients, and ecological attributes are selected to better understand the effects of CEPP hydrologic modifications to the volume of freshwater delivery south of Tamiami Trail and saltwater intrusion on the biogeochemistry, coastal wetland vegetation dynamics, and soil accretion within the southern coastal wetlands adjacent to Florida Bay and the Lower Southwest Coast. The area of concern is the southern coastal wetlands (lower portions of Shark River and Taylor Sloughs) adjacent to Florida Bay and the Lower Southwest Coast. These attributes were selected based on existing knowledge of 1) surface/groundwater connectivity in Shark River and Taylor Sloughs and adjacent estuaries; 2) biogeochemical processes in Shark River and Taylor Sloughs; and 3) soil accretion dynamics and mechanisms. Many of the attributes listed are currently monitored by other agencies or USACE projects and may provide, in part, input to the testing of this uncertainty's hypothesis. It is anticipated additional monitoring will be necessary for the Project, to be determined during Design. Costs for the additional monitoring have been included in the Monitoring Cost Table. The timeframe in which the attributes listed below will be able to measure changes as function of the Project range from a minimum of 1 year (wetland surface and groundwater quality) to a maximum of 5 years (soil nutrients, mangrove and white zone, soil elevation). Estimated timeframes to begin perceiving changes are listed below in parentheses.

The attributes to be measured and time needed to begin perceiving changes are the following (these time frames are indications of speed of response, not limits on the monitoring to be conducted):

1. Soil Nutrients (5 years)
2. Mangrove and White Zone (5 years)
3. Soil Elevation (5 years)
4. Wetland Surface and Groundwater Salinity (1 year)

Methodology for testing each expectation or hypothesis (including frequency of monitoring) and for reporting:
More information on what to measure, how, how often, how to analyze, and when and how to report results. PLEASE NOTE: the CEPP Adaptive Management Plan varies in the level of methodology detail provided; in several cases the details will be formed after CEPP design details are known. In ALL cases, methodology will be reviewed, updated and adjusted if needed, by agency subject experts before initiation to best meet the intent of the Adaptive Management Plan.

The current rate and extent of mangrove and "white zone" expansion and surface/groundwater intrusion into the southern coastal wetlands is not known. Analyses of historic and current databases and/or aerial photos to determine the current rate and extent of mangrove and "white zone" expansion and surface/groundwater intrusion are necessary to set the baseline condition for CEPP. Annual vegetation transects, landscape scale aerial vegetation mapping every 5 years, quarterly porewater conductivity and below ground resistivity, monthly groundwater conductivity, and continuous surface water conductivity in areas of concern (e.g. Model Lands to Lostman's River) beginning with construction of the first feature and/or operational change and carried through O/M is necessary to document any changes to the vegetation distribution and the location of the surface/ground saltwater wedge resulting from incremental increase in deliveries past Tamiami Trail with each constructed feature.

Studies are needed prior to the completion of construction and operation of CEPP features to better understand the interaction of surface and groundwater conductivity on plant growth and soil decomposition processes in the southern coastal wetlands. This information is necessary to determine the rate of soil elevation change. Annual soil elevation and depth monitoring in the areas of concern (e.g. Model Lands to Lostman's River) beginning with construction of the first feature and/or operational change and carried through O/M is necessary to document any change in the rate of soil elevation resulting from incremental increase in deliveries past Tamiami Trail with each constructed feature.
Studies are needed prior to the completion of construction and operational features of CEPP to better understand the effects of the groundwater salt wedge on phosphorus release to surface waters in the southern coastal wetlands. This information is necessary to understand the extent and magnitude of the phosphorus pool. Quarterly soil phosphorus, surface and groundwater conductivity, and below ground resistivity in the areas of concern (e.g. Model Lands to Lostman's River) beginning with construction of the first feature and/or operational change and carried through O/M is necessary to document any change in the rate and extent of phosphorus mobilization resulting from incremental increase in deliveries past Tamiami Trail with each constructed feature.

Triggers/thresholds that indicate good CEPP performance or need for adaptive management action.
The restoration target triggers and baseline threshold for the implementation of adaptive management measures for the region are listed below. Non-attainment of any one of the restoration targets and/or exceedence of any one of the baseline thresholds necessitates the implementation of the adaptive management measures. These triggers and threshold are based on the best professional judgment of scientists familiar with the region, actual environmental monitoring data, modeled scenario data, and scientific research. Refinements or additions to the listed triggers and thresholds may occur in the future as new research and data are analyzed and incorporated by the PDT. Data analyses of existing conditions as referenced below may be found in the CERP RECOVER System Status Reports. Additional data analyses may need to be performed prior to any CEPP construction or operational change to determine existing conditions from pre-construction collected monitoring information.

CEPP Restoration Target Triggers:

- Alteration of current spatial distribution of soil and vegetation nutrient pools relative current conditions
- Increase in the rate of mangrove expansion in the white zone
- Increase in soil loss and/or elevation reduction
- Change in spatial extent of wetland surface water or groundwater salinity relative to two similar rainfall years from the period of record

Baseline Thresholds:

- Movement of spatial nutrient front or increase in nutrient rate of release from soils as observed along soil and/or vegetation transect

- White zone expansion rate exceeds Ross rate (3 km/50 yr west of US1, 1km/50 yr east of US1) and mangrove zone expansion rate exceeds current rate of expansion
- Increase in rate of coastal soil loss over the existing rate
- Magnitude of wetland surface or groundwater salinity exceeds equivalent rainfall conditions for the past 2 years from the period of record
- Inland movement of the saltwater wedge from current location

Management options that may be chosen based on test results.
Suggested Adaptive Management Options listed below are not in any particular order and can be implemented simultaneously, as appropriate.

1. Spatial redistribution of water into less sensitive areas
2. Reduce point source discharges (e.g., S12A, S12B, S12C, S12D) and shift more water to the Blue-Shanty flowway
3. Redistribution of water to more closely match historic timing of flows to the coastal wetlands and estuaries
4. Refinement of existing hydrologic and hydrodynamic models in the southern coastal wetlands, Florida Bay, and the Lower Southwest Coast
5. Adjustments to operations along Tamiami Trail and the LECSA 2 & 3 SFWMD Canal System to improve water deliveries to Biscayne Bay, Florida Bay, and the Lower Southwest Coast

D.4.3.4 Ecological Food Web in Southern ENP and the Southern Coastal Systems

CEPP Uncertainty #65
If salinity is affected by overland flow increases through ENP to Florida Bay, how much benefit is generated for SAV, sportfish, prey, coastal wading birds, and crocodiles? Can operations be adjusted to improve estuarine performance in Florida Bay?

CEPP Objective or Constraint:
Uncertainty #65 is related to the following CEPP objectives:

- Restore seasonal hydroperiods and freshwater distribution to support a natural mosaic of wetland and upland habitat in the Everglades System;
- Improve sheetflow patterns and surface water depths and durations in the Everglades system in order to reduce soil subsidence, the frequency of damaging peat fires, the decline of tree islands, and salt water intrusion;
- Reduce water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization; and
- Restore more natural water level responses to rainfall to promote plant and animal diversity and habitat function

Region(s). CEPP Uncertainty #65 is focused on the ecological effects of CEPP hydrology as a function of increased freshwater deliveries across Tamiami Trail to Shark River and Taylor Sloughs, Florida Bay, and the Lower Southwest Coast.

Associated CEPP features: The associated CEPP features are:
1. The L-30, L-31N, C-111, LECSA 2 & 3 SFWMD Canal System canals;
2. The S-12 Structures, S-356, G-211, divide and coastal water management structures LECSA 2 & 3 SFWMD Canal System
3. Blue Shanty Flow Way; and
4. The partial seepage barrier south of Tamiami Trail along L-31N.

Driver or uncertainty type: The primary driver for this uncertainty is hydrology.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? The primary hydrologic driver for the ecosystems in Florida Bay and the Lower Southwest Coast is salinity. CEPP is predicted to increase flows to Florida Bay and the Lower Southwest coast resulting in a positive change in the salinity regime. Ecological indicators are also predicted to result in comparable response to the salinity regime. CEPP flows to Florida Bay and the Southwest coast will result in an improved salinity regime resulting in: 1) an increase in the coverage of *Halodule* and *Ruppia* densities and community diversity in the nearshore basins and coastal wetland fringe and 2) improved status of the ecological indicators (e.g. spotted seatrout, pink shrimp, coastal wading birds, and crocodiles).

Expectations or hypotheses to be tested to address uncertainty #, and attribute(s) that will be measured to test each. More Information on attributes to be measured:
- **What is expected to be learned by measuring this attribute, i.e., how will CEPP benefit from knowledge gained about this attribute?**
- **What is the time frame in which changes to this attribute are expected to be measurable?**

- **Is this attribute complimented by other monitoring programs (within and/or outside of CEPP)? If so, provide reference to other monitoring and make sure that monitoring paid for by others is noted in the CEPP adaptive management budget spreadsheet.**
- **When during CEPP's life cycle should this monitoring begin and end?**

Hydrologic and ecologic attributes are selected to monitor the effects of CEPP hydrologic modifications to the volume of freshwater delivery south of Tamiami Trail and the associated ecological responses in Shark River and Taylor Sloughs, Florida Bay, and the Lower Southwest Coast. These attributes were selected based on existing knowledge of 1) surface/groundwater connectivity in Shark River and Taylor Sloughs and adjacent estuaries; and 2) ecological food web dynamics and mechanisms in the region. Many of the attributes listed are currently monitored by other agencies or USACE projects and may provide, in part, input to the testing of this uncertainty's hypothesis. It is anticipated additional monitoring will be necessary for the Project, to be determined during Design. Costs for the additional monitoring have been included in the Monitoring Cost Table. The timeframe in which the attributes listed below will be able to measure changes as function of the Project range from a minimum of 7 days (wetland and canal/stage, surface and groundwater flow) to a maximum of 5 years (juvenile pink shrimp and crocodiles, estuarine fish, Roseate Spoonbills). Estimated timeframes to begin perceiving changes are listed below in parentheses.

The attributes to be measured and time needed to begin perceiving changes are the following (these time frames are indications of speed of response, not limits on the monitoring to be conducted):

1. Estuarine Salinity (2 years)
2. Estuarine Submerged Aquatic Vegetation (2 years)
3. Juvenile Pink Shrimp and Associated Estuarine Epifauna (5 years)
4. Estuarine Fish (5 years)
5. Roseate Spoonbills (5 years)
6. Juvenile Crocodiles (5 years)
7. Wetland and Canal/Creek Stage (7 days)
8. Surface and Groundwater Flow (7 days)

Methodology for testing each expectation or hypothesis (including frequency of monitoring) and for reporting: *More information on what to measure, how, how often, how to analyze, and when and how to report results. PLEASE NOTE: the CEPP Adaptive Management Plan varies in the level of methodology detail provided; in several cases the details will be formed after CEPP design details are known. In ALL cases, methodology will be reviewed, updated and adjusted if needed, by agency subject experts before initiation to best meet the intent of the Adaptive Management Plan.*

Real-time analyses of operational changes to the S-12 structures, S-333, and the LECSA 2 & 3 SFWMD Canal System and their subsequent effect on surface and ground water flows to the southern coastal creeks and salinity and ecosystems in Florida Bay and the Lower Southwest Coast prior to construction, during construction, and into O/M for CEPP is necessary to provide feedback to water managers on operational decisions and their subsequent effect on the estuaries. Focus of the analyses are on the distribution, magnitude, and timing of surface and groundwater flows at water management structures, select wetland stage/flow gages, and select coastal creek flow gages; changes to salinity at the Marine Monitoring Network stations; changes in the coverage of *Halodule* and *Ruppia* densities and community diversity in the nearshore basins and coastal wetland fringe; and changes in the status of ecological indicator (e.g. seagrass, spotted seatrout, pink shrimp, coastal wading birds, and crocodiles) species in Florida Bay and the Lower Southwest Coast. Preferably, refinement to couple the existing hydrologic, hydrodynamic, and ecological models in the southern coastal wetlands, Florida Bay, and the Lower Southwest coast is necessary to better forecast the effects of operational changes on the hydrology and ecology prior to actual implementation and avoid irreversible negative impacts through a trial and error approach.

Triggers/thresholds that indicate good CEPP performance or need for adaptive management action. The restoration target triggers and baseline threshold for the implementation of adaptive management measures for the region are listed below. Non-attainment of any one of the restoration targets and/or exceedence of any one of the baseline thresholds necessitates the implementation of the adaptive management measures. These triggers and threshold are based on the best professional judgment of scientists familiar with the region, actual environmental monitoring data, modeled scenario data, and scientific research. Refinements or additions to the listed triggers and thresholds may occur in the future as new research and data are analyzed and incorporated by the PDT. Data analyses of existing conditions as referenced below may be found in the CERP RECOVER System Status Reports. Additional data analyses may need to be performed prior to any CEPP construction or operational change to determine existing conditions from pre-construction collected monitoring information.

CEPP Restoration Target Triggers:

- RECOVER Southern Coastal Systems Performance Measure: Salinity in Florida Bay (http://www.evergladesplan.org/pm/recover/recover_docs/perf_measures/062812_rec_pm_scs_salinity_flbay.pdf) metrics less than those predicted for the selected alternative (4R2) or exhibits a negative long-term trend at each of the 17 NPS Marine Monitoring Network stations in Florida Bay
- Stage/flow distribution inconsistent to those predicted for the selected alternative (4R2)
- No increase in submerged aquatic vegetation habitat diversity and coverage as predicted for the selected alternative (4R2) in Florida Bay and the Lower Southwest Coast or exhibits a negative long-term trend.
- Juvenile Spotted Seatrout, Juvenile Pink Shrimp, Juvenile Crocodile, and Roseate Spoonbill indicators are less than those predicted by each indicator's respective HSI for the selected alternative (4R2) or exhibits a negative long-term trend

Baseline Thresholds:

- 5% decrease in seagrass, mangrove fish, juvenile pink shrimp, juvenile crocodile, or Roseate Spoonbill spatial coverage and/or species specific densities from existing conditions as a function of upstream hydrologic changes.
- Salinity exceeds the 90th percentile of the recorded salinity values at the NPS Marine Monitoring Network for the NE Florida Bay and nearshore Florida Bay stations for the entire period of record for the equivalent rainfall years.
- Magnitude of wetland surface or groundwater salinity exceeds equivalent rainfall conditions for the past 2 years from the period of record
- Increased frequency of yellow and/or red conditions for the algal bloom, seagrass, juvenile pink shrimp, juvenile crocodile, or Roseate Spoonbill system-wide indicator report
- Violation of the Minimum Flows and Levels for Florida Bay

Management options that may be chosen based on test results. Suggested Adaptive Management Options listed below are not in any particular order and can be implemented simultaneously, as appropriate.

1. Spatial redistribution of water into less sensitive areas
2. Reduce point source discharges (e.g., S12A, S12B, S12C, S12D) and shift more water to the Blue-Shanty flowway
3. Redistribution of water to more closely match historic timing of flows to the coastal wetlands and estuaries
4. Refinement and coupling of existing hydrologic, hydrodynamic, and ecological models in the southern coastal wetlands, Florida Bay, and the Lower Southwest Coast
5. Adjustments to operations along Tamiami Trail and the LECSA 2 & 3 SFWMD Canal System to improve water deliveries to Biscayne Bay, Florida Bay, and the Lower Southwest Coast

D.4.4 Lower East Coast Seepage Management

D.4.4.1 CEPP Effects on LEC Water Supply and Flood Risk Management

The Lower East Coast (LEC) is primarily the area of Miami-Dade County, Florida, although it extends beyond this county to others such as Broward County. It lies on a limestone ridge between the Everglades to the west and Biscayne Bay to the east, and historically was hydrologically connected to both via groundwater and overland flow. Water management activities such as construction of canals and associated flood damage reduction operations, and the transformation of historic wetlands to agriculture or urban land use in the past several decades, have changed the magnitude, distribution, and timing of fresh surface and ground water to the LEC and the associated estuaries of Biscayne Bay, Manatee Bay, Barnes Sound, and Card Sound. The fresh water in the LEC and its associated estuaries are now mostly hydrologically controlled by a network of water management levees, canals, and seepage walls along the eastern border of the Everglades and throughout the LEC. The transitional areas of the southern coastal wetlands of Biscayne Bay, Manatee Bay, Barnes Sound, and Card Sound and the estuaries themselves, constitute some of the most ecologically productive areas in Florida, supporting a portion of Florida's tourism and fishing industry, as well as being considered aesthetically amongst the most beautiful areas in Florida (Ogden 2005). CEPP planning included a constraint in the LEC and associated estuaries for no change in the water supply for both human and natural needs, and flood damage reduction (i.e. "level of service") compared to that currently provided in this economically and aesthetically important area.

Federal laws and regulations applicable to implementing the CERP require PIRs to address certain assurances as part of the project recommendation for approval and subsequent implementation. For the CEPP PIR, the analyses for CEPP associated with Section 601(h)(4) and 601 (h)(5) of WRDA 2000 and the Programmatic Regulations for the CERP (33 CFR Part 385) for Project-Specific Assurances and Savings Clause were conducted for the CEPP recommended plan (**Annex B**). The recommended plan will be implemented in multiple Project Partnership Agreements (PPAs). The USACE and the SFWMD will undertake updated project assurances and savings clause analyses, if necessary, for the implementation phases that are selected to be included in a Project Partnership Agreement or amendment thereto prior to entering into the PPA or PPA amendment. The USACE District Engineer will ensure that Project-Specific Assurances and Savings Clause requirements are met per PPA, per applicable policies and laws. NEPA documentation will be updated, if applicable, as revisions are made to Water Control Plans and/or Project Operating Manuals associated with each PPA. Compliance with the requirements of the Savings Clause will be maintained throughout the entirety of the CEPP implementation period.

However, the questions listed below promote continued investigation, adjustment, and back-checking to confirm that the expected balance is achieved between the existing level of service for the LEC and its associated estuaries and the restoration of the Greater Everglades, Florida Bay, and the Lower Southwest Coast portions of CEPP. A coordinated approach to model refinements, updating Savings Clause and Project Assurance Analyses, CEPP infrastructure design, operations, and monitoring assessment and adaptive response strategies for seepage control features must be emphasized during the expected future efforts to refine the CEPP Adaptive Management Plan. Without adequate coordination, important cost-saving opportunities may be missed and potential Savings Clause and Project Assurances constraints could be prompted. The adaptive management opportunities identified here by the CEPP Project Delivery Team will help to inform CEPP's multi-year construction; pre-construction engineering and design (PED) assessments will inform construction steps and potentially lower project costs by reducing the extent of construction needed. The adaptive management opportunities will continue beyond PED for several years after construction in this area. It is expected that normal PED activities will lead to the correct design for the CEPP seepage barrier in this area; the adaptive management activities described below address potential needs that have low probability of occurring but are of high importance to PDT members and stakeholders.

For a detailed analysis of water supply and flood risk management modeling done for this area, see CEPP PIR Annex B: Analysis Required by WRDA 2000 and State Law.

Existing water supply and flood damage reduction for the Lower East Coast of Florida east of the L30, L31-N, and C-111 are considered a constraint on CEPP. The 2.5 million residents of Miami-Dade County's residents rely on the flood protection provided by the Central and Southern Florida Project (C&SF) and the groundwater supply from the Biscayne Aquifer supported by surface and groundwater flows from the greater Everglades. Constructed and operational features of CEPP are expected to be sufficient to maintain the: 1) current level of flood damage reduction provided by the C&SF system, 2) current water supply during the dry season and/or drought periods, 3) current spatial extent of saltwater intrusion at the base of the aquifer, 4) current levels of surface water quality in the canals of the South Dade Conveyance System, and 5) current level of surface water influence on the groundwater in the Miami-Dade Wellfield Protection Areas. However, due to the complexity of the region's hydrology and inevitable modeling uncertainties, the following adaptive management strategies are provided to ensure that CEPP proceeds cautiously and with the most current information available in this area. The strategies and the Implementation section of this adaptive management plan describe how the work will be coordinated, the monitoring programs and data that will be used, and the process for assessing the data and reporting results, and the process for elevating findings and concerns quickly, if needed.

CEPP Uncertainty #35

Will the constructed and operational features of CEPP maintain flood risk management (WS/FRM) level of service east of the L-30, L-31N, L-31W, and C-111 without reducing quantity or quality of groundwater in water supply wellfields compared to existing conditions?

CEPP Objective or Constraint: The CEPP constraint related to this uncertainty is as follows. In accordance with Section 601(h)(5) of WRDA 2000 and Chapter 373.1501(4)(d), Federal Statute (F.S.), the project will:

- Avoid any reduction in level of service for flood protection
- Provide replacement sources of water of comparable quantity and quality for existing legal users caused by Plan implementation

Project constraints were recognized to ensure that the proposed project would not reduce the level of service for flood protection, protect existing legal users, and meet applicable water quality standards for the natural system by providing an incremental increase in water supply to the Lower East Coast Service Area basins that include Broward and Miami-Dade Counties (called LECSA 2 and 3) in the amounts of 12 MGD total annual average to Broward County and 5 MGD total annual average to Miami-Dade County. More detailed description of the project constraints related to flood risk management and water supply are provided in CEPP PIR **Annex B**.

Region(s). Historically, the Miami-Dade County was hydrologically connected to the Greater Everglades System (e.g. Taylor Slough) to the west of the Miami Rock Ridge and to Biscayne Bay east of the Ridge. Water management activities such as the construction of canals and associated flood control operations, and the transformation of historic wetlands to agriculture or urban land use in the past several decades have changed the magnitude, distribution, and timing of fresh surface and ground water available to Miami-Dade County as a source of freshwater recharge for the Biscayne Aquifer, the only source of water supply for the County. Surface and groundwater flow in Miami-Dade County is now hydrologically controlled by a network of water management features (levees, canals, seepage walls) along the eastern border of ENP and throughout LECSA 2 and 3. The 2.5 million residents of Miami-Dade County rely on the flood protection provided by the LECSA 2 & 3 SFWMD Canal System and the groundwater supply from the Biscayne Aquifer supported by surface and groundwater flows from the greater Everglades.

Associated CEPP features: The associated features are the L-30, L-31N, L-31W, C-111, LECSA 2 & 3 SFWMD Canal System; the S-356 and G-211 divide and coastal water management structures of the LECSA 2 & 3 SFWMD Canal System; and the CEPP partial seepage barrier south of Tamiami Trail along L-31N.

Driver or uncertainty type: The primary driver for this uncertainty is hydrology.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? There are remaining uncertainties about the effectiveness of the CEPP recommended plan seepage wall in maintaining desired stages in marshes of ENP while maintaining flood protection and canal stages to the east without limiting water availability to water users and Biscayne Bay. Therefore, additional analysis of the CEPP seepage wall will be conducted as an early phase in PED. See the Engineering Appendix (**Appendix A**), and the analyses required by WRDA 2000 (**Annex B**) for more detail about the remaining uncertainties. The AM strategy here suggests the analysis to be completed to determine the need for and extent of a CEPP seepage barrier wall. This strategy may be updated during future refinements of the CEPP AM Plan in order to incorporate new information that may be available before the implementation of the seepage barrier. A coordinated approach to model refinements, updating Savings Clause and Project Assurance Analyses, CEPP infrastructure design, operations, and monitoring assessment and adaptive response strategies for seepage control features must be conducted during the expected future efforts to refine the CEPP Adaptive Management Plan. A coordinated approach will help to ensure the Savings Clause and Project Assurances constraints are met as the seepage barrier wall is considered and designed. The expectations or hypotheses listed below promote "back-checking" to confirm that the expected balance is achieved between the existing WS/FRM level of service for Miami-Dade County and the restoration of the Greater Everglades, Florida Bay, and the Lower Southwest Coast. The CEPP Project Delivery Team has identified in this AM strategy opportunities to learn during CEPP's multi-year construction. The lessons learned could inform remaining construction steps and potentially lower project costs by reducing the extent of construction needed.

CEPP will not reduce the WS/FRM level of service to LECSA 2 and 3 and will provide an incremental increase in water supply to the LECSA 2 and 3 in the amounts of 12 MGD (total annual average) to Broward County and 5 MGD (total annual average) to Miami-Dade County. The 2.5 million residents of Miami-Dade County's residents rely on the flood protection provided by the LECSA 2 & 3 SFWMD Canal System and the groundwater supply from the Biscayne Aquifer supported by surface and groundwater flows from the greater Everglades. Constructed and operational features of CEPP are sufficient to maintain the: 1) current level of flood protection provided by the C&SF system, 2) dry season (permitted) pumpage volume for water supply east of the L-30/L-31N without significant drawdown of the Biscayne Aquifer. "Significant drawdown" is to be defined during the PED phase of CEPP in close coordination with interested stakeholders, 3) current spatial extent of saltwater intrusion at the base of the aquifer, 4) current levels of surface water quality in the canals of the LECSA 2 & 3 SFWMD Canal

System, and 5) current level of surface water influence on the groundwater in the Miami-Dade Wellfield Protection Areas.

Expectations or hypotheses to be tested to address uncertainty #, and attribute(s) that will be measured to test each.
More Information on attributes to be measured:

- ***What is expected to be learned by measuring this attribute, i.e., how will CEPP benefit from knowledge gained about this attribute?***
- ***What is the time frame in which changes to this attribute are expected to be measurable?***
- ***Is this attribute complimented by other monitoring programs (within and/or outside of CEPP)? If so, provide reference to other monitoring and make sure that monitoring paid for by others is noted in the CEPP adaptive management budget spreadsheet.***
- ***When during CEPP's life cycle should this monitoring begin and end?***

CEPP Uncertainty #35 is focused on the hydrologic modifications, both structural and operations, to the flood control function of the LECSA 2 & 3 SFWMD Canal System and the potential effects on the quality and quantity of water supply for Miami-Dade County. Addressing this uncertainty will help CEPP meet WS/FRM requirements by informing the detailed design of the CEPP seepage barrier. Informing the detailed design may bring cost savings by reducing the proposed size of the seepage barrier or potentially, show the barrier is not needed. If the barrier is needed, a post-construction component has been included as a check for unintended impacts.

Pre-construction A: Verify whether a CEPP seepage barrier is needed. Studies are needed utilizing MODFLOW groundwater models that have been used routinely for seepage evaluations in the area. Existing models may be improved, where needed, with existing leveraged monitoring data. Attributes to evaluate include, but are not limited to: water level, stage, hydroperiod, and seepage flux. Analyses and performance metrics need to include seasonal and extreme wet or drought conditions, whether related to flood, water supply for human uses, or water supply for fish and wildlife, which are the periods where risk of damaging high or low water levels and flows could occur. Comparisons of annual average flow or long-term temporal averages of flow or stage cannot adequately address water supply and flood considerations during the evaluation and design process, or during assessment when project components are being implemented. The analysis summary provided with the PIR Annex B includes difference maps and evaluation discussion for April 1978 (average rainfall year), April 1989 (extreme dry year), April 2001 (extreme dry year), period-of record mean April, October 1995 (extreme wet year), and period-of-record mean October. The difference maps include all of the Lower East Coast, including historically flood-prone areas and wellfield areas. Modeling efforts may take up to 6 months to refine and focus on the area(s) and parameter(s) of interest.

Pre-construction B: If CEPP seepage barrier is needed, determine depth and extent needed. Studies are needed during the PED phase of the project to incorporate configuration and permeability information from the Rock Mining seepage barrier along with additional information on hydrology and water quality to be collected during the geotechnical analysis and subsurface investigations that are normally completed during the PED phase of the project at least 3 years prior to construction of the seepage barrier. Attributes to evaluate include, but are not limited to: existing seepage barrier configuration and permeability data including the Rock Mining seepage barrier data, USGS hydrogeologic reports (for example, Cunningham, K.J. and M.C. Sukop, 2001), and exploratory bore holes as necessary per USACE PED protocols. All applicable NEPA analysis, coordination, and permitting requirements will be met and/or updated where necessary before initiating construction of a CEPP seepage barrier.

Post-construction:
If data shows that CEPP seepage barrier shifts seepage to area north of the L-31N, the CEPP PDT may determine that the seepage barrier should be extended north of L-31N/Tamiami Trail (along the "triangle area"). Trigger or justification for this decision would be if monitoring data shows continued need to capture WCA 3B eastward seepage in this area. This will be determined by assessing whether seepage increases to the L30 or L29, which would indicate that there is increased seepage north of Tamiami Trail that may need to be addressed.

Hydrologic and water quality attributes are selected to measure the effects of CEPP hydrologic structural modifications to the L-30, L-31N, L-31W, and C-111 canals and operation of the LECSA 2 & 3 SFWMD Canal System on the quantity and quality of the groundwater available for water supply for Miami-Dade County. These attributes were selected based on existing knowledge of surface/groundwater connectivity in Miami-Dade County. Many of the attributes listed are currently monitored by other agencies or USACE projects and may provide, in part, input to the testing of this uncertainty's hypothesis. It is anticipated additional monitoring will be necessary for the Project and that the monitoring suggested here will be reviewed during CEPP Design to adjust to potential needs or changes in data availability that may occur after publication of this adaptive management plan. In addition, project permits may require monitoring to confirm that the project is remaining within applicable Savings Clause and Assurances requirements. This monitoring may extend longer than the 10-year limit imposed on most adaptive management and ecological monitoring. If so, this monitoring may be extended for an appropriate period according to the future permit, in coordination with the implementing agencies. It is anticipated that such monitoring requirements will be assessed periodically and revised as needed. Costs for the proposed monitoring, and potential extension of permit-required monitoring periods, have been included in the Monitoring Cost Table and in the CEPP project contingency estimations. Regarding the monitoring of attributes listed below, the timeframe in which the attributes may begin to show changes as function of the Project range from a minimum of 7 days (wetland and canal stage/flow) to 2 years (estuarine salinity). These are timeframes to begin perceiving changes, not limits on the monitoring time. Estimated timeframes to begin perceiving changes are listed below in parentheses.

The attributes to be measured and time needed to begin perceiving changes are the following (these time frames are indications of speed of response, not limits on the monitoring to be conducted):

1. Wetland and Canal/Creek Stage (7 days)
2. Surface and Groundwater Flow (7 days)
3. Wetland Surface and Groundwater Salinity (1 year)
4. Surface and Groundwater Quality (2 months)
5. Estuarine Salinity (2 years)

Methodology for testing each expectation or hypothesis (including frequency of monitoring) and for reporting:
More information on what to measure, how, how often, how to analyze, and when and how to report results. PLEASE NOTE: the CEPP Adaptive Management Plan varies in the level of methodology detail provided; in several cases the details will be formed after CEPP design details are known. In ALL cases, methodology will be reviewed, updated and adjusted if needed, by agency subject experts before initiation to best meet the intent of the Adaptive Management Plan.

Pre-construction A: At the time of publishing this adaptive management plan, the extent of seepage management that CEPP will need to achieve is not determined due to ongoing and proposed seepage barrier and operational testing in the area; the seepage barrier proposed in the CEPP recommended plan is sufficient to meet project constraints without the test barrier that has recently been installed. The actual CEPP seepage barrier may not need to be as extensive as that proposed in the recommended plan. Real-time analyses of structural changes by the rock miner installed seepage barrier, S-356 pump station, and operational changes to the LECSA 2 & 3 SFWMD Canal System and their subsequent affect on surface and ground water flows east of the L29, L30, L31-N, and C-111 is necessary prior to CEPP construction to provide adaptive management feedback to the CEPP PDT on the efficacy of a seepage barrier and its subsequent effects on flood risk management and water supply for the Lower East Coast. The evaluation may follow routine methods for seepage evaluations and incorporate specific suggestions from agencies and stakeholders based on knowledge gained from the Rock Mining seepage barrier and other activities in the region.

Pre-construction B: Technical analysis to incorporate configuration and permeability information from the Rock Mining seepage barrier along with additional information on hydrology and water quality to be collected during the geotechnical analysis and subsurface investigations to further develop the design of CEPP's seepage wall.

Post-construction:
Real-time analyses of structural changes by the CEPP installed seepage barrier and operational changes to the LECSA 2 & 3 SFWMD Canal System and their subsequent affect on surface and ground water flows east of the L29, L30, L31-N, L-31W, and C-111 during construction and into O/M for CEPP is necessary to provide feedback to water managers on operational decisions and their subsequent effect on flood control and water supply for the Lower East Coast. Focus of the analyses are on: 1) the distribution, magnitude, and timing of surface and groundwater flows and stage elevation at water management structures and select wetland stage/flow gages; 2) surface and ground water quality monitoring at select locations in: the LECSA 2 & 3 SFWMD Canal System, areas of concern throughout Miami-Dade County associated with the public wellfields, and areas of concern along the saltwater intrusion line for Miami-Dade County; and 3) possible seepage increases to the L29 or L30, which would indicate that there is increased seepage north of Tamiami Trail that may need to be addressed. Team will then need to decide if the increased seepage is a problem, i.e., canal stages exceeding mandated levels. Preferably, refinement of the existing hydrologic and hydrodynamic models for the Lower East Coast is necessary to better forecast the effects of constructed features and operational changes prior to actual implementation and avoid irreversible negative impacts through a trial and error approach.

Triggers/thresholds that indicate good CEPP performance or need for adaptive management action. The baseline thresholds to signify the need for the implementation of adaptive management measures for the region are listed below. Exceedence of any one of the baseline thresholds necessitates action; the adaptive management measures are provided here as suggested actions. These threshold limits are based on the Savings Clause; requirements of Consumptive Use Permits issued for the LEC; Chapter 62-302, F.A.C.: Surface Water Quality Standards; Chapter 62-303, F.A.C.: Impaired Waters Rule; Chapter 62-520, F.A.C.: Ground Water Quality Standards; Chapter 40E-8 F.A.C.: Minimum Flows and Levels Rules; SFWMD Water Reservations Rule for the CERP Biscayne Bay Coastal Wetlands Project – Phase 1, approved in 2013; and best professional judgment of scientists familiar with the region. **Refinements or additions to the listed triggers and thresholds may occur in the future as new and/or updated research, standards, permits, or rules and data are analyzed and incorporated by the PDT.** Data analyses of existing conditions as referenced below may be found in the CERP RECOVER System Status Reports. Additional data analyses may need to be performed prior to any CEPP construction or operational change to determine existing conditions from pre-construction collected monitoring information.

Baseline Thresholds:

General:

- Magnitude of wetland surface or groundwater salinity exceeds equivalent rainfall conditions for the past 2 years from the period of record
- Inland movement of the saltwater wedge from current location
- Greater than 1% decrease in canal flow and/or stages compared to existing April conditions and/or in dry years
- Violation of existing Consumptive Use Permit requirements
- Increase of 1% or greater in canal or groundwater stage compared to existing October average water table
- Violation of Chapter 62-305 or 62-520, F.A.C. for various surface and groundwater quality parameters
- Increased frequency or magnitude of exceedences in surface water monitoring segments that would lead to designation of "impaired" per Chapter 62-303, F.A.C.
- Declining trend in surface or groundwater quality compared to prior condition
- Detection of indicators of surface water influence in groundwater monitoring wells.

L-29 and L-30:

- Increased levels of seepage in the L-29 and L-30 as a function of the CEPP seepage barrier resulting in canal stages exceeding mandated levels.
- Stage in WCA 3B exceeds the maximum design criteria for the L-30 East Coast Protective Levee.
- RECOVER Greater Everglades Performance Measure: Sheet flow in the Everglades Ridge and Slough Landscape (http://www.evergladesplan.org/pm/recover/recover_docs/et/ge_sheetflow_01.pdf) metrics less than those predicted for the selected alternative (4R2) or exhibits a negative long-term trend at Transects 16 (East WCA-3B) and 18 (Tamiami Trail East)

Dry season pumping:

- Suggested for consideration based on maximum aquifer drawdown limits for the Biscayne Bay Aquifer per the Consumptive Use Permit: Threshold limit of 2 feet of drawdown within the cone of influence of any of the Miami-Dade public water supply wells during the dry season.

Management options that may be chosen based on test results. Suggested Adaptive Management Options listed below are suggestions that capture current understanding of potential future issues and solutions. They are not automatic actions. They are not in any particular order and some can be implemented simultaneously, as appropriate.

- Adjustments to operations in the L-30, L-31N, C-111, and the LECSA 2 & 3 SFWMD Canal System to improve water deliveries to the Biscayne Bay, Manatee Bay, Barnes Sound, and Card Sound
- Refinement and coupling of existing hydrologic and hydrodynamic in the LECSA 2 & 3, Biscayne Bay, Manatee Bay, Barnes Sound, and Card Sound to improve ability to forecast effects of structures and operations to avoid costly trial and error
- Coordinated operational test scenarios prior to conveyance of "new water" of existing S-356 pump station, Modified Waters Deliveries detention features, and existing barrier wall and G-211, during wet season/storm events and during the dry season to develop data on marsh,

canal and groundwater stages (including in reference areas) and structure flows to assess effectiveness of components in maintaining wetland hydrologic targets, without adversely affecting flood protection or affecting water supply. Specifically assess ability to maintain canal stages as specified in existing water use permits in water supply wellfields near the L-30/31.

- Develop dry season/drought condition operational plan, similar to "prestorm drawdown" operational plan. Refinement of standard ERTP or regional operating plans, as necessary, including schedule of S-356 and G-211 operations.
- Additional targeted modeling, using more detailed data above, to evaluate need for additional segments of barrier wall or increases in pump capacity to control seepage expected from expected increased flows to WCA 3B and NE Shark River Slough.
- Dry season pumping: Retain water in WCA 3B and ENP during dry season by adjusting operations to send more water east of L-30/L-31N
- Dry season pumping and L-29/L-30: Initiate discussions with stakeholders on how to continue level of service for LEC water supply while avoiding ecological impacts in WCA 3B.
- L29/L30: Hydraulic analysis of levee stability with the increased average stages in WCA 3B. (This may be done as part of the ongoing National Levee System updated data base.) Determine if reinforcing the levee would allow for higher stages, if such stages would benefit CEPP.
- L29/L30: Install hydraulic pass-throughs (windows) in the seepage barrier to increase flow across seepage barrier and reduce increased seepage to the north.
- L29/L30: Adjust operations to route the water to locations where it is needed, rather than sending the water to tide.
- L29/L30: Extension of the CEPP seepage barrier to the north of Tamiami Trail.

D.4.4.2 CEPP Hydrologic Effects on Lower East Coast Ecosystems including Pennsuco Wetlands, south Miami-Dade wetlands, and Biscayne Bay

CEPP Uncertainty #62

Will the constructed and operational features of CEPP reduce surface and/or groundwater base flows and wetland/groundwater recharge to the east of the L-30 and L31-N in areas such as the Pennsuco Wetlands, south Miami-Dade wetlands, and Biscayne Bay?

CEPP Objective or Constraint: In accordance with Section 601(h)(5) of WRDA 2000 and Chapter 373.1501(4)(d), Federal Statute (F.S.), the project will:

- Avoid any reduction in level of service for flood protection existing as of December 2000 caused by Plan implementation
- Provide replacement sources of water of comparable quantity and quality for existing legal users caused by Plan implementation

Project constraints were recognized to ensure that the proposed project would not reduce the level of service for flood protection, protect existing legal users (to include water supply for fish and wildlife in Biscayne Bay), and meet applicable water quality standards for the natural system by providing an incremental increase in water supply to the LECSA 2 and 3 in the amounts of 12 MGD (total annual average) to Broward County and 5 MGD (total annual average) to Miami-Dade County and at the same time, meet applicable Water Quality Standards.

Region(s). CEPP Uncertainty #62 is focused on the ecological effects of CEPP hydrology as a function of the fresh surface and groundwater flows throughout the inland portions of Miami-Dade County and their input to Biscayne Bay, Manatee Bay, Barnes Sound, and Card Sound.

Associated CEPP features: The associated CEPP features are:
1. The L-30, L-31N, C-111, LECSA 2 & 3 SFWMD Canal System;
2. The S-356, G-211, divide and coastal water management structures of the LECSA 2 & 3 SFWMD Canal System; and
3. The partial seepage barrier south of Tamiami Trail along L-31N.

Driver or uncertainty type: The primary driver for this uncertainty is hydrology.

What is expected to be learned by addressing this uncertainty, i.e., how will CEPP benefit from addressing this uncertainty? The Pennsuco Wetlands provide groundwater recharge to the Northwest Wellfield public water supply for Miami-Dade County. These wetlands along with other wetlands and designated conservation lands east of the L30, L-31N, and C-111 canals provide essential habitat to many native floral and faunal species. Biscayne Bay is the estuary immediately east of Miami-Dade County and is a Florida Outstanding Water and has within its boundaries Oleta River and Bill Baggs-Cape Florida State Parks, the Biscayne Bay Aquatic Preserve, state-designated critical wildlife areas (e.g. Virginia Key), Biscayne National Park, and the Florida Keys National Marine Sanctuary. Constructed and operational features of CEPP are sufficient to maintain the current level surface and groundwater base freshwater flows to both the Pennsuco Wetlands and Biscayne Bay to where there is no change in the ecological conditions of these two areas.

Expectations or hypotheses to be tested to address uncertainty #, and attribute(s) that will be measured to test each. More information on attributes to be measured:
- **What is expected to be learned by measuring this attribute, i.e., how will CEPP benefit from knowledge gained about this attribute?**
- **What is the time frame in which changes to this attribute are expected to be measurable?**
- **Is this attribute complimented by other monitoring programs (within and/or outside of CEPP)? If so, provide reference to other monitoring and make sure that monitoring paid for by others is noted in the CEPP adaptive management budget spreadsheet.**
- **When during CEPP's life cycle should this monitoring begin and end?**

Hydrologic and ecologic attributes are selected to measure the effects of CEPP hydrology on the ecosystems of the region (inland portions of Miami-Dade County, Biscayne Bay, Manatee Bay, Barnes Sound, and Card Sound). These attributes were selected based on existing knowledge of 1) surface/groundwater connectivity in the LEC and adjacent estuaries and 2) wetland and estuarine species and habitat status and function. Many of the attributes listed are currently monitored by other agencies or USACE projects and may provide, in part, input to the testing of this uncertainty's hypothesis. It is anticipated additional monitoring will be necessary for the Project, to be determined during Design. In addition, project permits may require monitoring to confirm that the project is remaining within applicable Savings Clause and Assurances requirements. This monitoring may extend longer than the 10-year limit imposed on most adaptive management and ecological monitoring. If so, this monitoring may be extended for an appropriate period according to the future permit, in coordination with the implementing agencies. It is anticipated that such monitoring requirements will be assessed periodically and revised as needed. Costs for the proposed monitoring, and potential extension of permit-required monitoring periods, have been included in the Monitoring Cost Table and in the CEPP project contingency estimations. Regarding the monitoring of attributes listed below the timeframe in which the attributes may begin to show changes as function of the Project range from a minimum of 7 days (wetland and canal stage/flow) to a maximum of 5 years (juvenile pink shrimp and associated epifauna and fish). These are timeframes to begin perceiving changes, not limits on the monitoring time. Estimated timeframes to begin perceiving changes are listed below in parentheses.

The attributes to be measured and time needed to begin perceiving changes are the following (these time frames are indications of speed of response, not limits on the monitoring to be conducted):

1. Estuarine Salinity (2 years)
2. Estuarine Submerged Aquatic Vegetation (2 years)
3. Juvenile Pink Shrimp and Associated Estuarine Epifauna (5 years)
4. Estuarine Fish (5 years)
5. Wetland and Canal/Creek Stage (7 days)
6. Surface and Groundwater Flow (7 days)
7. Wetland Surface and Groundwater Salinity (1 year)
8. Surface and Groundwater Quality (2 months)
9. Wetland Vegetation (1 year)

Methodology for testing each expectation or hypothesis (including frequency of monitoring) and for reporting: *More information on what to measure, how, how often, how to analyze, and when and how to report results. PLEASE NOTE: the CEPP Adaptive Management Plan varies in the level of methodology detail provided; in several cases the details will be formed after CEPP design details are known. In ALL cases, methodology will be reviewed, updated and adjusted if needed, by agency subject experts before initiation to best meet the intent of the Adaptive Management Plan.*

Real-time analyses of structural changes by the rock miner installed seepage barrier, S-356 pump, and operational changes to the LECSA 2 & 3 SFWMD Canal System and their subsequent affect on surface and ground water flows and the ecosystems east of the L30, L31-N, and C-111 and into Biscayne Bay is necessary prior to CEPP construction to provide adaptive management feedback to CEPP on the efficacy of a seepage barrier and its effects on the ecological conditions of the Pennsuco Wetlands and Biscayne Bay. Real-time analyses of structural changes by the CEPP installed seepage barrier and operational changes to the LECSA 2 & 3 SFWMD Canal System and their subsequent affect on surface and ground water flows and the ecosystems east of the L30, L31-N, and C-111 and into Biscayne Bay during construction and into O/M for CEPP is necessary to provide feedback to water managers on operational decisions and their subsequent effect on the ecological conditions of the Pennsuco Wetlands and Biscayne Bay. Focus of the analyses are on: 1) the distribution, magnitude, and timing of surface and groundwater flows and stage elevation at water management structures and select wetland stage/flow gages; 2) salinity at the Marine Monitoring Network and other select stations in Biscayne Bay; 3) wetland vegetation condition and status in the Pennsuco Wetlands and other wetlands east of the L-31N and C-111; and 4) seagrass and along shore epifauna and fish condition and status in Biscayne Bay. Preferably, refinement and coupling of the existing hydrologic, hydrodynamic, and ecological models for LECSA 2 & 3 and Biscayne Bay is necessary to better forecast the effects of operational changes prior to actual implementation and avoid irreversible negative impacts through a trial and error approach.

Triggers/thresholds that indicate good CEPP performance or need for adaptive management action. *Triggers or thresholds are a point, range, or limit that signifies when restoration performance is veering away from expectations and is trending toward an unintended outcome. Triggers/thresholds should be described per attribute to be monitored because each should result in an outcome that informs management decisions.*

The baseline threshold for the implementation of adaptive management measures for the region are listed below. Exceedence of any one of the baseline thresholds necessitates the implementation of the adaptive management measures. These threshold limits are based on the Savings Clause; requirements of Consumptive Use Permits issued for the LEC; Chapter 62-302, F.A.C.: Surface Water Quality Standards; Chapter 62-303, F.A.C.: Impaired Waters Rule; Chapter 62-520, F.A.C.: Ground Water Quality Standards; Chapter 40E-8 F.A.C.: Minimum Flows and Levels Rules; SFWMD Water Reservations Rule for the CERP Biscayne Bay Coastal Wetlands Project – Phase 1; and best professional judgment of scientists familiar with the region. Refinements or additions to the listed triggers and thresholds may occur in the future as new and/or updated research, Standards, Permits, or Rules and data are analyzed and incorporated by the PDT. Data analyses of existing conditions as referenced below may be found in the CERP RECOVER System Status Reports. Additional data analyses may need to be performed prior to any CEPP construction or operational change to determine existing conditions from pre-construction collected monitoring information.

Informing operations with triggers, thresholds, and monitoring results: The CEPP Operating Manual will undergo several updates and refinements over time as explained in Section 6 of the CEPP PIR and in the current CEPP Operating Manual (Annex C). The triggers, thresholds, and knowledge gained over time will be used in future modeling and updates, and the Operating Manual will be developed in coordination with and consistent with the CEPP Adaptive Management Plan.

Baseline Thresholds:

- 5% decrease in seagrass, mangrove fish, juvenile pink shrimp, or select wetland vegetation spatial coverage and/or species specific densities from existing conditions as a function of upstream hydrologic changes.
- Salinity exceeds the 90th percentile of the recorded salinity values at the NPS Marine Monitoring Network nearshore Biscayne Bay stations for the entire period of record for the equivalent rainfall years.
- Magnitude of wetland surface or groundwater salinity exceeds equivalent rainfall conditions for the past 2 years from the period of record
- Inland movement of the saltwater wedge from current location.
- Greater than 1% decrease in canal flow and/or stages compared to existing April conditions and/or in dry years
- Greater than 1% decrease in average annual flows to Biscayne Bay through the coastal structures
- Violation of existing Consumptive Use Permit requirements
- Increase of 1% or greater in canal or groundwater stage compared to existing October average water table
- Violation of Chapter 62-305 and 62-520, F.A.C. for various surface and groundwater quality parameters
- Increased frequency or magnitude of exceedences in surface water monitoring segments that would lead to designation of "impaired" per Chapter 62-303, F.A.C.
- Declining trend in surface or groundwater quality compared to prior condition
- Detection of indicators of surface water influence in groundwater monitoring wells.

Management options that may be chosen based on test results. Suggested Adaptive Management Options listed below are not in any particular order and can be implemented simultaneously, as appropriate.

- Adjustments to operations in the L-30, L-31N, C-111, and the LECSA 2 & 3 SFWMD Canal System to improve water deliveries to Biscayne Bay, Manatee Bay, Barnes Sound, and Card Sound

- Refinement and coupling of existing hydrologic, hydrodynamic, and ecological models in the LECSA 2 & 3, Biscayne Bay, Manatee Bay, Barnes Sound, and Card Sound
- Redistribution of water to more closely match existing flow volumes and to more closely match historic timing of flows to Biscayne Bay.
- Coordinated operational test scenarios prior to conveyance of "new water" of existing S-356 pump station, Modified Waters Deliveries detention features, and existing barrier wall and G-211, during wet season/storm events and during the dry season to develop data on marsh, canal and groundwater stages (including in reference areas) and structure flows to assess effectiveness of components in maintaining wetland hydrologic targets, without adversely affecting flood protection or affecting water supply. Specifically assess ability to maintain canal stages as specified in existing water use permits in water supply wellfields near the L-30/31.
- Develop dry season/drought condition operational plan, similar to "prestorm drawdown" operational plan. Refinement of standard ERTP or regional operating plans, as necessary, including schedule of S-356 and G-211 operations.
- Additional targeted modeling, using more detailed data above, to evaluate need for additional segments of barrier wall or increases in pump capacity to control seepage expected from expected increased flows to WCA 3B and NESRS.

Table D.1.8: Southern Coastal Systems Management Options Matrix. See caption for Table D.1.3 for further explanation.

Uncertainty	Time to detect change of attribute/ indicator	Attribute/Indicator	Specific Property to be Measured and Frequency	Decision Criteria: Confirmation of CEPP Performance or Trigger(s) for Management Action	Management Action Option(s)
63	2 Months	Periphyton (nutrient availability)	• periphyton tissue nutrient content, quarterly • soil nutrient, every 2 years	• Alteration of current spatial distribution relative to current conditions • Increased frequency of yellow and/or red conditions for the periphyton nutrient content system-wide indicator report	• Adjust operations to change *spatial* and /or *temporal* distribution of water • Model refinement and coupling to improve ability to forecast effects of operations and adaptive operational changes
63	2 Month	Algal bloom (surface water quality)	• water quality, monthly	• Alteration of current surface water nutrient spatial distribution or concentrations relative to current conditions • Increased frequency of yellow and red conditions for the algal bloom system-wide indicator report	
63	2 years	Cattail (vegetation change)	• vegetation transects, annually • aerial landscape analysis every 5 years	• Alteration of current spatial distribution relative to current conditions • Increased rate of cattail expansion above current rate.	
63, 64	5 years	Soil nutrients (transport & availability)	• Soil and vegetation nutrient transects, bi-annually • soil P, quarterly	• Movement of spatial nutrient front or increase in nutrient rate of release from soils	
35, 61, 62, 65, 67	2 years	Salinity (estuarine)	• Salinity, continuously	• RECOVER Southern Coastal Systems Performance Measure: Salinity in Florida Bay metrics less than those predicted for the selected alternative (4R2) or exhibits a negative long-term trend at each of the 17 NPS MMN stations in Florida Bay • Salinity exceeds the 90th percentile of the recorded salinity values at the MMN NE Florida Bay and near shore Biscayne and Florida Bay stations for the entire period of record for the equivalent rainfall years.	
61, 65, 67	7 days	Stage/Flow	• Stage and/or flow, continuous	• Distribution inconsistent to those predicted for the selected alternative (4R2) • Exceed a 1% reduction in flow to Biscayne Bay relative to current conditions • Violation of the Minimum Flows and Levels for Florida Bay.	
64	5 years	Mangrove and white zone (vegetation change)	• vegetation transects, annually • aerial landscape analysis every 5 years	• White zone expansion rate exceeds Ross rate (3 km/50 yr west of US1, 1 km/50 yr east of US1) • mangrove zone expansion rate exceeds current rate of expansion.	
64	5 years	Soil elevation	• soil elevation and depth, annually	• Reduction in elevation • Increase in rate of coastal soil loss over the existing rate.	
35, 62, 64	1 year	Salinity (wetland surface and groundwater)	• surface water conductivity, continuously • groundwater conductivity, monthly • porewater conductivity and below ground resistivity, quarterly	• Change in spatial extent of wetland surface water or groundwater salinity relative to two similar rainfall years from the period of record • Salinity magnitude exceeds equivalent rainfall conditions for the past 2 years from the period of record) and/or saltwater wedge movement inland.	
62, 65	2 years	Seagrass	• seagrass densities and community diversity, quarterly	• No increase in seagrass habitat diversity and coverage as predicted for the selected alternative (4R2) in Florida Bay and the Lower Southwest Coast • 5% decrease in seagrass coverage and/or species specific densities from existing conditions function of upstream hydrologic changes.	
65	5 years	Spoonbills	• Spoonbill system-wide ecological indicator parameters, annually	• Spoonbill HSI is less than what is predicted for the selected alternative (4R2) or exhibits a negative long-term trend • Increased frequency of 'yellow' and 'red' status for the Roseate Spoonbill in the system-wide indicator report. • 5% decrease in spoonbill densities from existing conditions as a function of upstream hydrologic changes.	
62, 65	5 years	Fish	• Juvenile Seatrout system-wide ecological indicator parameters, annually	• Juvenile Seatrout HSI is less than what is predicted for the selected alternative (4R2) or exhibits a negative long-term trend • Increased frequency of yellow and red for the fish and macroinvertebrates system-wide indicator report for Florida Bay • Salinity exceeds the 90th percentile of the recorded salinity values at the MMN Florida Bay stations for the entire period of record for the equivalent rainfall years • In Florida Bay, 5% decrease in juvenile seatrout spatial coverage and/or species specific densities from existing	

Uncertainty	Time to detect change of attribute/ indicator	Attribute/Indicator	Specific Property to be Measured and Frequency	Decision Criteria: Confirmation of CEPP Performance or Trigger(s) for Management Action	Management Action Option(s)
				conditions as a function of upstream hydrologic changes.	
62, 65	5 years	Pink Shrimp and other epifauna	• Pink Shrimp system-wide ecological indicator parameters, annually	• Juvenile Pink Shrimp HSI is less than what is predicted for the selected alternative (4R2) or exhibits a negative long-term trend • Increased frequency of yellow and red for the juvenile pink shrimp system-wide indicator report for Florida Bay • Salinity exceeds the 90th percentile of the recorded salinity values at the MMN Florida Bay stations for the entire period of record for the equivalent rainfall years • In Florida Bay, 5% decrease in juvenile pink shrimp spatial coverage and/or species specific densities from existing conditions as a function of upstream hydrologic changes.	• Adjust operations to change *spatial* and/or *temporal* distribution of water • Model refinement and coupling to improve ability to forecast effects of operations and adaptive operational changes
65	5 years	Juvenile Crocodiles	• Juvenile growth and survival system-wide ecological indicator parameters, annually	• Juvenile Crocodile HSI is less than what is predicted for the selected alternative (4R2) or exhibits a negative long-term trend • Increased frequency of yellow and red for the crocodilians system-wide indicator report for Florida Bay • 5% decrease in juvenile crocodile growth and survival from existing conditions as a function of upstream hydrologic changes.	
59	1 month	Invasive exotic vegetation and animals	• Vegetation, monthly or seasonally • Animals, daily or seasonally *Per Invasive Species Monitoring Plan	• No new introductions of invasive exotic species into area • Suppression of established invasive species to the lowest feasible level such that ecosystem impacts are minimized • Management decisions based on Florida Weed Risk Assessment Tool, biological profiles and risk assessments (animals) using ECISMA and FWC approach. Trigger is a function of K vs. R-selection by the invasive species.	• Refinement or development of Invasive Species Risk Assessment Tools • Implement CEPP Invasive Species Management Plan measures • CEPP invasive and nuisance species management team may provide information to reduce future species management costs by redesigning or retrofitting project features. If the suggestions are beyond the scope of the CEPP Plan, additional authorization would be required.
35, 62	7 days	LEC Stage/Flow	• stage and/or surface/groundwater flow monitoring, continuous	• Exceed a 1% reduction in flow to Biscayne Bay relative to current conditions • Violation of the Minimum Flows and Levels for Florida Bay; greater than 1% decrease in canal flow and/or stages compared to existing April conditions and/or in dry years • violation of existing consumptive use permit requirements • Increase of 1% or greater in canal or groundwater stage compared to ECB October average water table.	• Operational tests • Develop/refine operational plans • Model development/refinement
35, 62	2 Month	LEC Water Quality (ground and surface)	• water quality, monthly	• Violation of FAC 62-160 for various water quality parameters • increased frequency or magnitude of exceedences in surface water monitoring segments that would lead to designation of "impaired" • Declining trend compared to prior condition • Detection of indicators of surface water influence in groundwater monitoring wells.	• Adjust operations to change *quantity* of water delivered
62	1 Year	LEC Wetland Vegetation	• vegetation transects, annually • aerial landscape analysis every 5 years during construction and into O/M.	• Exceed a 1% reduction in flow to Biscayne Bay relative to current conditions • Violation of the Minimum Flows and Levels for Florida Bay • greater than 1% decrease in canal flow and/or stages compared to existing April conditions and/or in dry years • violation of existing consumptive use permit requirements • Increase of 1% or greater in canal or groundwater stage compared to ECB October average water table • 5% reduction in spatial coverage and/or species specific densities from existing conditions as a function of upstream hydrologic changes.	• Operational tests • Develop/refine operational plans • Model development/refinement

D.5 Implementation of CEPP Adaptive Management

Adaptive management provides an interdisciplinary, integrated, structured process for lowering risk, increasing certainty and informing decisions. For adaptive management to be successful in ensuring the delivery of intended benefits and avoid unintended negative impacts of CEPP, adaptive management activities should continue beyond project planning for the entire project-life cycle from completion of the PIR through all aspects of monitoring, engineering, design, construction, operations, and maintenance components. In addition, mechanisms must be in place to collect, manage, analyze, synthesize, coordinate, and integrate new information into management decisions. Adaptive management implementation can only succeed when decision makers have sufficient funding and staffing resources to implement the adaptive management and monitoring plans. In addition, success requires political and stakeholder support to implement the adaptive management decision methodology and to adjust management decisions based on what is learned.

Per the Programmatic Regulations for the Comprehensive Everglades Restoration Plan (2003), an adaptive management process has been developed for CERP that guides system-wide CERP adaptive management and project level adaptive management (CGM 56 2010; RECOVER 2011b). This detailed CERP guidance adheres to WRDA 2007 and the WRDA 2007 implementation guidance provided by USACE in 2009 in that it focuses on using monitoring information to inform projects and project components by resolving uncertainties and providing mechanisms to efficiently incorporate new knowledge in project planning, design, and implementation. CEPP has and will use this framework to implement adaptive management. Doing so will allow CEPP to both take advantage of and contribute to work being done system-wide and by other projects. Because new information is continually becoming available, CEPP adaptive management and monitoring plan must be recognized as a living document that is improved upon through incorporation of new information. In particular, as each project component is designed and implemented, specific adaptive management strategies and monitoring should be reviewed and adjusted as necessary.

To facilitate implementation of the CEPP Adaptive Management Plan, RECOVER scientists will coordinate the adaptive management monitoring, analysis, and reporting. RECOVER will include expertise from multiple agencies and disciplines, such as, hydrologists, engineers, and water managers; in other words, while RECOVER will be the central organizing entity of the adaptive management monitoring, analysis, reporting, and elevating of options to adjust CEPP, RECOVER will continually coordinate with others to ensure that a full suite of experts is included. CEPP project funds during pre-construction engineering and design (PED), construction, and operations and maintenance will support RECOVER's coordination efforts and the adaptive management strategies described in this CEPP Adaptive Management Plan. CEPP funds will be used to fund monitoring directly related to CEPP adaptive management monitoring needs and the funds are not designed to replace RECOVER's system-wide monitoring and science efforts. However, the RECOVER system-wide monitoring information will be used in combination with CEPP's monitoring to best address key questions about achieving restoration success. The intent is to have complementary efforts that maximize efficiency of monitoring. RECOVER will be responsible for ensuring that the adaptive management and monitoring plans are implemented and that the information is appropriately managed and integrated into the CERP decision process as outlined in the Adaptive Management Integration Guide (RECOVER 2011b).

Because of the fast track of the CEPP planning process it will be particularly important that RECOVER include scientists, engineers, and water managers in refinement of the monitoring and adaptive management plans during the project design, construction, and operating phases of the CEPP project. This section identifies which adaptive management activities will occur during these phases of CEPP project implementation and how they relate back to the project's adaptive management plan. Unless otherwise noted RECOVER will be engaged in all activities. Adaptive management will be reiterated in the coming phases of CEPP, and the Adaptive Management Plan will be reviewed and updated. At such time, more baseline data and lessons learned will be available from other monitoring programs and restoration projects. Given the new knowledge, key questions, monitoring thresholds/triggers, and adaptive management options proposed in this Plan may need refinement. Therefore, items included in this plan are not guaranteed to be included or funded as-is, but will be refined and considered again prior to CEPP implementation.

Adaptive management was incorporated during CEPP's planning with adaptive management experts integrally involved throughout the planning process. All of the items in the CERP "Project Level Adaptive Management Checklist" were considered and/or incorporated during the planning of CEPP, with the following exceptions: a conceptual ecological model (CEM) was not used in the Everglades Agricultural Area to develop hypotheses, since an approved model does not exist; scientific and local knowledge was used in lieu of developing a model for this area. CEMs were used for the other project areas including Lake Okeechobee, Northern Estuaries, Greater Everglades, Southern Coastal Systems, and the Total System (http://www.evergladesplan.org/pm/recover/cems.aspx). A cost effectiveness/incremental cost analysis of the future adaptive management options was not conducted due to time constraints during planning. Adaptive management activities on the checklist that will take place during and after the project's implementation are described here in the Adaptive Management Plan (CERP adaptive management checklist: http://www.evergladesplan.org/pm/pm_docs/adaptive_mgmt/062811_am_guide_final.pdf). The following subsections identify how adaptive management has been and will be incorporated into each CEPP project phase: planning, design, construction, and operations and maintenance.

D.5.5 How Adaptive Management Activities were Applied during CEPP Planning

The checklist of adaptive management activities (RECOVER 2011b) focuses on gathering sound information to develop a project's goals, objectives, and vision; involving agencies and stakeholders; identifying concerns and uncertainties; coordinating with interagency science groups during planning; addressing uncertainties as possible with robust and flexible project design; and identifying key uncertainties, monitoring, and management options that relate to the key uncertainties in order to systematically gather information to address them. Highlights of CEPPs incorporation of these adaptive management principals include the use of extensive scientific knowledge and modeling during all steps of the study. CEPP also had a robust interagency and public participation process throughout the study. Concerns and uncertainties were identified in an initial step for CEPP, discussed throughout the USACE "In Progress Review" meetings, and discussed throughout the interagency and public participation process. During screening of management measures to develop alternative plans, screening criteria included flexibility (the speed, ease, efficiency that a management measure could move water to adjust to changing real-time conditions such as storms or extreme events), robustness (the ability to function effectively in the face of broad-scale, uncertain future conditions such as climate change [NRC 2007]), and future compatibility (the efficiency with which this management measure or configuration would compliment future restoration work). Finally, a broadly invited interagency team developed the adaptive management plan to prioritize the remaining uncertainties and describe in the plan how they may be addressed through the life of CEPP and inform CERP implementation.

Overall, the inclusion of adaptive management principals during this study provided several avenues to address and reduce risks and uncertainties and, during its continued implementation in the following phases of CEPP, will provide a mechanism to continue CEPP's achievement of its vision, goals, and objectives and effectively remain within its constraints.

D.5.6 How Adaptive Management Activities Will be applied during CEPP Implementation

D.5.6.1 Project Management

RECOVER will work with the CEPP project managers to develop workplans and monitoring scopes of work in coordination with other technical resource providers as needed to provide the budget, schedule, and details to execute the adaptive management strategies identified in the Annex D. At a minimum, one RECOVER scientist should be dedicated to overall all coordination of the CEPP monitoring and adaptive management efforts. Additional technical expertise should be engaged as needed. adaptive management activities will be implemented in sequence with the project components being implemented (see **Table D.1-6**). Workplans will include all necessary activities, resources needed, and schedule for completion so that they can be resourced appropriately and tracked by the project manager for progress and execution as part of the project schedule and implementation plan during design, construction, and operations.

Project components will be implemented in a staggered fashion due to budget (amount of funds available each year), regulatory requirements (permits and compliance monitoring feedback), and CEPP dependency constraints (state and federal projects required prior to implementation of a specific CEPP project component). Time needed to conduct certain adaptive management activities and tasks to inform subsequent project component is incorporated in the CEPP implementation schedule and the Strategies section of the CEPP Adaptive Management Plan. Each adaptive management strategy workplan will explain the timing needed to observe, understand, and report restoration performance results from any design tests, pilot projects, and/or response to phases of project components or full project components being implemented to inform CEPP implementation (see **Figure D.1.8** for adaptive management strategies and project implementation diagram).

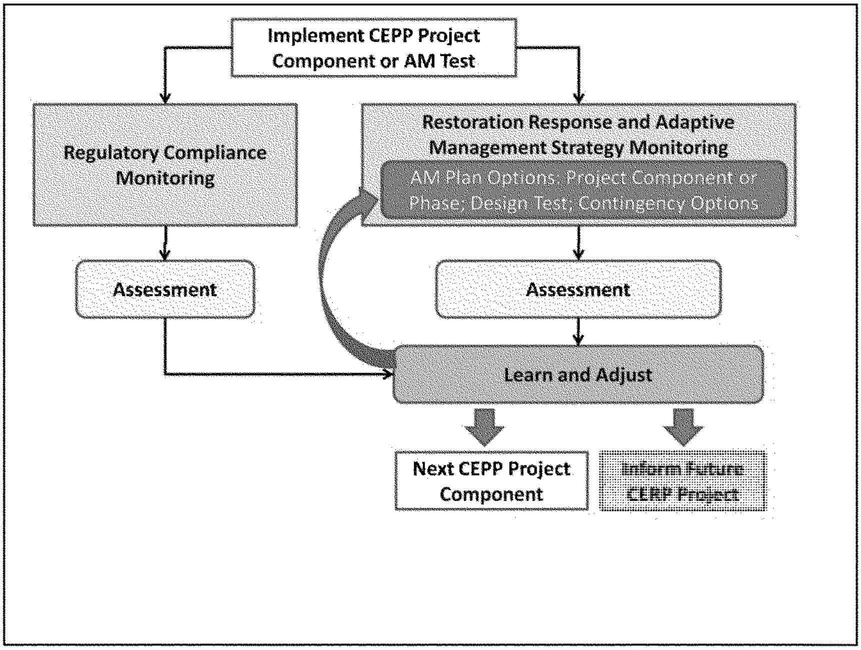


Figure D.1.8: Adaptive Management Strategies and Project Implementation Diagram.
This diagram shows that adaptive management can proceed associated with a full project component, phase, or test, with associated monitoring, to inform subsequent restoration actions. Monitoring should be implemented before and after implementation for regulatory compliance, restoration response, and adaptive management purposes, as described in the adaptive management and monitoring plans. The monitoring data assessed after construction, and any other current information, can then be coordinated with appropriate CERP agencies to determine progress or the need for adjustments. Adjustments are implemented as part of the adaptive management strategies or made to the next set of CEPP project components. The information can also be used to inform future CERP projects.

Adaptive management during CEPP's staggered implementation will incorporate learning to reduce uncertainties and associated risk with some of the components, with the intent of achieving cost savings and providing the ability for certain project components to be implemented more efficiently. In order for this learning to occur, adaptive management strategies will need to be implemented in sequence with the project schedule (see **Figure D.1.9**: CEPP Project Component Schedule and Adaptive Management Implementation).

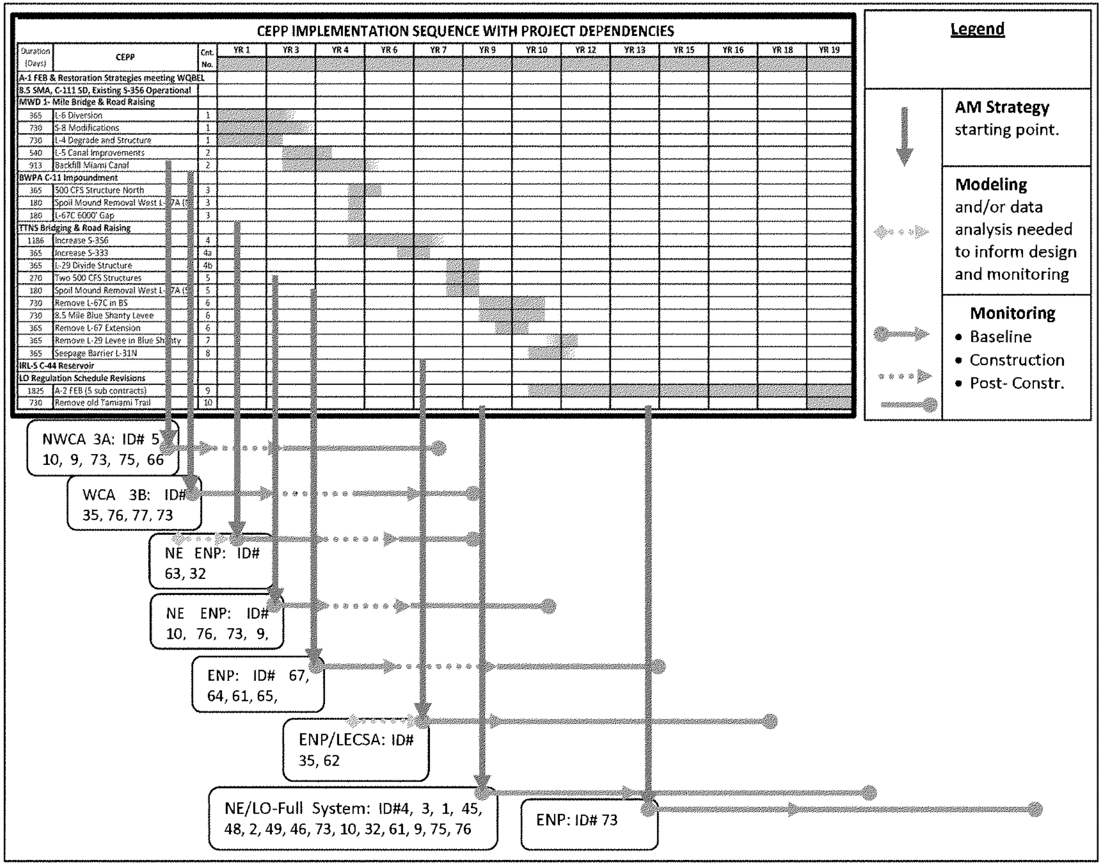

CEPP IMPLEMENTATION SEQUENCE WITH PROJECT DEPENDENCIES
Duration (Days)
CEPP
Cnt. No.
YR 1
YR 3
YR 4
YR 6
YR 7
YR 9
YR 10
YR 12
YR 13
YR 15
YR 16
YR 18
YR 19
A-1 FEB & Restoration Strategies meeting WQBEL
8.5 SMA, C-111 SD, Existing S-356 Operational
MWD 1- Mile Bridge & Road Raising
365 L-6 Diversion 1
730 S-8 Modifications 1
730 L-4 Degrade and Structure 1
540 L-5 Canal Improvements 2
913 Backfill Miami Canal 2
BWPA C-11 Impoundment
365 500 CFS Structure North 3
180 Spoil Mound Removal West L-67A 3
180 L-67C 6000' Gap 3
TTNS Bridging & Road Raising
1186 Increase S-356 4
365 Increase S-333 4a
365 L-29 Divide Structure 4b
270 Two 500 CFS Structures 5
180 Spoil Mound Removal West L-67A 5
730 Remove L-67C in BS 6
730 8.5 Mile Blue Shanty Levee 6
365 Remove L-67 Extension 6
365 Remove L-29 Levee in Blue Shanty 7
365 Seepage Barrier L-31N 8
IRL-S C-44 Reservoir
LO Regulation Schedule Revisions
1825 A-2 FEB (5 sub contracts) 9
730 Remove old Tamiami Trail 10
NWCA 3A: ID# 5, 10, 9, 73, 75, 66
WCA 3B: ID# 35, 76, 77, 73
NE ENP: ID# 63, 32
NE ENP: ID# 10, 76, 73, 9,
ENP: ID# 67, 64, 61, 65,
ENP/LECSA: ID# 35, 62
NE/LO-Full System: ID#4, 3, 1, 45, 48, 2, 49, 46, 73, 10, 32, 61, 9, 75, 76
ENP: ID# 73
Legend
AM Strategy starting point.
Modeling and/or data analysis needed to inform design and monitoring
Monitoring
• Baseline
• Construction
• Post- Constr.

Figure D.1.9: CEPP Project Component Schedule and Adaptive Management Implementation.
This figure integrates the CEPP Adaptive Management Plan with CEPP's component implementation by showing when certain monitoring and adaptive management activities will start and stop in coordination with the implementation of CEPP. The timeframes for this monitoring are limited to "up to 10 years" per WRDA 2007 Section 2039. The ID numbers reference CEPP Adaptive Management uncertainty IDs, which are described throughout this AM Plan (Sections 1.2 – 1.5). Due to the aggressive planning schedule of CEPP, this figure was created before the CEPP implementation schedule was finalized, and therefore this figure should be viewed as hypothetical and used only for purposes of explaining the staggered monitoring schedule. The purpose of the figure is to show that the adaptive management monitoring will adhere to the ten-year policy limit, by following a 'rolling implementation' that is coordinated with the construction of CEPP.

Table D.1.9: CEPP Adaptive Management Strategy Implementation with CEPP Project Construction in NWCA 3A. This table is associated with the following map (Figure D.1.10), and adds to Figure D.1.9 (above) by identifying CEPP project components (□ Drivers – Water management and restoration drive ecological change by changing stressor frequency, duration, and magnitude) and adaptive management strategies by area. This table specifies performance objectives and constraints to be avoided/minimized with each set of project components and the associated adaptive management strategies. Certain strategies involve sequential implementation of CEPP project components, e.g., ID# 73 regarding flow velocity for ridge and slough and the potential need for vegetation management to facilitate slough restoration. CEPP restoration performance expectations below are organized in a way that aligns with CERP conceptual ecological models: by stressors (o – Stressors are the factors most responsible for altering the Everglades ecosystem, such as altered hydrology; loss of habitat spatial extent and connectivity; altered geomorphology and topography), **ecological effects** (◊ - Ecological effects are the "cause-and-effect" linkages between stressors and ecological attributes)**, and attributes** (⇔ Attributes –a minimum set of key ecological indicators to track the decline or improvement of desired restoration changes) **following the symbology used in the South Florida Everglades Ecosystem conceptual ecological models (Ogden et al. 2005)**

Region	CEPP Project Component	CEPP Restoration Performance Expectations	CEPP Adaptive Management Strategy
Northern WCA 3A	□ L-6 Diversion □ S-8 Modifications □ L-4 Degrade and Structure □ L-5 Canal Improvements	o Improved hydroperiods o Increased sheetflow ◊ Reduced fire risk and soil oxidation ◊ Peat accretion ⇔ Improve fish, alligator, wading bird conditions ⇔ Maintain sawgrass ⇔ Restore ridge and slough	ID# 5, 10, 9, 73, 75, 66, 59, 6
	□ Miami Canal Backfill	o Improve hydroperiods ◊ Reduced risk of muck fires and soil oxidation	ID# 5, 10, 9, 73, 75, 66, 59, 6

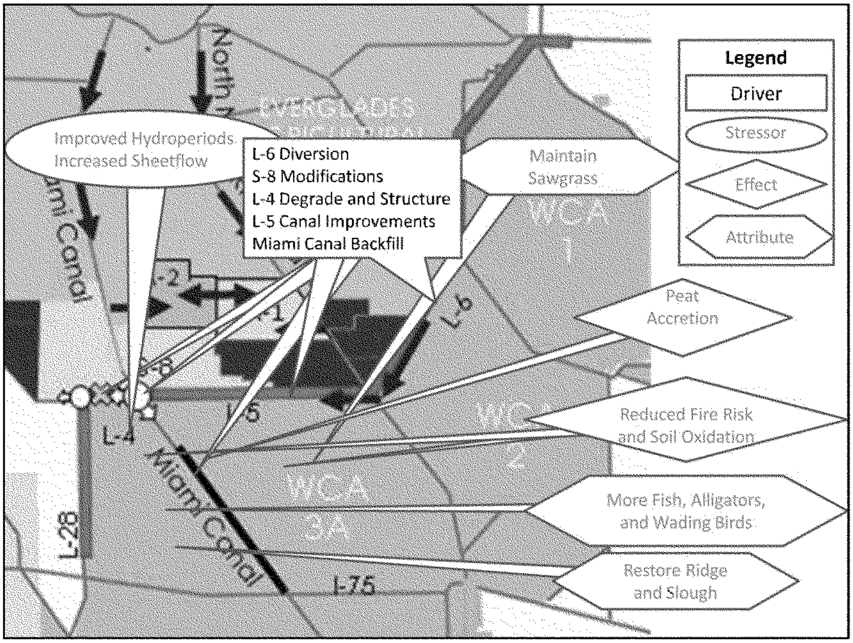


Figure D.1.10: Map of NWCA 3A Restoration Area, Associated Project Components, and Expected Performance.

Table D.1.10: CEPP Adaptive Management Strategy Implementation with CEPP Project Construction in WCA 3B. CEPP project components will be implemented incrementally in WCA 3B to test whether restoration performance objectives (hydroperiods, sheetflow, soil oxidation, fire, tree islands and ridge and slough) can be met minimum structures. This table and figure focus on restoration performance expectations east of the proposed Blue Shanty levee.

Region	CEPP Project Component	CEPP Restoration Performance Expectations	CEPP Adaptive Management Strategy
WCA 3B	☐ Northern most L-67A conveyance structure ☐ 6,000-ft L-67C levee degrade	Improved hydroperiods Improved sheetflow ◊ Reduced soil oxidation and fire ⇔ Maintain and restore tree island and ridge and slough	ID# 5, 35, 76, 77, 73
ENP	☐ S-333 increase flows ☐ S-356 testing		ID# 5, 63

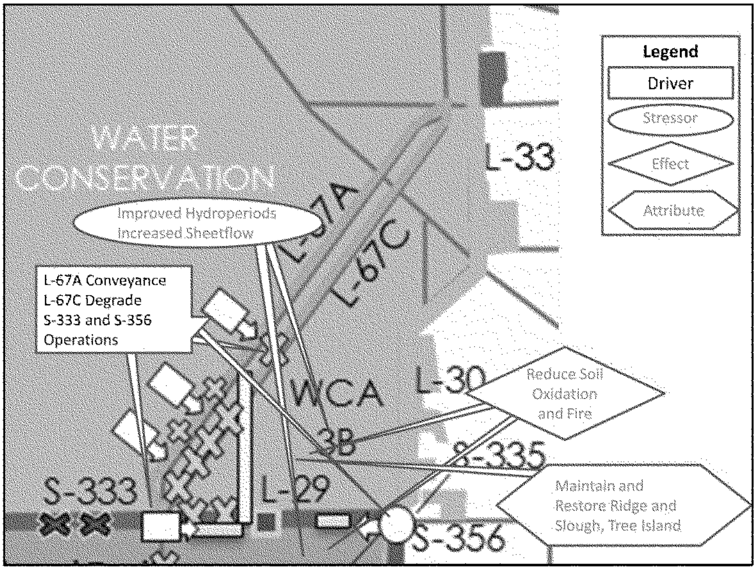


Figure D.1.11: Map of Restoration Area and Associated CEPP Project Components and Performance Expectations WCA 3B.

Table D.1.11: CEPP Adaptive Management Strategy Implementation with CEPP Project Construction in WCA 3B flowway and ENP.

The next CEPP project components will be implemented in WCA 3B and ENP to meet restoration performance expectations (hydroperiods, sheetflow, soil oxidation, fire, salinity in Florida Bay, tree islands and ridge and slough, small aquatic prey and wading birds, Florida Bay ecology)**.**

Region	CEPP Project Component	Restoration Performance Objectives	Adaptive Management Strategy
WCA 3B, Flowway, and ENP	☐ S-333 and S-356 improvements ☐ L-29 Divide Structure ☐ Additional L-67A conveyance ☐ Remove L-67C in Blue Shanty Flowway	⬭ Improved hydroperiods ⬭ Improved sheetflow ◊ Reduced soil oxidation and fire ◊ Peat accretion ⇔ Tree islands and ridge and slough ⇔ Increase small aquatic prey and large predators	ID# 5, 10, 76, 73, 9, 75, 77
	☐ Spoil Mound Removal West L-67A ☐ 8.5 Mile Blue Shanty Levee ☐ Remove L-29 Levee in Blue Shanty Flow Way	⬭ Improved hydroperiods ⬭ Improved sheetflow ◊ Salinity and ecological improvements to Florida Bay ◊ Reduced soil oxidation and fire ⇔ Tree islands and Ridge and Slough ⇔ Increase small aquatic prey and large predators	ID# 5, 67, 64, 61, 65,

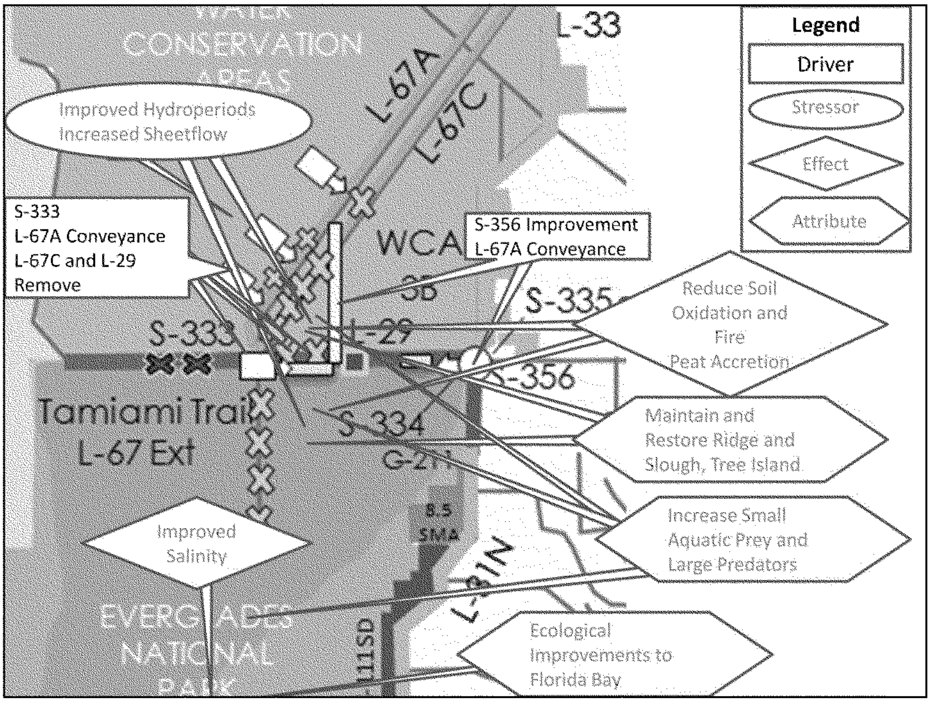


Figure D.1.12: Map of Restoration Area and Associated CEPP Project Components and Performance Expectations WCA 3B and ENP including Florida Bay.

Table D.1.12: CEPP Adaptive Management Strategy Implementation with CEPP Project Construction in ENP, Miami-Dade, and Biscayne National Park (BNP).

Seepage management features will be implemented with adjustments to WCA 3 and South Dade Conveyance System operations to ensure restoration objectives in the Central Everglades are met, while not impacting current water supply, flooding risk, and Biscayne Bay salinity and ecology in BNP. Restoration performance expectations (hydroperiods, sheetflow, Lower East Coast (LEC) water supply, flood control, Biscayne Bay salinity, Biscayne Bay ecology) are to maintain current performance.

Region	CEPP Project Component	Restoration Performance Objectives	Adaptive Management Strategy
ENP-Miami-Dade – BNP	□ Seepage Barrier L-31 N Increment □ WCA 3 and South Dade Conveyance System Operations	⬭ Maintain flows in dry season ⬭ Maintain seepage control in wet season ◊ LEC water supply ◊ Flood control ◊ Biscayne Bay Salinity ⇔ Biscayne Bay Ecology	ID# 35, 62, 77

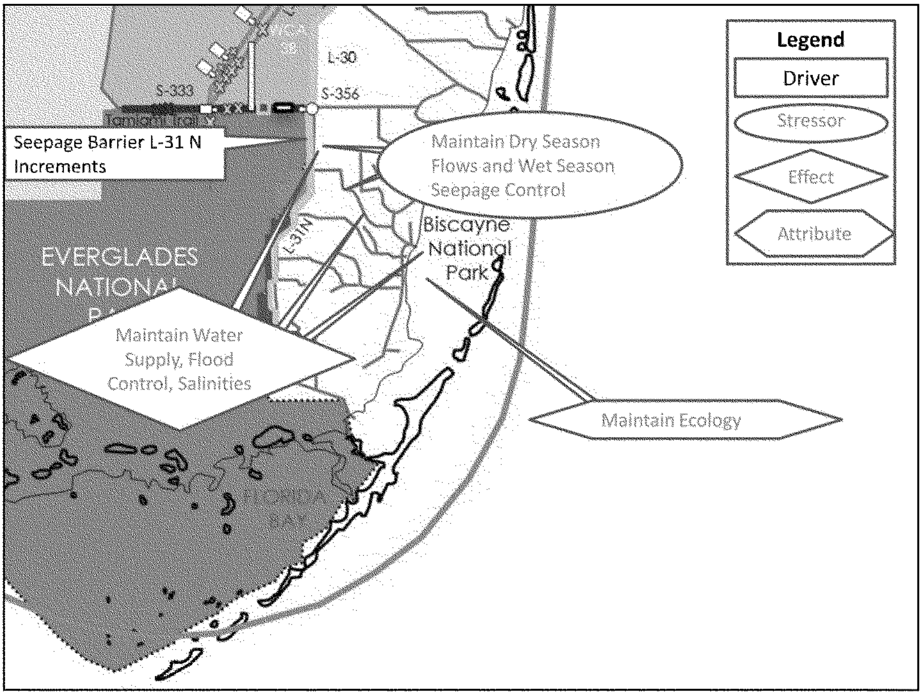


Figure D.1.13: Map of Restoration Area and Associated CEPP Project Components and Performance Expectations Lower East Coast and Biscayne National Park.

Table D.1.13: CEPP Adaptive Management Strategy Implementation with CEPP Project Construction and Operations Full System.

The next CEPP projects will be implemented: L-31 seepage management based on learning from seepage management testing, and A-2 FEB based on learning from A-1 FEB State Water Quality Strategies Science Plan to meet restoration performance objectives for the whole system. Stressors, effects, and attributes would continue to be observed for additional performance and avoidance/minimization of unintended effects. In addition, the restoration performance expectations in the Northern Estuaries (reduced high flows, improved salinities, increased oyster and seagrass density and acreage) can be met with implementation of these CEPP project components.

Region	CEPP Project Component	Restoration Performance Objectives	Adaptive Management Strategy
Full System	☐ Seepage Barrier L-31 N Additional Increment ☐ A2-FEB	◊ ⇦ Full restoration benefits ◊ LEC water supply and flood control	ID#4, 3, 1, 2, 9, 10, 45, 49, 46, 61, 67, 73, 75, 76

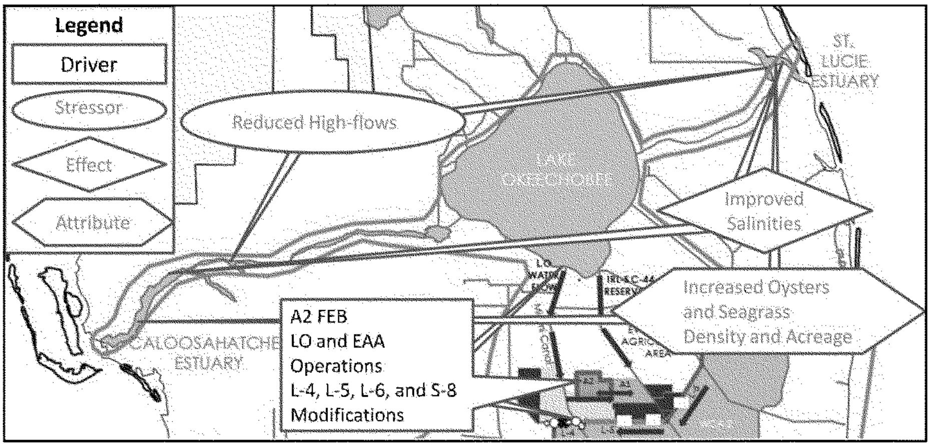


Figure D.1.14: Map of Restoration Area and Associated Project Components and Performance Objectives in Northern Estuaries.

Table D.1.14: CEPP Adaptive Management Strategy Implementation with CEPP Project Construction and Operations in ENP – Table describes remaining CEPP project components to construct if needed to improve sheetflow in ENP.

Region	CEPP Project Component	Restoration Performance Objectives	Adaptive Management Strategy
ENP	☐ L-67 extension levee removal and modifications to old Tamiami Trail	Improved sheetflow	ID# 73

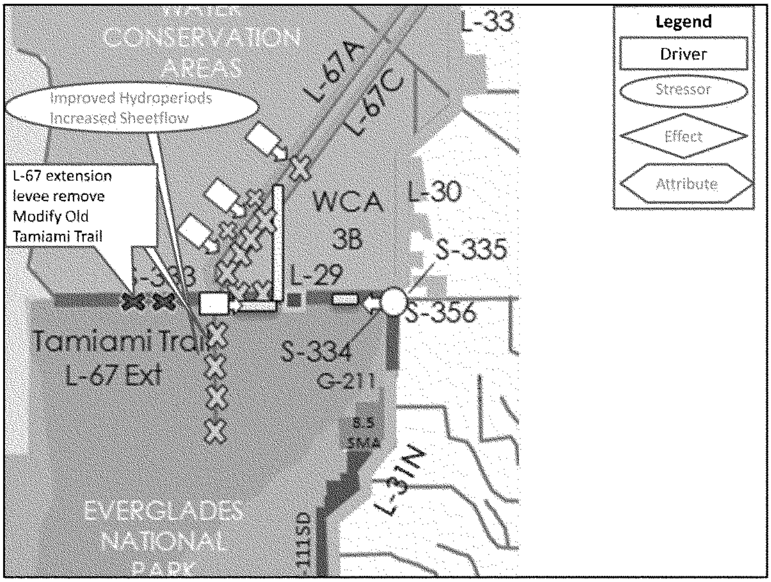


Figure D.1.15: Map of Restoration Area and Associated CEPP Project Components and Performance Expectations in ENP.

D.5.7 Design

Adaptive management activities will also be executed during the preliminary engineering and design (PED) phase of the project. Adaptive management strategies that may involve pilot projects, operational tests, and phased implementation as described in this adaptive management plan will be discussed during value engineering and detailed design to determine the full scope of each test, project construction phase and implementation. RECOVER team members tasked with overseeing CEPP adaptive management will coordinate with the CEPP engineers and water managers to ensure project designs, tests, and project operations manual allow flexibility for adaptive management implementation, as well as ensure monitoring plan designs, thresholds-triggers, and reporting is consistent with engineering design and water management needs. Adaptive management strategies will also involve updates to monitoring and assessment plans to better develop experimental designs, monitoring locations, and analysis methods, as well as initiate baseline monitoring data. Some adaptive management activities will need to begin early enough to allow development of the monitoring plan design and to implement monitoring contracts to support establishment of a minimal baseline before construction of CEPP project components is completed.

Monitoring and Experimental Design

RECOVER and other agency monitoring that is being relied upon to inform the CEPP implementation as identified in the adaptive management plan will be reviewed to determine if changes in scope and frequency are needed to better capture CEPP effects. The activities described here fall within the approved CEPP adaptive management budget. CEPP specific monitoring identified in the monitoring and adaptive management plan will require scopes of work, schedules, and assessment protocols to be developed and coordinated by RECOVER to determine monitoring location and experimental design details to update the monitoring plan. Data analysis and modeling may be needed to inform the statistical sampling design needed for monitoring to be able to test CEPP project hypotheses. Before and after control designs will be specified in the monitoring plan update, consistent with the parameters identified in each strategy and within the constraints specified by regulatory permits. CEPP monitoring plan design will use existing data where possible, e.g., RECOVER and other agency monitoring efforts. Adaptive management strategies maybe updated with more detailed decision trees to outline the decision-points associated with triggers/thresholds identified in each strategy. Decision trees will describe who receives reports, who provides guidance on decisions associated with the results, and what potential adjustments might occur. Updated monitoring plans will be coordinated for approval by implementing agencies and concurrence by participating agencies and Tribes.

Baseline Monitoring

In cases where there is not sufficient pre-project data monitoring, contracts will need to be initiated prior to construction of specific CEPP components (see **Figure D.1.9** for illustration of baseline monitoring needs). Final assignment of agency monitoring responsibilities will be made after state and federal regulatory permits are issued for a component. RECOVER, USACE, and SFWMD monitoring points-of-contact will be identified to coordinate and implement monitoring with in-house agency resources or via contracts with CERP partner agencies and/or contracted universities or consultants to most efficiently and effectively execute the monitoring plan designs. Designated contacts will ensure that results are shared with the partnering agencies and non-governmental stakeholders for the duration of the monitoring plan. In addition, prior to construction of any component and/or test, a baseline monitoring report will be developed by RECOVER and coordinated with the project team and stakeholders, as stated in the PIR monitoring and adaptive management plan. The report results will be presented during annual (or as frequently as needed) State of the Central Everglades Planning Project technical meeting described below in the post construction and operations and maintenance section.

Pre-construction Engineering and Design (PED)

Project component designs will be developed and coordinated with RECOVER to ensure project component designs are consistent with the testing objectives identified in the adaptive management plan strategy. Further data analysis or review of other project design and monitoring information may be required to inform the design of CEPP project components (e.g., FEB and Seepage Management project components). In addition, monitoring locations that need to be installed prior to construction for baseline monitoring will be coordinated with the PED team to ensure they are aligned properly. The PED team will share project component plans and specifications with the RECOVER. Monitoring contract schedules will be aligned with project construction schedules and operating protocol as defined in the project component's operational strategy and consistent with the experimental design outlined in the adaptive management plan. RECOVER CEPP point of contacts will also be responsible for conveying results from annual monitoring reports to the PED team to help determine options for improving project designs, particularly for the blue shanty and seepage management features, but also for additional project components when deemed relevant and necessary.

Project Operating Manuals

Project operating manuals are developed during design by water managers in coordination with engineers, and hydrologists to specify the operating criteria for each structure. Water managers and engineers will coordinate with RECOVER to understand what hydrologic analysis is needed to inform operational criteria to be used as part of adaptive management tests. In addition, RECOVER will work with water managers, planners, and hydrologists to ensure flexibility is incorporated into the project operational plan to allow for potential needed adjustments in the future consistent with regulatory constraints and NEPA analysis. RECOVER will work with water managers to identify the monitoring information, triggers and process to be included in the project operating manual that will inform operational adjustments. Project operating manuals should also include the process by which operational changes will be assessed throughout the year to integrate with assessments of monitoring data and report the effects of operational decisions as part of the annual State of the Central Everglades meeting, and/or similar relevant discussions. Draft project operating manuals will be reviewed by the RECOVER CEPP points of contacts, as well as regulatory agencies, to coordinate with the adaptive management strategies outlined in the PIR monitoring and adaptive management plan and with regulatory permit requirements.

D.5.8 Construction

Construction schedules, construction contract language, and implementation progress will be coordinated with RECOVER to ensure that appropriate flexibility is included as needed to be effective in fulfilling the intent of the adaptive management plan. Schedules and implementation should include monitoring and operational tests consistent with the adaptive management strategies described in the adaptive management plan in order to learn from project component implementation. In some cases, when agreed to by the implementing agencies, adaptive management strategies may require adjustment to construction schedules to be able to learn from implementation of one phase to inform additional phases. This logic will reduce uncertainty and risk, could reduce cost, and will need to be incorporated into the construction schedule and contracting approaches to ensure this flexibility. See **Figure D.1.9**, CEPP Project Component and Adaptive Management Implementation, for specific adaptive management strategies that are intended to inform construction schedule. For more detail, see specific example provided in **Figure D.1.16** for how one CEPP adaptive management strategy informs the construction schedule.

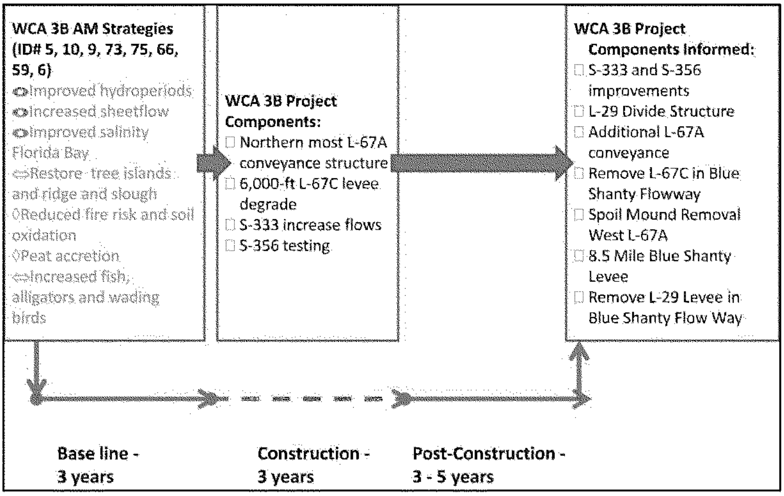


Figure D.1.16: CEPP Adaptive Management Strategy Informs Construction Schedule.
This figure identifies how the adaptive management strategies and monitoring timelines could inform the construction schedule to ensure opportunities to improve CEPP implementation. Adaptive management strategies (ID# 5, 10, 76, 73, 9, 75, 77) monitoring for WCA 3B should be implemented at least 3 years before all project components affecting the delivery of water into WCA 3B are constructed to establish a minimal baseline. (Please note that baseline monitoring will extrapolate backwards in time to create a longer baseline where possible, using RECOVER and other agency monitoring data). Minimal monitoring may occur during construction for 3 years. Between 3-5 years of post-construction monitoring is needed verify performance, and determine which CEPP project components to implement next in WCA 3B to achieve goals and objectives. In order to ensure WCA 3B projects are informed from lessons learned in WCA 3B, the design/construction of additional WCA 3B features would occur after the monitoring results are expected to be available. In this example, using the current recommended plan implementation schedule, the additional L-67 A structures could be modified during design, need for Blue Shanty substantiated, and the schedule lengthened by 3 -5 years before initiating construction for these features, if needed.

D.5.9 Post Construction and Operations, Maintenance, Repair, Replacement, and Rehabilitation

Post Construction Monitoring

CEPP specific project monitoring, RECOVER system-wide monitoring and other agency monitoring will be assessed by RECOVER to determine the restoration performance related to key project components or groups of components (see **Figure D.1.9** CEPP Adaptive Management Strategy Implementation and Project Construction). The timing outlined in each strategy will determine when data analysis and reporting should occur based on the temporal and spatial scale of the parameters being assessed. The triggers and thresholds outlined in the management option matrices and adaptive management strategies will guide the frequency of reporting and whom the reports are intended to inform. For example, strategies developed to address higher risk uncertainties may require more frequent reporting to CEPP implementing agencies and associated regulatory agencies to ensure constraints are addressed. Other strategies will have monitoring implemented after a particular project component is constructed for a specific timeline to report results to inform CEPP operations or construction of subsequent project components (See **Figure D.1.17**).

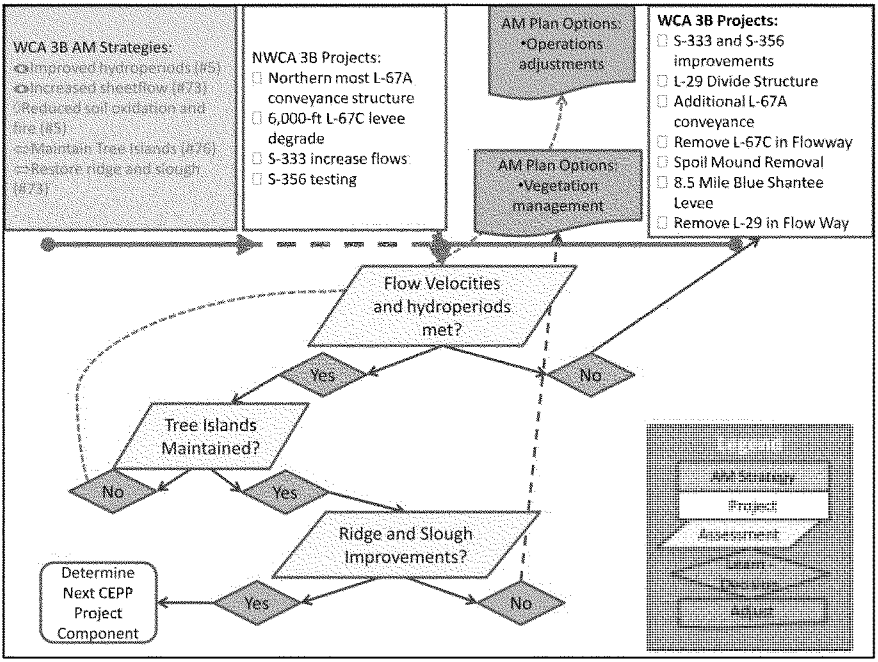


Figure D.1.17: CEPP Adaptive Management Strategies Inform Implementation.
Diagram of post-construction monitoring and adaptive management process, to compare with the during-implementation monitoring and adaptive management process illustrated in Figure D1X. In WCA 3B, post construction monitoring focuses first on whether flow velocities and hydroperiods being met. If not, analysis needs to determine why before determining the next set of CEPP project components to implement to improve performance. If yes, monitoring must substantiate tree islands are being maintained to avoid large unintended consequences. Monitoring is actually focused on both hydroperiods necessary for tree islands and tree island vegetation to determine if tree islands may be impacted. If tree islands are not being maintained (no), then operations need to be adjusted to minimize adverse affects on tree islands. If tree islands are being maintained (yes), then monitoring should examine the ecological effects and attributes indicating whether ridge and slough is improving. If not, vegetation management may be needed to open up sloughs and reinforce ridges. If they are improving, then scientists, engineers, managers need to determine next CEPP project components to implement, because original plan for additional L-67 conveyance and Blue Shanty Levee would not be needed.

Post Construction Assessment, Reporting, and Linking to Decision-Making

CEPP assessment results will be reported to the implementing agencies and CEPP partner agencies as part of the RECOVER system-status report, South Florida Environmental report, or more frequently if needed. The process for reporting results to decision-makers is provided in the CERP science feedback to decision-making diagram in the CERP Adaptive Management Integration Guide (Figure 3-9, RECOVER

2011b). The process has changed slightly since publication: 1) Senior-level decision-making/coordination bodies have been renamed from the Joint Project Review Board (JRB) to the Quarterly Executive Team (QET), and the Quality Review Board (QRB) to the Quarterly Agency Team (QAT.

As part of assessing and reporting CEPP's performance, annual State of the Central Everglades (CEPP) meetings will be coordinated by RECOVER to discuss assessment results. Scientists, hydrologists, engineers and water managers will present results of structural and operational changes (Drivers) and corresponding hydrological (Stressors), ecosystem processes (Effects), and ecological response (Attributes) specific to CEPP implemented project features, tests, and/or operational changes. The meeting goal will be to understand status and trends and potential causes of performance issues and/or success, as well as discuss the reality of what options (CEPP and non-CEPP related) are available to improve performance if needed. The meetings could occur in late summer or early fall after completing a water year (ending April 30). The meetings will be CEPP performance focused. The meetings will require coordination among RECOVER entities overseeing monitoring (CEPP project funded, RECOVER, and non-agency funded), and trained facilitation is recommended to ensure the technical meeting fulfills the CEPP assessment reporting goals. RECOVER will work with the South Florida Ecosystem Restoration Task Force's Science Coordination Group to determine if that forum should host the technical meeting to encourage broader non-governmental stakeholder participation.

No later than 1 -2 months after the annual State of the Central Everglades meeting, an environmental coordination meeting will be held with managers to discuss with managers any performance issues and to communicate success. This meeting will also be used to agree on the appropriate forum to make decisions about options to adjust CEPP implementation and operations, if determined to be needed, e.g., DCT, QET, or QAT.

Monitoring results will be reported in the context of the triggers/thresholds identified in the adaptive management strategies, e.g. if performance remains within the triggers/thresholds that are provided to indicate need for adjustments, then the operations may continue or the next project component may be constructed based on the demonstrated results. Constraint triggers/thresholds that are "triggered" will be reported to CEPP implementing agencies and associated regulatory agencies with suggestions of management options to implement, as stated in the adaptive management plan management options matrices (MOMs), to be evaluated by the agencies to decide what action is needed. Results of multiple monitoring trends will be integrated as part of a multiple lines of evidence analysis (Burton, et al. 2002; RECOVER 2006) to inform the potential need for adjusting CEPP implementation or documenting success.

Suggested options to adjust CERP implementation fall into several categories, listed here by level of effort required to implement:

1. Operational Decisions: Operations decisions are weekly/monthly, but get reported and summarized and reported at annual meetings. Annual meetings also are a forum to discuss potential upcoming operations decisions (e.g. , wet vs. dry years going into El Nino or La Nina years);
2. NEPA Covered Options, No Modeling Needed: CEPP adaptive management plan options that are covered by NEPA and do not require additional modeling or analysis beyond what has been discussed by scientists and managers;

3. NEPA Covered Options, Requires Modeling: CEPP adaptive management plan options that are covered by NEPA but may require model runs to determine best option;
4. Not NEPA Covered: CEPP adaptive management options that have not yet undergone sufficient NEPA analysis and therefore require additional environmental review and public comment, and potentially additional modeling.
5. Not Included in CEPP adaptive management plan: In some cases, the monitoring results may indicate the need for an option not identified in the adaptive management plan or PIR/EIS. This may result in agency-approved temporary adjustment to CEPP implementation and operations to avoid the constraint while potential project adjustments are further scoped, analyzed, approved, and budgeted for implementation. If additional technical expertise is required in RECOVER, an ad-hoc team could be formed to identify performance issues and options in a post authorization change report or make suggestions for a future CERP project.

The USACE Jacksonville District in consultation with Federal and State resource agencies and the USACE South Atlantic Division (SAD) and the South Florida Water Management District will guide decisions on determining whether restoration success has been achieved or additional operational, structural, or other contingency options identified in the adaptive management plan MOMs need to be implemented.

D.6 CEPP Adaptive Management Plan Cost Estimate

Identification of the CEPP monitoring contained in Annex D was guided partly by two objectives. First, it must be complete from a CEPP perspective in that it must provide the monitoring required to address CEPP-specific needs. Second, it must be integrated with other Everglades monitoring to take advantage of existing monitoring efforts, knowledge, and information and thereby leverage dollars committed and spent elsewhere to avoid redundancies and insure cost-effectiveness. These two objectives guided development of the adaptive management plan, hydrometeorological monitoring plan, water quality monitoring plan, and the ecological monitoring plan. Where possible, CEPP will rely on existing monitoring resources such as physical instrumentation, stations, locations, servicing, and analysis efforts funded by RECOVER, CERP sponsors, and partner agencies. Therefore the monitoring described in the CEPP Adaptive Management and Monitoring plan is limited to the additional, marginal increase in monitoring resources and analysis efforts needed to address CEPP-specific questions. It is assumed that the monitoring programs will continue for at least the time needed by CEPP. The cost estimate for the adaptive management monitoring can be found in Table D.1.1.

Table D.1.15: CEPP Adaptive Management Monitoring Cross-walked with Other Monitoring Programs.
CEPP monitoring costs are shown here as if all monitoring will take place in one 10-year window. Therefore CEPP costs here are a 'worst case', whereas the actually monitoring schedule is expected to be staggered over the CEPP implementation schedule as shown in Figure D.1.10 and would therefore cost the project less per year. Dollar amounts shown here have not been updated with CEPP project-wide contingency amounts. These costs were provided before CEPP project contingencies were applied. ***It should not be assumed that the added contingency amounts will be available specifically to fund monitoring efforts*****. See Table D.1.1 (this Annex) and PIR Section 6 for more information on final cost estimates for CEPP.**

Region or Specific CEPP Area	Uncertainty	ID#	Attributes to be Monitored	RECOVER 1-Yr Cost	Other Agency 1-Yr Cost	CEPP 1-yr Cost*	Sampling Frequency	Notes
Lake Okeechobee	Lake O littoral and near shore vegetation: potential effects Lake stages with CEPP	#3	littoral and near shore vegetation coverage	$ -	$ 47,000	$ 23,500	Current monitoring ranges from daily (Lake stages) to 3x per year (veg transects)	Assumptions based on need for additional labor to due analysis pursuant to CEPP objectives/constraints. SFWMD already pays for monitoring.
Everglades Agricultural Area Flow Equalization Basin (FEB)-2	How can we most effectively learn from the A-1 FEB to integrate A-1 FEB and FEB-2, to optimize their operations to maximize flows to the Everglades via the FEBs while balancing the related needs of Lake Okeechobee and the northern Everglades?	#4	TBD, but are likely to include the quality and quantity of fresh water delivered into and out of the integrated FEB-A-1 and FEB-2 units, STA 2 and STA 3/4, water into WCA 3A and at state water quality (WQ) monitoring compliance locations.	$ -	$ -	$ 135,000	Weekly	Estimate is based on proportion of additional monitoring needed to address A2 FEB specific questions that will arise after learning from the State Water Quality Strategies Science Plan reports on the A1 FEB.

Region or Specific CEPP Area	Uncertainty	ID#	Attributes to be Monitored	RECOVER 1-Yr Cost	Other Agency 1-Yr Cost	CEPP 1-yr Cost*	Sampling Frequency	Notes
Northern Estuaries Region (NE) SLE	Do reductions of high volume fresh water discharges result in measurable increases in submerged aquatic vegetation (SAV) coverage in the St. Lucie estuary (SLE)?	1	SLE SAV	$ 45,000	$ -	$ 45,000	6 summer months, 1 winter	
NE SLE	Will the increased frequency of low flow exceedences and timing in the SLE have a detrimental impact on oyster communities by increasing levels of predation and disease during extreme dry times? (ID#48)	45,48	SLE Oysters	$ 100,000	$ -	$ 10,000	Monthly, accept live /dead counts 4x/year	
NE SLE	To what extent will the reduction in the frequency and magnitude of high flows to the SLE help reestablish historic oyster beds on the south fork SLE? (ID#45)	1,45, 48	SLE Oyster and SAV mapping	$ -	$ -	$ 15,000	$75,000 every 5 years	

Region or Specific CEPP Area	Uncertainty	ID#	Attributes to be Monitored	RECOVER 1-Yr Cost	Other Agency 1-Yr Cost	CEPP 1-yr Cost*	Sampling Frequency	Notes
NE SLE	To what extent will the reduction in the frequency and magnitude of high flows to the SLE stabilize conditions enough to improve benthic habitat in the south fork St. Lucie estuary? (ID#46)	46	SLE Benthos	$ 85,000	$ -	$ -	quarterly	
NE SLE	see above	1,45, 48,46	SLE Salinity stations	$ -	TBD	$ -	daily	SFWMD and County salinity stations
NE SLE	see above	1,45, 48,46	SLE WQ	$ -	$ 40,867	$ -	monthly	SFWMD and County WQ stations
NE Caloosahatchee River Estuary (CRE)	Will the reduction in low flow exceedences in the Caloosahatchee estuary help re-establish healthy Vallisneria beds in the upper Caloosahatchee estuary? (ID#49)	2,49	CRE SAV	$ 68,000	$ -	$ -	6 summer months, 1 winter	
NE CRE	Do reductions of high volume fresh water discharges result in measurable increases in SAV coverage and oyster	2	CRE Oyster	$ 190,000	$ -	$ -	Monthly, accept live /dead counts 4x/year	

Region or Specific CEPP Area	Uncertainty	ID#	Attributes to be Monitored	RECOVER 1-Yr Cost	Other Agency 1-Yr Cost	CEPP 1-yr Cost*	Sampling Frequency	Notes
	acreage and health in the Caloosahatchee estuary? (ID#2)							
NE CRE	see above	1,49	CRE Oyster and SAV mapping	$ -	$ -	$ 25,000	$125,000 every 5 years	
	see above	1,49	CRE Salinity	$ -	TBD	$ -	daily	SFWMD and County salinity stations
	see above	1,49	CRE WQ	$ -	$ 20,433	$ -	monthly	monthly SFWMD
Greater Everglades (GE) Northeastern (NE) Water Conservation Area (WCA) 3A	Will CEPP reduce soil oxidation and peat fires in NE-WCA3A, WCA-3B and SRS?	5	Soil Moisture Content; Peat Accretion; Fire mapping; Community Structure; Radiometric Dating; Soil Decomposition; Weather; Hydrology	$ 30,000	$ -	$ 100,000	Monthly, Quarterly; 1 GRTS every year	NE-WCA3A; CEPP - Fire mapping; CEPP 3 N-S transects; 2 E-W transects; 6 General Randomized Tessalated Stratification (GRTS) (2 CEPP) panels; CEPP - Hydro/met stations.
GE WCA 3B	Will CEPP reduce soil oxidation and peat fires in NE-WCA3A, WCA-3B and SRS?	5	Soil Moisture Content; Peat Accretion; Fire mapping; Community Structure; Radiometric Dating; Soil Decomposition; Weather; Hydrology	$ 15,000	$ 20,000	$ 50,000	Monthly, Quarterly; 1 GRTS every yr	WCA3B: One N-S transect; One E-W transect; 4 GRTS panels (2 RECOVER).; Everglades Depth Estimation Network (EDEN) Hydro USGS
GE Shark River Slough (SRS)	Will CEPP reduce soil oxidation and peat fires in NE-WCA3A, WCA-3B and SRS?	5	Soil Moisture Content; Peat Accretion; Fire mapping; Community Structure; Radiometric Dating; Soil	$ 30,000	$ 100,000	$ 100,000	Monthly, Quarterly; 2 GRTS every yr	SRS: Two N-S transect; Two E-W transect; 8 GRTS panels (6 REOCVER). Other, Long Term Ecological

Region or Specific CEPP Area	Uncertainty	ID#	Attributes to be Monitored	RECOVER 1-Yr Cost	Other Agency 1-Yr Cost	CEPP 1-yr Cost*	Sampling Frequency	Notes
			Decomposition; Weather; Hydrology					Research Institute (LTER), ENP, USGS, and SFWMD hydro-Met Stations)
GE NE WCA 3A	Will CEPP hydroperiods, depths and flow velocities reestablish ridge and slough landscapes, including tree islands? -- Will Biogeochemical response be altered by changes in the timing and distribution of CEPP hydrology?	63, 73 and 76	Tree Island Attributes (Peat Accretion, Soil Nutrients, Community Structure, GW flows); Ridge & Slough Attributes (Community Structure, Floc analysis, periphyton, sediment movement, flow velocities); Canal Attributes	$ -	$ 60,000	$ 250,000	Large flow events, monthly; annual	Northern WCA-3A - Other SFWMD and EDEN.
GE WCA 3B and Blue Shanty Flowway	Will CEPP hydroperiods, depths and flow velocities reestablish ridge and slough landscapes, including tree islands?-- Will Biogeochemical response be altered by changes in the timing and distribution of CEPP hydrology?	63, 73 and 76	Tree Island Attributes (Peat Accretion, Soil Nutrients, Community Structure, GW flows); Ridge & Slough Attributes (Community Structure, Floc analysis, periphyton, sediment movement, flow velocities)	$ 65,000	$ 50,000	$ 425,000	Large flow events, monthly; annual	WCA-3B vs. Blue Shanty Flowway; Other (EDEN-SFWMD); RECOVER (GRTS panel and tree islands)

Region or Specific CEPP Area	Uncertainty	ID#	Attributes to be Monitored	RECOVER 1-Yr Cost	Other Agency 1-Yr Cost	CEPP 1-yr Cost*	Sampling Frequency	Notes
GE SRS	Will CEPP hydroperiods, depths and flow velocities reestablish ridge and slough landscapes, including tree islands?	73 and 76	Tree Island Attributes (Peat Accretion, Soil Nutrients, Community Structure, GW flows); Ecotone analysis	$ 150,000	$ 20,000	$ 75,000	Large flow events, monthly; annual	Western vs. Eastern SRS (RECOVER GRTS Panel, Transects marl prairie, Tree island, and vegetation mapping)
GE Everglades National Park (ENP) (SRS, Taylor Slough, Mangrove wetland, nearshore Fl Bay & Whitewater Bay Marl Prairie)	Will Biogeochemical response be altered by changes in the timing and distribution of CEPP hydrology?	63	Tree islands, Creeks and Marsh: Soil dynamics, Periphyton, WQ, Vegetation Mapping, Nutrient outflow to estuaries,	$ 100,000	$ 150,000	$ 150,000	monthly; Annual	ENP - RECOVER Vegetation mapping, periphyton, GRTS; Other (EDEN, SFWMD, ENP, LTER)
GE ENP (SRS, Taylor Slough, Mangrove wetland, nearshore Fl Bay & Whitewater Bay)	Will CEPP mitigate saltwater intrusion effects on coastal wetland vegetation , soil, and nutrient retention or release?	64	Changes in saltwater intrusion extent, salinity, vegetation, soil nutrient and carbon dynamics; Resistivity; Shallow wells.	$ 20,000	$ 100,000	$ 175,000	seasonal, Annual	ENP (SRS, Taylor Slough, Mangrove wetland, nearshore Fl Bay & Whitewater Bay) RECOVER - GRTS Other (SFWMD, ENP, LTER)

Region or Specific CEPP Area	Uncertainty	ID#	Attributes to be Monitored	RECOVER 1-Yr Cost	Other Agency 1-Yr Cost	CEPP 1-yr Cost*	Sampling Frequency	Notes
GE ENP (Fl Bay & Whitewater Bay / SW coast estuaries)	Will CEPP improve flows to Florida Bay and the Lower Southwest coast resulting in more natural salinity patterns (magnitude, spatial distribution and timing) to support estuarine food webs (SAV, sportfish, prey, coastal wading birds, and crocodiles)?	67,65	Coastal wetland and nearshore food web analysis and modeling	$ 400,000	$ 100,000	$ 75,000	daily, seasonal, annual	ENP (Fl Bay & Whitewater Bay / SW coast estuaries) Other (SFWMD, ENP, LTER)
GE WCA 3A (NW, NE, South)	How much will hydrologic restoration and vegetation management in Northwest WCA 3A, WCA 3B and NESRS result in increases in prey densities (aquatic fauna).	75, 9	Aquatic fauna density; Large fish density	$ 500,000	$ -	$ 50,000	Five times per year	WCA 3A (NW, NE, South)
GE WCA 3B	How much will hydrologic restoration and vegetation management in Northwest WCA 3A, WCA 3B and NESRS result in increases in prey densities (aquatic fauna).	75, 9	Aquatic fauna density; Large fish density		$ -	$ 25,000	Five times per year	WCA 3B

Region or Specific CEPP Area	Uncertainty	ID#	Attributes to be Monitored	RECOVER 1-Yr Cost	Other Agency 1-Yr Cost	CEPP 1-yr Cost*	Sampling Frequency	Notes
GE SRS	How much will hydrologic restoration and vegetation management in Northwest WCA 3A, WCA 3B and NESRS result in increases in prey densities (aquatic fauna).	75, 9	Aquatic fauna density; Large fish density		$ -	$ 20,000	Five times per year	NESRS
GE WCA 3A (NW, NE)	How much will CEPP improve terrestrial wildlife and alligator relative density and body condition in northern WCA 3A?	10	Alligator relative density; Alligator body condition; Deer abundance; Wildlife Diversity	$ -	$ -	$ 85,000	Twice a year (Spring and Fall)	CEPP (2 NW, 1 NE, 1 S routes)
GE WCA 3B	How much will CEPP improve alligator relative density and body condition in northern WCA 3A, WCA 3B and NESRS?	10	Alligator relative density; Alligator body condition	$ -	$ -	$ 15,000	Twice a year (Spring and Fall)	WCA 3B CEPP (1-2 routes)
GE SRS	How much will CEPP improve alligator relative density and body condition in northern WCA 3A, WCA 3B and NESRS?	10	Alligator relative density; Alligator body condition	$ -	$ -	$ 15,000	Twice a year (Spring and Fall)	NESRS(1-2 routes)

Region or Specific CEPP Area	Uncertainty	ID#	Attributes to be Monitored	RECOVER 1-Yr Cost	Other Agency 1-Yr Cost	CEPP 1-yr Cost*	Sampling Frequency	Notes
GE WCA-3B, Blue Shanty flowway, WCA 3A (NW, NE, South), SRS, Fl Bay	How much will hydrologic restoration and vegetation management result in increases in wading bird foraging conditions and increased nest number and success of Wood Storks and Roseate Spoonbills?	75	Prey availability, Integration/refinement of existing modeling tools/application after construction	$ 400,000	$ -	$ 120,000	One season (dry)	WCA-3B, Blue Shanty flowway, WCA 3A (NW, NE, South), SRS, Fl Bay
Lower East Coast (LEC) Uncertainties	Will the constructed and operational features of CEPP maintain flood protection level of service east of the L-30, L-31, and C-111 without reducing quantity or quality of groundwater in water supply wellfields compared to existing conditions? (ID#35 –);	35, 62	Hydrologic & WQ (Surface/GW; Salinity; Stage; Flow)	$ 110,000	$ 1,551,000	$ 225,000	Monthly; Continuous	Salinity - 38k@; 27 SWL-MC; 9 CG; expand 5 up SRS to existing gages (I have an exact estimate somewhere in my files, need more time to find it); drill 3 new GW wells to the east towards Model Lands; total ; 15K 1 time install to existing gage/well; 100k to drill new GW well; surface water $15K @. 15 stations in creeks/wetlands, 10 in estuary, 20 in LEC canals, 20 in LEC GW.USGS, NPS, SFWMD, Miami-Dade, RECOVER, Rock Miners

Region or Specific CEPP Area	Uncertainty	ID#	Attributes to be Monitored	RECOVER 1-Yr Cost	Other Agency 1-Yr Cost	CEPP 1-yr Cost*	Sampling Frequency	Notes
LEC Uncertainties	Will the constructed and operational features of CEPP reduce surface and/or groundwater base flows and wetland/groundwater recharge to the east of the L-30 and L-31N in areas such as the Pennsuco Wetlands, south Miami-Dade wetlands, and Biscayne Bay? (ID#62)	35, 62	Ecological (Seagrass; Spoonbills; Fish; Vegetation)	$ 316,000	$ 150,000	$ 175,000	Quarterly, Annual	spoon bill - Jerry FY11 RECOVER and C-111SC (150k); vegetation Estimate based on Ross Marl Prairie transect @ 125k FY11; fish - 450k for Serafy 2x year + Kelble annual
CEPP-wide Invasives and Nuisance Species Management Plan (INSMP)	How will CEPP influence the introduction and growth of non-native invasive and native nuisance species populations within the project area, and will the species influence the predicted landscape and performance of CEPP?	59	See INSMP	$ -	$ -	$ -	Daily, Monthly, Bi-annually	See INSMP
			CEPP subtotal per year	$ 2,624,000	$ 2,409,300	$ 2,437,500	**CEPP Total**	$24,375,000

D.7 CEPP Screened Uncertainties

D.7.10 Uncertainties Screened Out of CEPP Adaptive Management Plan

The following **Table D.1.16** lists the uncertainties screened out of the adaptive management plan. Reasons for screening out suggested uncertainties may have included lack of direct relevance to project object or constraint, low ratings in the screening criteria described earlier in this Plan, inappropriate scale for CEPP (system-wide scale questions may be more appropriate to include in the RECOVER System-wide Adaptive Management Plan; very small scale questions may have scored low in the screening criteria), lack of ability to improve CEPP performance by understanding more about the uncertainty, or simply that the uncertainty was already covered by another that had been suggested (duplicates). The suggested uncertainties are organized below by ID tracking number and geographic area. Brief CEPP adaptive management sub-team meeting notes on rationale for screening are included.

Table D.1.16: Uncertainties Screened Out of Adaptive Management Plan

Uncrty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
1	Northern Estuaries	Do reductions of high volume fresh water discharges result in measureable oyster responses in the south fork of the ST. Lucie estuary (NE)?	Operational uncertainty for this increment, will need to specify whether benefits come out as expected. Future increment of restoration may need to include muck removal.	Removed -Covered under Uncertainty #45 - To what extent will the slight reduction in the frequency and magnitude of high flows to the SLE help reestablish historic oyster beds on the South Fork?
2	Northern Estuaries	How much does CEPP reduce high flow events to the estuaries during the wet season? Does CEPP increase the ability of LO to make low flow releases during the dry season?		Removed -Uncertainty is covered under: # 45 (SLE oysters), 46 (SLE seebed), 49(CAL Vallisneria), 1 (SLE SAV), 2 (CAL SAV)
7	Northern 3A	It is anticipated that the current dominance of terrestrial and invasive vegetation (e.g., shrubs, willow and cattail), especially in the NW region, will transition to more aquatic wetland vegetation (e.g., sawgrass, water lily, spike rush), which could affect valued upland wildlife currently in this area (e.g., deer, raccoon, rabbits). What will be the rate of this transition and how will it impact terrestrial habitat and wildlife? How do we manage hydrology and vegetation to minimize losses of upland habitat across the most northern regions of WCA 3A so to minimize adverse impacts on terrestrial wildlife?	Not an uncertainty that needs testing.	Removed. Questions related to hydrologic restoration and vegetation management resulting in restoration goals covered under #6, and #75.
8	Northern 3A	Cattail and Willow expansion may be an issue and needs to be properly managed to avoid further degradation.	This is also discussed in the CEPP Invasive and Nuisance Species Management Plan.	Removed. Uncertainty covered under #75, and #9

Uncrty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
11	Northern 3A	How can CEPP maintain the pre-drainage sawgrass plain community in the northeast while increasing hydroperiods to the west?	Covered under different uncertainty	Removed: Uncertainty covered under #6
12	Northern 3A	Uncertainties exist related to the effectiveness of the Miami Canal designs and habitat value of Tree Islands vs. Spoil Islands; or, Are CEPP constructed tree islands a functional replacement for existing FWC vegetated mounds?	Lots of discussion on this, not sure if it will have transferable information once the work is complete. This is more of a design issue; will design and construct and probably not change. No experiment with this, but important to monitor that it functions as a tree island or not. Also scored low on Risk (i.e. important but would not cause CEPP to fail).	Make sure relevant scientists are involved in the detailed design of the planted Miami Canal mounds; design them to promote learning and gaining transferable information if possible.
13	Northern 3A	Will sheetflow be impeded with the current vegetated mounds or with the addition of CEPP planted mounds along backfilled Miami Canal, and how will they affect the unwanted drainage effect of the canal?	Discussed thoroughly by CEPP team and adaptive management team; not an uncertainty that would be tested. Don't think the mounds will impede desired flows, and they are aligned with historic ridges and sloughs. Confident that the mounds will block the canal flow.	Remove: real world experience with tree islands as part of ridge and slough landscape suggests tree islands will not inhibit sheet flow, but will inhibit unwanted canal flows.
14	Northern 3A	Will tree island plantings on mounds be as effective as non vegetated filled sections in promoting flow?	FWC may want to cover some of the questions as part of planting efforts.	Same comments as #13
15	Northern 3A	How will exotic fish respond to CEPP components?	If they do, what will we do? i.e. limited adaptive management opportunities. This will be addressed in CEPP invasive species plan. Also, partially covered in trophic web monitoring.	Ranked low in screening.
16	Northern 3A	Can ridge and sloughs be connected across the canal, after backfilling it?	Design of planted mounds partially addresses this.	Removed: essentially covered under uncertainty #13

Uncrty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
6	Northern 3A	Will CEPP achieve simultaneous sawgrass/ridge-slough habitats in northern WCA 3A with the addition of fresh water through the western hydropattern restoration feature?		Included in CEPP ecological monitoring plan rather than adaptive management plan.
17	Central and Southern WCA 3A	To what extent will ponding be reduced by allowing for additional outflows from the south end of WCA 3A along Tamiami Trail and the L-67s, and by gapping the C-11 extension levee?	S12s would address ponding in southern 3A and that is not changing. Could shift more water through 333 and away from S12s (management action). This would be covered under regulatory monitoring.	This question is appropriate for monitoring, but is not an adaptive management uncertainty for testing.
18	Central and Southern WCA 3A	How well can sheetflow be enhanced by operations in the first CEPP increment (e.g., additional conveyance across Tamiami Trail and L-67s)?	Feeds back to velocities uncertainties. Duplicate. Needs to be worked on in operations plan.	Removed. Covered under uncertainty #73
19	Central and Southern WCA 3A	How does seepage control constrain sheetflow in 3A? Because more water will be moving through WCA 3, how will seepage concerns be handled, if Broward County Water Preserve Areas project is not constructed before CEPP?	Issue considered during CEPP planning. Don't think this can be controlled through adaptive management. Operational constraint.	Removed.
20	Central and Southern WCA 3A	If hydrology is expected to improve, how much improvement in ridge and slough habitat will CEPP increment 1 achieve? How will ridge and slough landscape respond including slough connectivity, micro-topography, and peat accretion? Will increased flow velocities be needed periodically to reestablish sloughs and start reforming ridges?	This is a repeat uncertainty, covered under others.	Removed. Covered under uncertainty #73

Uncrty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
21	Central and Southern WCA 3A		This one was always blank, kept only for tracking purposes.	
22	Central and Southern WCA 3A	How much does reduced ponding improve wading bird and snail kite habitat?	Do not think we are reducing ponding enough to expect difference.	Removed: Modeling did not indicate that ponding would be reduced
23	Central and Southern WCA 3A	Will cattail and Typha spp. encroachment occur and how would it be best to manage it?	See CEPP Invasive and Nuisance Species Management Plan (INSMP)	Removed: covered under other uncertainties and in INSMP
24	WCA 3B	How will the project achieve sheetflow through 3B at hydroperiods that maintain tree islands?		Removed: covered under uncertainty #76
25	WCA 3B	How resilient are tree island communities to hydroperiod changes that result from hydrologic restoration? Which tree islands are likely to respond well, which tree islands might not? How should operations be improved to avoid tree island impacts, while trying to achieve restoration of flow?	Combined 24 and 25 into "If tree islands do not respond, what could the management response be?"	Removed: covered under uncertainty #76
26	WCA 3B	How will wading birds respond to hydrologic changes in WCA 3B?	Took snail kite, apple snail and wood stork not considered here because they will be covered under the BO. Remaining spp covered under #75.	Removed: covered under uncertainty #75
27	WCA 3B	How will ridge and slough landscape respond including slough connectivity, micro-topography, and peat accretion? Will increased flow velocities be needed periodically to reestablish sloughs and start reforming ridges?		Removed: covered under uncertainty #75

Uncrty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
28	WCA 3B	WCA 3B has been rain-driven for a long time, which contains low nutrient input. How will new flows from the marsh through WCA 3A mix with higher nutrient water in the L-67 canal? How can operations balance water quality and water quantity through this part of the system?	Could choose to put certain structures in WCA 3B first and operate at certain times (recommendation provided to CEPP implementation subteam)	Covered under #27.
29	WCA 3B	There is a potential for cattail and Lygodium encroachment that may need to be managed (Similar to 23)	See CEPP Invasive and Nuisance Species Management Plan (INSMP)	Removed; covered under other uncertainties and in INSMP
30	ENP	Will there be water quality effects to ENP? Nutrient processing/bio-chemical processes, and their effects will be an important consideration to understand the effect of significantly increasing the volumes of inflows to North East Shark River Slough.	Ecosystem development and how nutrients get redistributed are part of this. Management actions are hard for this uncertainty.	Removed; covered under Uncertainty 63.
31	ENP	How will changes in hydroperiod within marl prairies affect vegetation and species dependent upon those habitats.	CSSS covered in BO. ENP to keep track of vegetation. Not part of CEPP adaptive management plan.	Partially covered in BO. This item may be better as an ecological monitoring item.
32	ENP	In Northeast Shark River Slough, how can operations most effectively optimize hydroperiod and minimize dry-outs with the proposed infrastructure to best restore ridge and slough landscape, including tree islands? (Need better understanding of hydrology and landscape changes, including peat dynamics).		Merged uncertainty ID 5, 7, 76

Uncerty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
33	ENP	Will the increased flows through Shark River Slough improve the salinity regime in Florida Bay and the Southwest Coast? To what extent will the salinity regime of Florida Bay and the Southwest Coast be restored/improved?		Removed: covered under uncertainty #67.
34	ENP	Will CEPP improve nearshore habitat and prey availability (i.e. salinity, SAV, fish, spoonbill, croc)?		Removed: Repeat of uncertainty # 63 and 53
37	EAA	How can CEPP address the water supply and flood protection CERP goals for the CERP EAA Reservoir Project since the footprint intended for the reservoir projects will be used for FEBs ?	The question is valid, but not one that can be addressed in CEPP AM Plan. CEPP AM Plan scope is limited to questions where scientific method can be used to resolve or reduce an uncertainty to improve project performance.	Removed: This is a plan formulation question and overall system-wide planning issue for CERP. In addition, CEPP will not impact water supply or flood risk management per WRDA 2000. This issue is covered under #35 and 62.
38	CEPP Overall	Will FEB water use, water treatment, phosphorus reduction, and maintenance be similar to that simulated in model world? What actions or projects can be taken to minimize the chances that FEB performance will be problematic once a real FEB is constructed?	As worded, not a question that can be addressed through CEPP adaptive management. However the intent of this uncertainty will be covered in others that were not screened out.	Removed: covered under uncertainty #4.

Uncrty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
39	Miami-Dade	If a seepage management wall is part of the TSP, what actions, investigations, or projects can be undertaken to determine how best to construct a seepage management wall that will perform as simulated? Should there be more sensitivity simulations within the modeling effort to get an idea of what range of percentage seepage reduction achieves similar results in model world?	This is very similar (duplicate) to uncertainties #35 and 62, which are included in the CEPP AM Plan. Their AM strategies include pre-design investigations and focused modeling using updated data from several sources that should be available in coming months/years.	Removed: Covered better under uncertainty #35 and 62, which are included in the CEPP AM Plan.
40	CEPP Overall	What additional model runs, information and real world data will be developed to compensate for the areas in the CEPP modeling that are problematic? How can this be used in project development after a TSP is selected?		Removed: this question was brought up as part of water supply/flood control savings clause and RECOVER analysis. Additional modeling was done to address PDT concerns (A1-6R and A1-4R2) during formulation, while the uncertainties inherent in the modeling are recognized. Therefore remaining uncertainties #35 and 62 are included in the AM Plan and their strategies include focused modeling.
41	Miami-Dade County	What are the surface water and groundwater dynamics from ENP east and southeast across South Miami-Dade? How will conserving more water within ENP impact adjacent lands on a seasonal basis?	This could be part of a strategy to address uncertainties #35 and 62.	Removed: covered to the extent possible under uncertainty #35 and 62.
42	CEPP Overall	If elements of the project performance depends on simulated operations different from current operations or the operations of features to be constructed, how can adaptive management be used to either support the implementation of new operations compatible with CEPP or respond to adjust	Not an adaptive management uncertainty, modeling uncertainty (which is the same throughout all the uncertainties)	Removed: in general, the adaptive management plan will cover how operations will be informed and the operations plan will cover how the operations are adjusted.

Uncrty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
		project elements and performance when operations assumed in the CEPP TSP are not permitted?		
45	Lake Okeechobee	What data can be collected to determine that the operations proposed in CEPP to move water south to the FEBs has a neutral or beneficial impact on water availability from Lake Okeechobee for the Northern Estuaries and LOSA?	Not an uncertainty that can be tested, but partially covered under others in the CEPP plan.	Partially covered in Lake O, FEB-2, and northern estuaries uncertainties.
46	Lake Okeechobee	Lake O will likely be kept deeper with the FEB in operation. An increase in lake stage may be ecologically problematic at times. How will additional unwanted water be removed from the lake if the FEB goes off-line unexpectedly for a substantial time period (e.g., due to embankment failures as has happened at other new facilities, e.g., Ten Mile Creek Reservoir, Grassy Island STA, Hebden Slough STA, Lakeside Ranch STA)?	This is not a CEPP adaptive management question, add the information into the Ops plan that will be used for CEPP.	Removed: partially covered under uncertainty #3.
47	Northern Estuaries	Will the decreases in high flow events reduce the flow velocities enough to reduce the amount of suspended solids being introduced into the estuary?	Specific items to measure in relation to Uncertainty 1 and 2. Muck removal would be used under SAV or oysters, so took this uncertainty out.	Removed: Uncertainties # 1,2 cover the questions regarding freshwater discharge and SAV, which relates to both salinity and sediment.
48	Northern Estuaries	Will the increased frequency of low flow exceedences and timing in the SLE have a detrimental impact on oyster communities by increasing levels of predation and disease during extreme dry times?	Original North of the redline modeling revealed increased frequency of low flow exceedences to the SLE with the project alternative run.	Interagency Modeling Center modelers identified an error in the original modeling for basin flows, which were too low. In the modeling of the ALT4R2 TSP model, the low flow exceedences actually improved with the project alternatives. This is no longer seen as an issue that we are uncertain about that

Uncerty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
				needs to be addressed.
50	Northern Estuaries	Will decreases in the velocity of flows be enough to reduce the current condition in which spat introduced into the water column during the wet season tend to get pushed far downstream where they settle and are then subject to increased salinities, predation and disease during the next dry season?	Specific items to measure in relation to Uncertainty 1 and 2. This fits under timing (need lower flows during specific times to not disrupt spat). Adding timing of flows to the oyster uncertainty.	Removed: covered for St. Lucie under # 45, focused on oysters for all life stages.
51	Lake Okeechobee	Further LO operational refinements under existing LO Regulation Schedule (LORS) 2008 might reduce duration and number of high volume discharge events. There may be questions on the effects on the littoral zone.	Lake O has a monitoring program; can we use this information?	Removed: Covered under uncertainty #3. Existing monitoring will be leveraged.
52	Lake Okeechobee	Lake O will likely be kept deeper with the FEB in operation. An increase in lake stage may be ecologically problematic at times. How will additional unwanted water be removed from the lake if the FEB or the new reservoirs (C-43, C-44) go off-line unexpectedly for a substantial time period (e.g., due to embankment failures as has happened at other new facilities: e.g., Ten Mile Creek Reservoir, Grassy Island STA, Nubbin Slough STA, Lakeside Ranch STA)?		Not a CEPP adaptive management. Uncertainty that can be tested, but give this to Operations group as a comment to be addressed.

Uncrty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
53	Southern Coastal Systems	Will the SCS be provided the water it needs for restoration from upstream (timing, distribution, quality and quantity)?	Broad question. Model results depict the amount of water the SCS will receive. This will be covered by the operation plan for CEPP and should be rewritten to include specific uncertainties for quantity, quality, timing, distribution as they relate to salinity and the flora and fauna of the SCS. Not a CEPP adaptive management uncertainty to be tested as written.	Removed; covered by uncertainty #67
54	Southern Coastal Systems	How can we reasonably and accurately quantify the volume of water required for restoration of Bisc Bay, FL Bay and the SW Coast acknowledging real-world constraints?		Remove; covered under #67
55	Southern Coastal Systems	To what degree will sea level rise affect restoration efforts? Based upon how SLR will affect restoration efforts, what spatially sustainable areas should restoration afford a priority focus and how that priority determined?	Not entirely a CEPP specific question. May be more appropriate for RECOVER system-wide Adaptive Management Plan or other large scale program.	CEPP-specific scale of this question covered under #64
56	Southern Coastal Systems	Getting water south requires meeting WQ standards. Will the additional water for restoration meet these standards, or will/can the standard be revised? Will the WQ standards be met in time to allow for waters to flow prior to a permanent loss in the already declining ecosystem characteristics?		Removed; partially covered under #63

Uncrty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
58	Southern Coastal Systems	How will changes in funding affect implementation? How will delays in implementation due to funding constraints affect the final outcome (irreversible adverse changes)?	Budgetary uncertainty effects the whole implementation of this project, CERP, RECOVER monitoring. This is not a CEPP adaptive management question that can be tested.	Removed. Discussed in implementation section of CEPP PIR.
68	ENP	Ecol response in wetland food web - prey base, wading birds		Removed: not clearly worded, and addressed under uncertainty #65
69	LEC Water Supply	Will conveyance, seepage management, and/or operations alter quantity and quality of water reaching water supply wellfields and potable water wells, especially during the dry season or in dry/drought years? More specifically, will risk of saltwater intrusion be increased in coastal wellfields and private wells, will risk of surface water influence be increased, or will wellfield protection boundaries be affected?	Similar to other uncertainties, so consolidate for AM Plan. Need to clarify water quality question as nutrients or saltwater intrusion. Partially addressed in savings clause analysis. Need to coordinate with water supply and flood control team. Need right expertise on how to handle water supply questions and operations.	Removed: reworded and covered under uncertainty #35 and 62.
70	LEC flood risk manageme nt	Will conveyance, seepage management, and/or operations reduce flood protection in agriculture and urban areas, especially at the end of the rainy season, or during wet years? Will seepage walls (if selected) retain water as predicted in models?		Consolidate with uncertainty #s 35 and 62.
71	Pennsuco, Bird Drive,	Will conveyance, seepage management and/or operation affect water depths,	Savings Assurances. Seepage management experts will need to tell us	Removed: covered under uncertainty #35

Uncrty ID #	Region	Risk or question or uncertainty	Meeting notes and discussions	Rationale of uncertainty removal
	South Miami-Dade Wetlands	hydroperiod in wetlands east of the [illegible], especially in the dry season?	level of uncertainty, how it could be monitored, and what we would adapt (operations, implementation) to address.	
72	Biscayne Bay and adjoining tidal waters	Will conveyance, seepage management and/or operation affect salinity patterns in coastal wetlands and nearshore tidal waters, especially during the dry season?		Removed: partially covered under uncertainty #35, and 62
76		How will apple snails respond to CEPP hydrologic changes?	Can include operation indicators into the operations plan rather than using adaptive management. This will most likely be covered under the BO. No management options.	Removed: apple snails were not one of the key restoration objectives, but are covered under the biological opinion and will be tracked accordingly.

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PART 2. CEPP Water Quality Monitoring Plan

Water Quality Monitoring

for

Central Everglades Planning Project

(Approval date for

RECOVER

QAOT

EMCT)

Authoring Organization's Representative **Date**
(Monitoring plan coordinator)

Lead USACE Project Manager **Date**

Lead SFWMD Project Manager **Date**

Representative, Local Sponsor (Monitoring Organization) **Date**

Representative, Federal Sponsor (Monitoring Organization) **Date**

Project Quality Assurance Officer **Date**

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GLOSSARY/ACRONYMS

ADaPT – Automated Data Processing Tool software.

Assessment – to interpret responses in natural and/or human systems based on data acquired though monitoring activities.

BWRF – Biweekly if Recorded Flow – Sampling frequency to collect sample on bi-weekly basis if flow has occurred in the past week.

Constraint – a condition that is to be minimized or avoided in the plan formulation and selection process to ensure that the project component does not result in undesirable changes in the project area or downstream waters. Example: The component shall not cause or contribute to a violation of state water quality standards.

Data Qualifiers: a code that is added to data to serve as an indication of the quality of the data.

Data Quality Objectives (DQO) – a process that identifies the intended use of the data including the types of decisions that will be made based on the results. The analytes of interest, corresponding action levels, sampling design and quality control measures are also identified as well as data repositories into which the data will be entered, the mechanisms used to ensure that the data are accurately entered into a database and to verify that the data in the database are correct, and the level of data quality acceptable for this project.

EB – Equipment Blank, collected to monitor on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, sample transport and storage conditions and laboratory processes.

EM – Engineering Manual: USACE documents that provide guidance on various aspects of project design and implementation.

FB - Field Blank, collected to monitor on-site sampling environment, sample container cleaning, the suitability of sample preservatives and analyte-free water, sample transport and storage conditions and laboratory processes.

FCEB – Field Cleaned Equipment Blank, collected to monitor on-site sampling environment, sampling equipment decontamination in the field, sample container cleaning, the suitability of sample preservatives and analyte-free water, sample transport and storage conditions and laboratory processes.

FDEP – Florida Department of Environmental Protection

Local Sponsor – the agency responsible for matching the Federal funding available for a project. The South Florida Water Management District (SFWMD) is the local sponsor for the majority of CERP projects.

Matrix – refers to the material from which the sample is taken, such as surface water, ground water, pore water, sediment, soil or air.

MeHg – Methyl mercury, a highly toxic form of mercury which may be bioaccumulated along food chains.

Monitoring – all of the activities required to acquire, process, store, retrieve and analyze data used to assess the status of water resources. It includes data collection, data analysis, data validation, and data management.

Monitoring Data – data that are collected for the purpose of determining the effects of CERP projects at a given location.

Monitoring Plan – the plan to acquire additional meteorological, hydrologic, hydraulic, water quality or ecological data. It includes considerations of sampling location, frequency, method, parameters and duration. It is based on the elements identified in the development of data quality objectives for the project.

Objective – a measurable element of the goal(s) of a project or plan. Project objectives and constraints are identified in the Project Management Plan (PMP).

Permit Requirement – certain analytes are sampled, tested and results reported to state and/or federal agencies as a condition of a permit to build or operate a project.

PLMP – Project-Level Monitoring Plan

Project-level – A project has a defined scope, quality objectives, schedule, and cost. Project-level activities refer to those that are within the scope of a specific project.

QA – Quality Assurance: the system of management activities and quality control procedures implemented to produce and evaluate data according to pre-established data quality objectives.

QAOT – Quality Assurance Oversight Team, comprised of representatives from USACE, SFWMD, FDEP, and USEPA, ultimately responsible oversight of the implementation of the quality system for CERP.

QASR – Quality Assurance System Requirements, the CERP Quality manual that establishes minimum criteria for environmental data quality.

QC – Quality Control: The system of measurement activities used to document and control the quality of data so that it meets the needs of data users as specified by pre-established data quality objectives.

RACU – Remote Acquisition and Command Unit. A device used for data acquisition and remote system control.

RECOVER – REstoration COordination and VERification (RECOVER) is a process that evaluates and assesses CERP performance by linking scientific and technical information throughout the planning and implementation period to ensure that a system-wide perspective is maintained throughout the restoration program.

RECOVER AT - The RECOVER Assessment Team is a standing, interagency, interdisciplinary team of scientists and resource specialists who are responsible for achieving the five primary tasks of RECOVER: 1) create, refine and provide documentation for a set of conceptual ecological models for the total system and a set of attribute-based biological performance measures for the Comprehensive Plan; 3) design and review the system-wide monitoring and data management program needed to support the Comprehensive Plan; 4) use the information coming from the system-wide monitoring program to assess actual system responses as components of the Comprehensive Plan are implemented and produce an annual assessment report describing and interpreting these responses; and 5) coordinate all scientific peer reviews of RECOVER documents.

RS – Replicate samples defined as two additional samples collected in addition to the routine sample.

Sampling Frequency – how often samples are collected.

Sampling Methods – the methods used to collect samples in the field. The methods should be standard methods, methods based on a standard operating procedure, or a method that has been approved by the participating agencies.

SFWMD – South Florida Water Management District

THg – Total mercury

USACE – United States Army Corps of Engineers

USEPA – United States Environmental Protection Agency

WBS – Work Breakdown Structure: The WBS specifies a hierarchy of tasks and activities necessary to fulfill the objectives of the project. The WBS is structured in levels of work detail, beginning with the deliverable itself, and is then separated into identifiable work elements.

WRF – Weekly if Recorded Flow: Sampling frequency to collect a sample if flow has occurred in the past week.

Zone of Influence – the area over which a project alters or impacts the environment.

Additional terms and definitions for CERP can be found in CGM 13 – Acronyms and Glossary of Terms. http://www.cerpzone.org/documents/cgm/cgm_013.03.pdf

D.0 EXECUTIVE SUMMARY

The CEPP water quality monitoring plan presented here was developed by an interagency team from SFWMD, USACE, DOI, and FDEP. In developing this plan, the interagency team reviewed the ongoing monitoring efforts within the study area as of January 2013 to determine what additional monitoring would be likely required to demonstrate compliance with existing requirements as well as anticipated requirements. The Water Quality Monitoring sub-team also consulted with the Adaptive Management team to minimize duplication of effort across monitoring efforts. The monitoring stations are preliminarily identified in this plan since final designs have not been prepared for any of the project features. As such, this plan incorporates the best information available; however, as the project is designed and implemented, this plan will require revision. To accommodate imprecise information, a risk based 44% contingency was incorporated into the monitoring plan cost estimate. The estimated first year cost of this monitoring is $730,000 with the five-year cost estimated to be approximately $3,600,000 and the 50-year cost estimated as approximately $35,500,000. Generally, CERP water quality monitoring is cost-shared for the life of the project as long as this monitoring is specified in a permit or other regulatory agreement.

D.1 INTRODUCTION

This document serves as a reference for monitoring surface water quality for the Central Everglades Planning Project (CEPP). Monitoring will be conducted to evaluate the CEPP's performance with regard to restoration goals and regulatory requirements. Specifically, the project is intended to send additional environmental water supplies south from Lake Okeechobee to the Everglades Protection Area in order to restore the historic function of the remnant Everglades landscape. The additional water will restore the original hydrologic patterns within the Everglades freshwater wetlands, and improve the wetlands and salinity patterns in the nearshore region of the Bay. Improved salinity patterns will restore more estuarine habitat to Biscayne Bay.

The CEPP area of influence includes Lake Okeechobee, Caloosahatchee Estuary, St. Lucie Estuary, Everglades Agricultural Area, Water Conservation Areas, Everglades National Park and the southern estuaries. **Figure D.2.1** shows a map of the study area.

D.2 Project Description

The CEPP project features include the following elements:

1. Storage and Treatment
    a. A-2 FEB (14,000 acres) located in the EAA north of STA-3/4.
2. Northern Distribution and Conveyance (Northern WCA-3A)
    a. Hydrologic Restoration Feature, 3-mile long spreader canal located west of S-8 Structure.
    b. Backfill Miami Canal from S-8 to I-75.
3. Southern Distribution and Conveyance (Southern WCA-3A/B, ENP)
    a. Increased S-333 Capacity from 1,500 to 3,000 cfs
    b. Two 500 cfs Gated Structures in L-67A West of Blue Shanty
    c. Blue Shanty Training Levee in WCA-3B
    d. Degrade of L-67C Levee in Blue Shanty Flowway
    e. One 500 cfs Gated Structure East of Blue Shanty and 6,000 ft of degraded L-67C levee
    f. Degrade L-29 Levee in Blue Shanty Flowway
    g. New Divide Structure (S-333B) West of Western Bridge
    h. Degrade of L-67 Extension Levee
4. Seepage Management (L-31N Levee)
    a. Increase S-356 from 500 to 1,000 cfs
    b. Partial Seepage Barrier (5-Miles Long) along L-31N
    c. Modification of G-211 Flood Control Operations

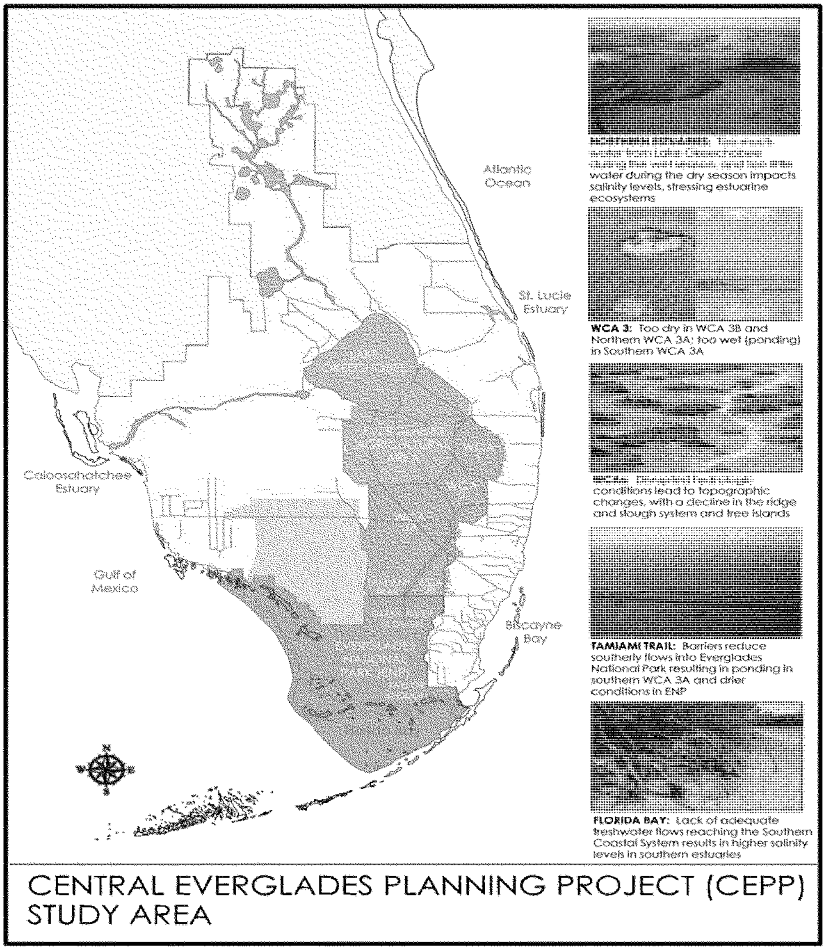

Figure D.2.1: Central Everglades Planning Project Study Area

D.3 Project Objectives

The monitoring stations described in this document are referenced to satisfy requirements of the Comprehensive Everglades Restoration Plan Project Implementation Report and requirements of (issued or pending) Department of the Army 404 permits and/or State of Florida 373.1502 Comprehensive Everglades Restoration Plan Regulation Act (CERPRA) permits for Start Up and Operational Phase Monitoring. This plan provides an outline for quantifying the quality of surface water entering and downstream of the project area for a period of ten years and may be updated to meet permit requirements as necessary.

Surface water samples have been collected and analyzed for multiple constituents and at various frequencies within South Florida from stations adjacent to or nearby the targeted project features. These baseline data are compiled in the South Florida Water Management District's DBHYDRO database and in the annual South Florida Environmental Report (SFWMD 2012). Other organizations also collect surface water quality data in this region that may be relevant to the project as baseline data. To access relevant data, contact the program manager at the South Florida Water Management District.

The water quality data obtained under this program will be used to:

1. Evaluate water quality status and trends;
2. Assess compliance with federal and state water quality statutes, the EFA, and the applicable Everglades Consent Orders;
3. Guide mid- and long-term resource management decisions as part of the adaptive management plan for the project.

D.4 Active Mandates and Permits

Water quality monitoring of inflows to the Everglades Protection Area is generally governed by the 1992 Consent Decree, and Everglades Forever Act permits, most notably the Non-Everglades Construction Project permit and the STA permits. Monitoring of marsh stations is generally governed by the 1992 Consent Decree, the TP Rule, and the 2012 Consent Order. CEPP project features may also require the establishment of new monitoring locations; however, in many instances, the existing monitoring stations will be utilized to demonstrate project benefits or compliance with water quality standards. The permits and/or agreements that will govern new sampling requirements for this project will be developed through the permitting process. Since the final design and placement of the features has not been established at the time of this monitoring plan development, certain details of the actual permit required new monitoring may not exactly match the information presented in this plan.

D.5 Monitoring Components

D.5.1 Project Baseline Monitoring

Baseline sediment monitoring will be conducted in WCA-3B and northern ENP to determine the impact of water diversion and canal backfilling on sediment phosphorus content in affected areas. This baseline monitoring is necessary to establish pre-project sediment conditions in areas where no prior sediment sampling has been conducted in the past.

D.5.2 Construction Monitoring

Construction monitoring will be limited to turbidity sampling as required by FDEP construction permits. This monitoring is not included here since it is normally carried out by the construction contractor.

D.5.3 Post-Construction Monitoring (Effectiveness Monitoring)

Post-construction monitoring will be done to assess the compliance of project features with state and federal water quality statutes and applicable Everglades Consent Orders. The list of monitored parameters includes total phosphorus (TP), ortho-phosphorus (OPO4), total kjedahl nitrogen (TKN), nitrate + nitrite (NOx), calcium (Ca), sodium (Na), sulfate (SO4), DO, pH, Color, Specific Conductance, Temperature, and turbidity.

D.5.4 Inventory of Existing Monitoring Networks

New water quality monitoring efforts associated with the CEPP project are contemplated for the central and southern portions of Everglades so a review of the existing monitoring efforts in these areas was conducted. **Figure D.2.2 through D.2.5** show the existing monitoring network for the central everglades portion of the study area. The monitoring stations shown in these figures are required to demonstrate compliance with the non-Everglades Construction Project Permit (Non-ECP permit), the 1992 Consent Decree (commonly refered to as the "Settlement Agreement") and/or the Everglades Forever Act (TP-rule). **Figure D.2.2** shows the existing structure monitoring locations within WCA-3. Monitoring at these structure locations is generally required by the Non-ECP permit. **Figure D.2.3** shows the existing structure monitoring locations within ENP, along the L-29 levee (S12s, S333, S334, S355A/B, S356) and along the L-31N/C-111 levee canal (S332s, S176, S-18C, S-197). **Figure D.2.4** shows the existing marsh monitoring locations within WCA-3, and **Figure D.2.5** shows the existing marsh monitoring locations within ENP. On these two figures, the monitoring stations identified with a circle are monitored as required in the Total Phosphorus Rule (FAC 62-302.540) and those identified with diamonds are required as part of the Settlement Agreement. Monitoring at TP-Rule sites is limited to Total phosphorus collected on a monthly basis. Monitoring at the Settlement Agreement marsh sites includes temperature, Specific Conductance., dissolved oxygen (DO), pH, total phosphorus (TP), total dissolved phosphorus (TDP), ortho-phosphorus (OPO4), alkalinity (Alk), Ca, chloride (Cl), potassium (K), magnesium (Mg), sodium (Na), sulfate (SO4), dissolved silica (SiO2), Color, total suspended solids(TSS), total dissolved solids (TDS), dissolved organic carbon (DOC), and Turbidity. This monitoring is done on a monthly basis.

Since the CEPP project does not include any features in the Caloosahatchee or St. Lucie Estuaries, no new additional monitoring will be done there for the CEPP project. No maps of the existing monitoring programs are provided for the two estuaries since no additional monitoring is contemplated in these areas.

Figure D.2.2: Existing Structure Monitoring Locations in WCA-3A/B

Figure D.2.3: Existing Structure Monitoring in ENP

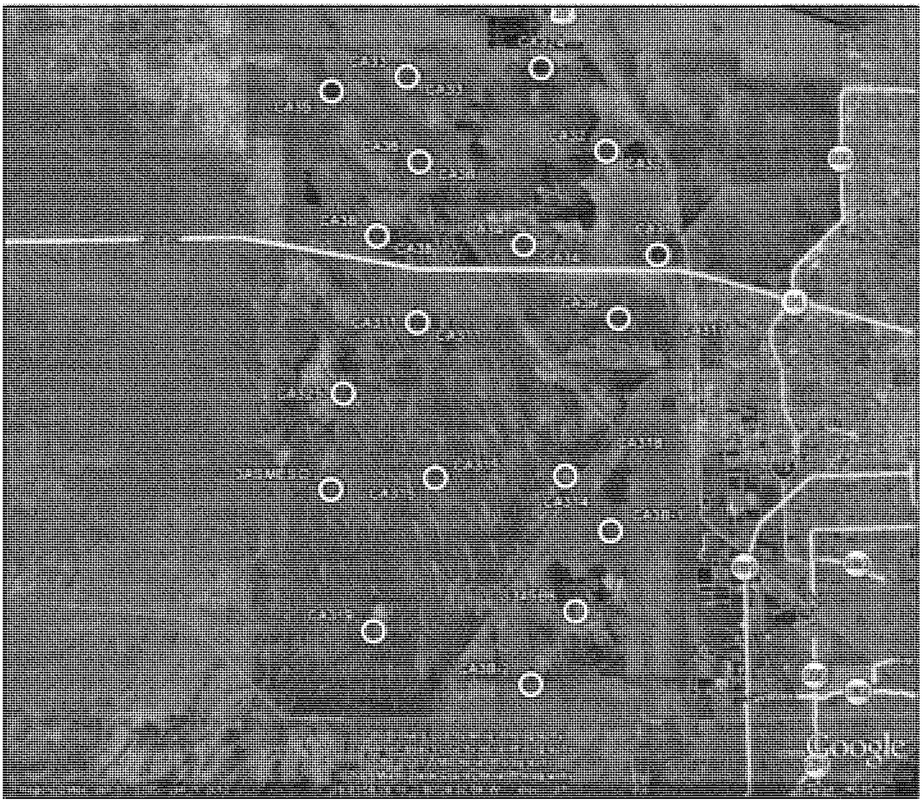

Figure D.2.4: Existing Marsh Monitoring Locations in WCA-3A/B

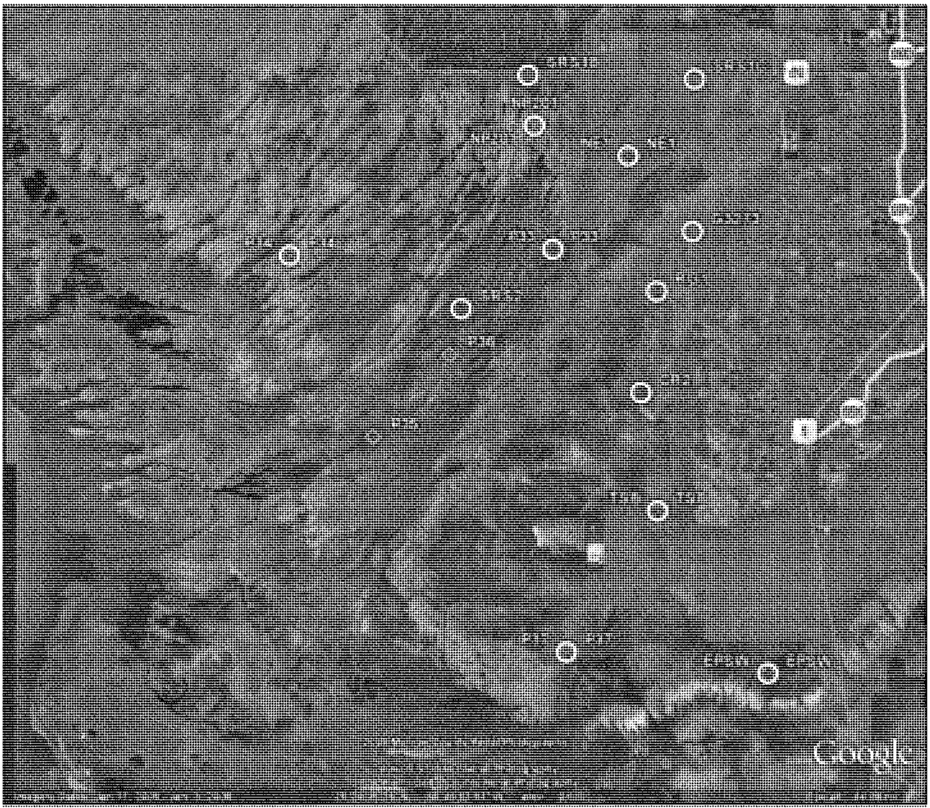

Figure D.2.5: Existing Marsh Monitoring Locations in ENP

D.5.5 Integration of Monitoring Components

New monitoring stations proposed as part of this project were selected based upon a review of the ongoing monitoring and the expected compliance requirements associated with the planned project features. Staff from SFWMD, USACE, DOI, and FDEP were consulted to ensure that the new monitoring stations were consistent with the permit requirements and not duplicative of ongoing monitoring at existing stations.

D.6 Duration

The USACE project life-cycle for the CEPP project is defined as 50-years. This monitoring plan includes a conservative estimate of funding for a scenario where water quality monitoring takes place for the life of the project (50-years). The duration of cost-shared project related monitoring required for compliance with the EFA, non-ECP, the Settlement Agreement, or future CERPRA or LOPA permits is assumed to be 50-years for this estimate. Project level monitoring may continue after this period;

however, this is not addressed in this plan. Changes to CEPP water quality monitoring efforts are keyed to future changes to any of the controlling laws, settlements, or permits. Since project construction will occur over a period of 10-years or so, monitoring efforts at some project features will not begin for several years after congressional authorization.

The monitoring plan will be periodically reviewed for effectiveness and modified as allowed under permitting constraints. As part of an adaptive management approach to this project, it is expected that the requirements to monitor particular parameters and frequencies may be change throughout the life of this project. In the event that monitoring reduction is warranted, demonstration that a parameter or group of parameters no longer represents a source of concern will be required.

The water quality monitoring plan was initiated by the Water Quality Sub-team of the CEPP, and technical review was provided by Comprehensive Everglades Restoration Plan Restoration Coordination and Verification (Recover) Group, Coordination and Verification staff of the South Florida Water Management District and the U.S. Army Corps of Engineers. Development of this plan is required as part of the Project Implementation Report document. The project implementation report development phase calls for sections detailing the water quality monitoring and adaptive assessment methods for the selected alternative. The plan was originally prepared under the assumption that water quality monitoring efforts directly funded by this project will last a total of 50-years. While CERPRA permits generally are granted for a period of 10-years, for the purposes of the costs provided here, it is assumed that the required monitoring will not change for subsequent permits.

D.6.1 Modification or Termination Conditions

Modification of the water quality monitoring plan will be determined by the needs of the project annually, and will be completely reassessed after five years from initiation. This plan may be changed to reflect any future design changes or permit requirements. It also may be terminated according to permit expiration dates or changes to the project objectives. The plan will be reviewed and modified annually or more frequently if necessary to reflect new requirements. Decisions to adjust monitoring will be coordinated through the project partners as well as the FDEP.

This CEPP monitoring plan was developed assuming that major, ongoing monitoring programs that are not funded directly by the Project would continue to supply data relevant to the Project. Should any of these programs be discontinued or significantly curtailed, then the Federal and local sponsors of the Project will reevaluate monitoring priorities and may redistribute funds for the benefit of the Project, even potentially not funding elements of this monitoring plan.

D.7 Monitoring/Sampling Locations and Naming Convention

A description of new or existing monitoring for each project feature is provided below.

It should be noted that detailed costs described here were calculated using the best available information at the time of writing, and were provided before the CEPP project-wide contingency of ~44% was added to the project cost estimate. Therefore several detailed estimates provided in this monitoring plan may be lower than the amounts shown in the cost summary tables that include the contingency (Table 6-9 in Section 6, Table D.1.1 in Annex D intro, and the summary of costs provided in the introduction to this plan).

D.7.1 Optimized Lake Okeechobee Operations

Optimization of the LOR08 operations will result in improved hydrology in Lake Okeechobee, Caloosahatchee Estuary, and the St. Lucie Estuary; however, this will not require any changes to the existing monitoring networks in these three ecosystems. No new monitoring is proposed in these areas as a result of this project.

D.7.2 A-2 Flow Equalization Basin

Monitoring of the A-2 FEB was discussed by the CEPP Water Quality Monitoring Sub-team in January of 2013. The team determined that regulatory monitoring of the inflows and outflows was necessary as well as well as optimization monitoring at one station within the FEB. Start-up and follow-up monitoring of pesticides and heavy metals for this facility is included in Sections 2.19 and 2.20 of this plan. The A-2 FEB has not been designed as of March 2013 the specific names, locations, and number of monitoring stations have not been finalized; however, the team determined that one inflow sampling site and two outflow sampling sites and one is the likely configuration for the compliance monitoring requirement. Optimization monitoring at one internal site is also included. The parameters and frequencies for routine monitoring at this FEB are shown in **Table D.2.1**. The annual cost for compliance monitoring is estimated to be $77,000 which includes approximately 520 hours of staff time, a vehicle, and $23,000 for laboratory analysis of samples from three sampling stations. The annual cost of optimization monitoring is estimated to be $78,000 which includes 520 hours of staff time, vehicle use, boat use, and $7,800 in laboratory analysis of samples from one sampling station. The total cost of monitoring the A-2 FEB is estimated to be $155,000.

Table D.2.1: Monitoring Plan for A-2 FEB

Sampling Locations	Sample Type	Sampling Frequency	Parameter
Inflow and 2 Outflows, and one internal location	Grab Sample	Weekly if recorded flow (WRF)	Specific Conductance, Color, pH, Dissolved Oxygen), Temperature, TP
	Grab Sample	Biweekly if recorded flow (BWRF)	TKN, NOX, SO4

D.7.3 Northern WCA 3A Spreader Canal West of S-8

A three mile long spreader canal is proposed south the L-4 canal and west of the S-8 structure. This spreader canal that discharges from the EAA into the Water Conservation Areas will be subject to the requirement of a CERPRA permit and the Settlement Agreement). The design and operation of this spreader canal will affect the number and placement of new monitoring sites. Since the spreader canal will not be designed prior to publishing the PIR, the WQ monitoring sub-team determined that a placeholder of three sampling sites can be used to develop the monitoring plan costs used in this document. **Table D.2.2** provides the sampling scheme for these monitoring locations. The estimated cost for conducting this sampling is $78,000 which includes 520 hours of staff time, vehicle use, and $24,000 for laboratory analytical cost for samples collected from three stations.

Table D.2.2: Monitoring Plan for Spreader Canal at North End of WCA 3A

Sampling Locations	Sample Type	Sampling Frequency	Parameter
NWCA3_1, NWCA3_2 NWCA3_3	Grab Sample	BWRF	Specific Conductance, Color, pH, Dissolved Oxygen, Temperature, TP, OPO4, TKN, NOx, Na, Ca, SO4, and Turbidity

D.7.4 Miami Canal Backfill

Backfilling the northern portion of the Miami Canal will impact marsh hydrology in the vicinity of the canal. The CEPP WQ monitoring team has reviewed the existing marsh monitoring efforts and determined that the ongoing monitoring is sufficiently dense in the vicinity of the backfilled canal that no additional monitoring is required. **Table D.2.3** includes a list of the existing monitoring stations and sampling scheme. No new monitoring is proposed so there is no project cost.

Table D.2.3: Existing Sampling in the Vicinity of the Miami Canal Backfill

Sampling Locations	Sample Type	Sampling Frequency	Parameter
CA33, CA34, CA35, CA36, CA38, CA324	Grab Sample	Monthly	Specific Conductance, Color, pH, Dissolved Oxygen, Temperature, TP, TDP, OPO4, Alk, Ca, Cl, K, Mg, Na, SO4, SiO2, TDS, TSS

D.7.5 L-67 A / C Features

Three new structures are proposed for the L-67A levee and partial levee degrading is proposed for the L-67C levee. This will require a CERPRA permit monitoring condition, and be subject to the Settlement Agreement. Depending on policy and legal implications, the two new structures west of the Blue Shanty levee may be used to calculated Settlement Agreement compliance for Shark River Slough. No new monitoring is proposed for the cuts in the L-67C canal. **Table D.2.4** shows the locations and sampling scheme for the new structures in the L-67A levee. The estimated cost of conducting this sampling is $111,000 which includes 830 hours of staff time, vehicle use and $24,000 for analytical costs for the three stations. Additional staff time was estimated for these sites given the remote location of the three stations.

Table D.2.4: Sampling Locations and Scheme for New Structures in the L-67A Canal

Sampling Locations	Sample Type	Sampling Frequency	Parameter
S-631, S-632, S-633	Grab Sample	WRF	Specific Conductance, Color, pH, DO Temperature, TP
	Grab Sample	BWRF	TKN, NOX, SO4

D.7.6 L-67 Extension Backfill

Filling of the L-67 Extension Canal may impact water quality in the northern ENP marsh as well as impact ponding and sedimentation south of the S-12D structure. The CEPP Water Quality Monitoring team reviewed the ongoing marsh monitoring network south of Tamiami Trail and determined that the existing P33 station would provide sufficient monitoring in this area. The team also determined that periodic sediment cores downstream of the S12D structure are necessary to monitor changes in sedimentation and sediment content. **Table D.2.5** contains a list of the planned sediment sampling parameters and frequencies. The estimated cost of sediment marsh monitoring is $17,000 which includes 20 hours of staff time, helicopter use, and $5,000for analytical expenses. The estimated cost of marsh water quality monitoring is $20,000 which includes 50 hours of staff time, helicopter use, and $3,600 for analytical expenses. The total cost of monitoring the L-67 Extension Backfill is $37,000 per year. This monitoring is scheduled to begin at the initiation of the construction of the backfill work so that there is sufficient time to collect baseline sediment samples.

Table D.2.5: New Sediment Sampling Locations South of the S-12D Structure

Sampling Locations	Sample Type	Sampling Frequency	Parameter
SRS-S1, SRS-S2, SRS-S3	Sediment Grab Sample	Biennially	TP, SO4, TOC, TN, organic matter, bulk density, and depth.
L67E Marsh Site	Water Grab Sample	Monthly	Specific Conductance (uS/cm), Color (PCU) , pH(SU), Dissolved Oxygen (mg/l), Temperature (deg. C), TP (mg/l), TDP, OPO4, Alkalinity, Ca, Cl, K, Mg, Na, SO4, SiO2, TDS, TSS

D.7.7 Blue Shanty Flow-way

Construction of the Blue Shanty Flowway includes construction of a training levee from the L-29 Levee north to the L-67A levee along the existing Blue Shanty Canal right-of-way, construction of a new divide structure (S-333B) in the L-29 levee just west of the western Tamiami Trail Bridge, and the degradation of the L-29 levee between the S-333 and S-333B structures. The CEPP WQ monitoring sub-team determined that new monitoring would be required at the S-333B structure but that no additional monitoring would be necessary along the degraded portion of the L-29 levee, within the bridge flow paths, or in the marsh adjacent to the Blue Shanty training levee. **Table D.2.6** provides a summary of the monitoring at the planned divide structure. The estimated cost for conducting the monitoring at the L-29 Canal Divide Structure is $30,000 per year which includes 210 hours of staff time, vehicle use, and $7,800 in analytical expenses. The estimated cost for conducting the marsh water quality monitoring is $20,000 per year which includes 50 hours of staff time, helicopter use, and $3,600 in analytical expenses. The total cost for new monitoring at the Blue shanty Flow-way is estimated at $50,000 per year.

Table D.2.6: Monitoring Scheme for the Blue Shanty and Divide Structure

Sampling Locations	Sample Type	Sampling Frequency	Parameter
B.S. Marsh Monitoring	Grab Sample	Monthly	Specific Conductance, Color, pH, Dissolved Oxygen, Temperature, TP, TDP, OPO4, Alk, Ca, Cl, K, Mg, Na, SO4, SiO2, TDS, TSS
L-29 Canal Divide Structure	Grab Sample	WRF	Specific Conductance, Color, pH, Dissolved Oxygen, Temperature, TP
	Grab Sample	BWRF	TKN, NOX, SO4

D.7.8 L-29 Degrade

The L-29 levee will be degraded between the S-333 Structure and the new L-29 Canal divide structure. Monitoring downstream of this area will be done to document impacts to marsh areas. **Table D.2.7** provides a summary of the monitoring at the planned divide structure. The estimated cost of monitoring at this location is $20,000 per year which includes 50 hours of staff time, helicopter use, and $3,600 for analytical expenses.

Table D.2.7: Monitoring Scheme L-29 Degrade

Sampling Locations	Sample Type	Sampling Frequency	Parameter
L-29 Degrade Marsh Monitoring	Grab Sample	Monthly	Specific Conductance, Color, pH, Dissolved Oxygen, Temperature, TP, TDP, OPO4, Alk, Ca, Cl, K, Mg, Na, SO4, SiO2, TDS, TSS

D.7.9 L-31N Seepage Cutoff Wall and Operational Changes to G-211

The L-31N Seepage Cutoff Wall will be placed within the levee cross-section and the operations of the G-211 structure will be modified. The CEPP WQ monitoring sub-team determined that these project features will not require new monitoring since any changes to surface water quality will be reflected in the ongoing monitoring at the nearby structure monitoring locations (S331, etc.). **Table D.2.8** provides a summary of the monitoring at the planned divide structure. The estimated cost of monitoring at this location is $20,000 per year which includes 50 hours of staff time, helicopter use, and $3,600 for analytical expenses.

Table D.2.8: Monitoring Scheme L-31N Seepage Cutoff Wall and Operational Changes to G-211

Sampling Locations	Sample Type	Sampling Frequency	Parameter
L-31N Seepage Cutoff Wall	Grab Sample	Monthly	Specific Conductance, Color, pH, Dissolved Oxygen, Temperature, TP, TDP, OPO4, Alk, Ca, Cl, K, Mg, Na, SO4, SiO2, TDS, TSS

D.7.10 S-356 Flow Capacity Increase

The plan includes increasing the S-356 capacity from 500 cfs to 1,000 cfs. The CEPP WQ monitoring sub-team determined that the existing Settlement Agreement monitoring efforts at this structure was sufficient and no additional monitoring at this station was warranted.

D.7.11 S-333 Flow Capacity Increase

The plan includes increasing the S-333 capacity from 1,500 cfs to 3,000 cfs. The CEPP WQ monitoring sub-team determined that the existing Settlement Agreement monitoring efforts at this structure are sufficient and no additional monitoring at this station was warranted.

D.7.12 Geographic Location of Monitoring Stations

The exact location of the new monitoring stations has not been determined at this time. After project authorization, this monitoring plan will be revised to include the latitude and longitude of each new station.

D.7.13 Access and Authority

New Monitoring stations located at water control structures will be accessed via existing levees or public roadways. Triennial sediment monitoring within ENP will either be conducted using airboats or with helicopters depending upon location and season. To perform environmental sampling within Everglades National Park, a sampling and access permit will first be obtained from the park service.

D.8 Project Reporting

Reporting for project monitoring conducted to comply with the Settlement Agreement, Non-ECP permit, or EFA will be accordance with the applicable requirements. Project monitoring that is not tied to those requirements will be reported on in accordance with the applicable CERPRA permit requirement.

D.8.1 Frequency

Monitoring results will be reported no less frequently than annually.

D.8.2 Content and Format

The content and format of the monitoring reports have either been previously established by the applicable permit or settlement. In the case of yet to be issue permits, the content and format will be determined at the time of permit issuance.

D.8.3 Report Recipients and Broader Distribution

The recipients for the monitoring reports include: 1) regulators from the USEPA and FDEP; 2) scientists from local, state, and federal agencies; and 3) non-governmental organization scientists and the general public. Distribution of the reports will be via email and web link.

D.8.4 Revisions and Modifications

[This section is reserved for future changes as they are made and should be referenced throughout the document as revisions occur. Sections should be added chronologically. As revisions are made, a note should be added to the corresponding section of the plan.]

D.9 Administration and Implementation of the Monitoring Plan

Training or Certification: Field and laboratory training requirements are specified in the FDEP SOPs and FSQM for the field and in the NELAP standard and CLQM for the laboratory

D.9.1 Organization Structure and Responsibilities

Overall project organization and responsibilities are detailed in the South Florida Water Management District Water Quality Bureau (WQB) Quality Management Plan (QMP). Field activity responsibilities are detailed in the District's Field Sampling Quality Manual (FSQM). Laboratory analysis and data validation responsibilities are detailed in the District's Chemistry Laboratory Quality Manual (CLQM). These documents define the procedures used by SFWMD personnel to meet the Florida Department of Environmental Protection's (FDEP) Quality Assurance Rule, Florida Administrative Code (F.A.C.) 62-160. Refer to these documents for details on key personnel and relevant responsibilities.

D.9.1.1 Monitoring Program Manager (or Project Manager)

The monitoring program manager is responsible for overseeing the monitoring procedures and determining Reporting Leads. This person will make sure all Leads and Managers are following procedure.

Name : To Be Determined (TBD)
Address:
Telephone:
Email address:

D.9.1.2 Monitoring Field Project Manager

The field project manager for this project is *[INSERT: name]*. The field project manager is responsible for maintaining this document and making sure that any changes are well documented and communicated to the field staff and other parties as necessary.

Name: TBD
Address:
Telephone:
Email address:

D.9.1.3 Monitoring Field Lead

Name: TBD
Address:
Telephone:
Email address:

D.9.1.4 Analytical Lead/Contract Manager

Name: TBD
Address:
Telephone:
Email address:

D.9.1.5 Quality Assurance Lead

Name: TBD
Address:
Telephone:
Email address:

D.9.1.6 Reporting Lead

Name: TBD
Address:
Telephone:
Email address:

D.9.1.7 Program Implementation

This monitoring plan is part of a federal-state cost shared project. The USACE is likely to be responsible for constructing most of the project features. Monitoring efforts during start-up as well as regular operation will likely be conducted by the SFWMD given its extensive experience conducting on-going environmental monitoring. Partnerships

The SFWMD may chose to engage local governments or private contractors to conduct the monitoring outlined in this plan.

D.9.1.8 Program and Protocol Review

Review Summary (to be completed by RECOVER QAOT)

[List the reviews that the monitoring plan has undergone (i.e. RECOVER, QAOT) and the reviews that are expected in the future (i.e. scope of work (SOW) review by the QAOT and any Standard Operating Procedures (SOPs) that need to be reviewed by the QAOT). Additionally, technical representatives of the respective monitoring units of the Federal and local sponsor should review SOPs and SOWs. Also list if there will be any periodic reviews (annually, biannually, etc), and by whom. Items that might be considered in a periodic review:

- *Are the right parameters or indicators being monitored?*
- *Are the SOPs appropriate, do they need to be modified, or new SOPs developed?*
- *Is the project management structure working effectively or are changes in roles and responsibilities required?*
- *Do the project results demonstrate the verity of conceptual models, restoration hypotheses, and restoration techniques utilized? If not, how will findings be utilized and findings made in monitoring program review?].*

D.10 Cost Estimates

Estimated costs are provided below in **Table D.2.9.**

It should be noted that detailed costs described here were calculated using the best available information at the time of writing, and were provided before the CEPP project-wide contingency of ~44% was added to the project cost estimate. Therefore several detailed estimates provided in this monitoring plan may be lower than the amounts shown in the cost summary tables that include the contingency (Table 6-9 in Section 6, Table D.1.1 in Annex D intro, and the summary of costs provided in the introduction to this plan).

Table D.2.9: Estimated Project Water Quality Monitoring Cost

Feature	Monitoring Description	Annual Cost	1-Year	5-year	50-year
A-2 FEB					
	Inflows / Outflows	77,000	77,000	385,000	3,850,000
	Internal Optimization	78,000	78,000	390,000	3,900,000
	Start up Toxicants				
	Start-Up (year 1)	30,000	30,000	30,000	30,000
	Stabilization (years 2-3)	25,000		50,000	50,000
	Routine (years 4-50)	15,000		30,000	675,000
Northern WCA 3A					
	Marsh Water Quality	78,000	78,000	390,000	3,900,000
L-67A/C Structures					
	Structure Compliance	111,000	111,000	555,000	5,550,000
L-67 Extension Backfill					
	Marsh Water Quality	20,000	20,000	100,000	1,000,000
	Marsh Sediment	17,000	17,000	85,000	850,000
Blue Shanty Flow-way					
	Structure Compliance	30,000	30,000	150,000	1,500,000
	Marsh Water Quality	20,000	20,000	100,000	1,000,000
L-29 Degrade					
	Marsh Water Quality	20,000	20,000	100,000	1,000,000
L-31N					
	Marsh Water Quality	20,000	20,000	100,000	1,000,000
Total, Field Work and Analytical Cost			501,000	2,465,000	24,305,000
	Reporting Cost		10,000	50,000	500,000
Total Cost			511,000	2,515,000	24,805,000
Total Cost with Contingency (assume 43%)			730,730	3,596,450	35,471,150

D.11 Water Quality Monitoring

D.12 Data quality objectives

While it is recognized that data quality objectives (DQOs) are typically developed separately for each specific monitoring project, all mandated monitoring conducted by the SFWMD must meet the objectives conveyed in the FDEP's Quality Assurance Rule, 62-160 F.A.C. The SFWMD has adopted a uniform set of DQOs following criteria detailed within the "Analytical Methods and Default QA/QC Targets" table of the SFWMD's Chemistry Laboratory Quality Manual (CLQM). For those samples analyzed by the FDEP Laboratory, the SFWMD has adopted the DQOs within the most recent version of the FDEP's Laboratory Chemistry Quality Manual.

Water Quality and sediment samples, including field testing and field quality control samples, are collected in accordance with the FDEP Quality Assurance Rule, 62-160 F.A.C. and the current version of the Field Sampling Quality Manual (SFWMD-FIELD-QM-001) (FSQM). Applicable sections of the FSQM include, but are not limited to, field sample collection procedures, decontamination procedures, field testing, quality control requirements, and documentation requirements.

The DQOs of the field testing parameters for this project are specified in the field testing section of the FSQM. This manual is updated annually, and therefore, the most recent version of the FSQM details the specific field testing data quality objectives for this project at the time of sample collection.

Samples are analyzed according to the provisions within the FDEP Rule 62-160 F.A.C. and the CLQM. This manual is annually updated, and therefore, the most recent version of the CLQM details the specific laboratory analyses' DQOs for this project at the time of sample collection

Data not meeting the quality objectives must be qualified using standard FDEP qualifier codes (F.A.C. 62-160) and corrective actions may be taken as outlined in the SFWMD's FSQM and CLQM and Data Validation and Reporting Sections SOPs.

D.13 Monitoring Data Elements/Indicators

Monitoring proposed for this project is primarily required for compliance with existing or future permits or the Settlement Agreement. In addition to demonstrating compliance with water quality criteria, the data collected under this plan is referenced in the CEPP Adaptive Management Plan. Discussion of decision-criteria is found in that plan.

D.13.1 Procedures and Methods

Sampling methods will follow well-defined methodologies that have been approved by Federal and state regulatory agencies. The SFWMD's FSQM shall be used for all water quality and sediment sampling procedures. Once the DQOs are established, the QASR should be consulted to identify the analytical methods that will meet the project objectives. Methods specified in the CLQM or their equivalent shall be used when specified.

The laboratory that processes the samples collected in this plan will report data using ADaPT (Automated Data Processing Tool) software. Staged Electronic Data Deliverable (SEDD)(http://www.epa.gov/fem/pdfs/sedd_adr_imp_overview.pdf) or the Automated Data Review (ADR) software may be used in addition to ADaPT.

Each discrete sample will be assigned a unique sample identification number that ensures that it can eventually be retained as a unique database record linked to a specific location. All these activities regarding a sample will be documented in a format that assures that the resulting data are traceable and of known and documentable quality.

D.13.2 Laboratory Qualifications

Laboratories used in this plan will be certified by the Florida Department of Health Environmental Laboratory Certification Program (FDOH ELCP). At the time the laboratory(s) are selected, this plan will be updated to include the laboratory certifications by the test method, analytes/parameters and matrix that are reported for the project. As specified by QASR Chapter 4.0, laboratories used for analysis of CERP environmental samples will be pre-approved and subjected to comparative testing if available, such as the performance evaluations overseen by the QAOT. These requirements shall be defined in the laboratory's contract or work order with the contracting agency.

D.13.3 Rationale for indicator selection

Field and Laboratory analytes are collected per the requirements of the EFA, Settlement Agreement, and anticipated CERPRA and EFA permits. The focus of the monitoring efforts is on the collection of macronutrients as they are used as indicators of restoration success or project impact.

D.13.4 Sampling frequency and duration

Sampling frequencies proposed in this monitoring plan are either directly the result of the requirements of the EFA, Settlement Agreement, or Non-ECP permit, or are anticipated to be required for future EFA or CERPRA permits.

D.13.5 Assessment Process and Decision Criteria (triggers and thresholds)

Assessment frequency is annual as established by the requirements of the EFA, Settlement Agreement or Non-ECP permit. Decision criteria are established by the compliance values from these cited permits and settlements.

D.14 Data Collection

D.14.1 Sample/Data Collection Standards and Ethics

Every person performing field sampling must commit to following project specific requirements, SFWMD's FSQM, field SOPs, QASR requirements, and other instructions as issued, to assure that samples collected are of known and documented quality and are defensible.

D.14.2 Sample Submission

Requirements for sample handling, custody and analysis holding times are detailed in the ***SFWMD's Chemistry Laboratory Quality Manual and FDEP SOPs (DEP-SOP-001/01).***

D.14.3 Chain of Custody

The Chain of Custody (COC) must accompany all samples submitted to internal or external laboratories. A COC form documents the possession of the samples from the time of collection to receipt in the laboratory. A COC form will be utilized and must be signed by the collector before it is relinquished to the laboratory. Field documentation must conform to the requirements specified in FDEP SOP FD1000 and the field documentation section of the SFWMD FSQM.

D.14.4 Quality Control of Samples

D.14.4.1 Laboratory Quality Control

Laboratories must meet NELAC requirements, the requirements detailed in Chapter 4 of the CERP QASR (http://www.evergladesplan.org/pm/program_docs/qasr.aspx) and applicable requirements as detailed in FDEP's Quality Assurance Rule, 62-160 F.A.C. All laboratory and applicable quality control data shall be submitted to the District in the ADaPT compatible format.

D.14.4.2 Field Quality Control Samples

Field Quality control samples will comply with the Field Quality Control section of the FSQM, Florida Department of Environmental Protection (FDEP) requirements (DEP-SOP-001/01,), and those developed in the DQO process. All requirements in the FDEP's Quality Assurance Rule should also be followed.

D.14.5 Field Record and Data Review

Field record and data review procedures are specified in the SFWMD FSQM and associated SOPs Responsibilities of the Laboratory Data Validation

Data validation shall be performed in accordance with the requirements detailed in Chapter 5 of the CERP QASR. When preparing the ADaPT file the laboratory will review the data for completeness and accuracy.

D.14.6 Data Storage and Archiving

Long-term maintenance and management of digital information are vital to all PLMPs. Maintaining and managing digital data, documents, and objects that result from projects and activities is the responsibility of all parties involved. CGM54 will be followed to help ensure the continued availability of crucial project information and permit a broad range of users to obtain, share, and properly interpret that information. After the data validation process, all data are maintained so that end users can retrieve and review all information relative to a sampling event. Field notes are maintained on an internal server either by scanning actual field note pages or by uploading narratives from field computers path to server. All analytical data and field conditions are sent to the SFWMD database (DBHYDRO) for long-term storage and retrieval. If data are not suitable for DBHYDRO they will be entered into the CERP Integrated Database (CID) on CERPZone through the Morpho interface.

SFWMD or its surrogate shall maintain records of field notes and copies of all records relative to the chain of custody and analytical data. It is the responsibility of the SFWMD or its surrogate to maintain both current and historical method and operating procedures so that at any given time the conditions that were applied to a sampling event can be evaluated. Upon completion of the project, the collecting agency shall provide all original field notes to the District's WQB for permanent archival.

Records shall be maintained for the life of the project and five years thereafter, in a manner that will protect the physical condition and integrity of the records. Storage shall follow the District's records storage procedure. Access to archived methods shall be through designated records custodian. Corrections of data or records shall follow the established SFWMD SOPs.

D.15 Documentation

Field records shall be documented in accordance with the procedures specified in the SFWMD FSQM.

D.16 Quality Assurance and Quality Control

D.16.1 Laboratory and Field Audits

Audits will be performed according to the SFWMD FSQM and associated SOPs. Audit reports will be provided to the project manager. The authority of the auditor to stop work for processes that impact the quality of the data will also be defined, along with how and to whom the audit findings are reported and distributed.

D.17 Data Analyses and Records Management

The SFWMD has adopted a uniform set of DQOs following criteria detailed by the table entitled *Field Quality Assurance Objectives* found in the field testing section of the FSQM and within the "Analytical Methods and Default QA/QC Targets" table of the CLQM.

D.17.1 Data Quality Evaluation and Assessment

The data quality assessment (DQA) process uses scientific and statistical data evaluation procedures to determine if the data are of the right type, quantity, and quality to support their intended use. The DQA process is discussed in the QASR Chapter 11 and detailed guidance is described in EPA QA/G9R, Data Quality Assessment: A Reviewer's Guide (EPA, 2006a) http://www.epa.gov/quality/qs-docs/g9r-final.pdf.

The Science Policy Council has defined general data quality assessment factors (EPA, 2003) http://www.epa.gov/osa/spc/pdfs/assess2.pdf) that should be considered during the DQA process. These include soundness, applicability and utility, clarity and completeness, uncertainty and variability, and evaluation and review.

Reporting on mercury and pesticides or other toxicants should be done under the supervision of professionals with a record of published research in these areas using approved guidance such as the QASR Manual and CGM 42 Toxic Substances Screening Process - Mercury and Pesticides.

D.18 Adaptive Management Considerations

Please reference the Adaptive Management Plan for the CEPP project, Annex D Part 1.

D.19 Mercury and Toxicant Monitoring

Based on the guidance contained in *"A Protocol for Monitoring Mercury and Other Toxicants"* (dated April 2011; hereafter referred to as the *Protocol*), the District shall initiate Phase 1 – Tier 2: Field Sampling for Initial Startup Monitoring Prior to Discharge for the A-2 Flow Equalization Basin (FEB) as follows:

D.20 Phase 1: Baseline Collection and Assessment

D.20.1 Phase 1 - Tier 2: Field Sampling for Initial Startup Monitoring Prior to Discharge

D.20.1.1 Mosquitofish

i) When construction of the A-2 FEB is completed, the USACE will notify the SFWMD who shall notify the Department and within one month of initial flooding collect mosquitofish from multiple locations within the A-2 FEB (to total at least 100 fish; see **Figure 5** for map). Additionally, mosquitofish (to total at least 100 fish) will be collected from a single station located in the receiving water of the project, immediately downstream of G-13. The data for the downstream station will serve as a baseline for any future evaluations of potential impacts to the receiving waters. Samples shall be physically composited into one (spatially-averaged) sample per operating unit and analyzed for total mercury (THg), cis-chlordane, trans-chlordane, dieldrin, cis-nonachlor, trans-nonachlor, toxaphene, arsenic, and copper (note, a single aliquot should be analyzed per composite).

ii) The District shall provide the Department with the results of the first collection of mosquitofish as well as the appropriate action levels for comparison (90% upper confidence level of the basin-wide average or the 75th percentile concentration for the period of record for all basins if basinwide data are not available). If tissue concentrations from the A-2 FEB are below the 90% upper confidence level of the basin-wide average or below the 75th percentile concentration for the period of record for all basins (if basin-specific data are lacking) after concurrence from the Department, the District may initiate flow-through operation and routine monitoring for the A-2 FEB.

However, if Hg or other toxicant concentrations in the mosquitofish composite exceed one of the above-referenced action levels, the District shall immediately (within 14 days of receiving quality-assured data from the laboratory) collect a sample(s) to confirm the exceedance(s). In addition, the District shall consult with the Department to determine the most appropriate course of action and obtain authorization to initiate flow-through operation. At a minimum, the course of action will include implementation of Tier 2 Expanded Monitoring and Risk Assessment by the District during initial flow-through operations (e.g., collection of monthly mosquitofish within the A-2 FEB and at one station downstream of the A-2 FEB at a minimum), additional details on expanded monitoring are provided in the *Protocol*. The recommended course of action may also include additional measures as determined to be appropriate. When results of expanded monitoring demonstrate concentration of Hg in mosquitofish from the A-2 FEB has decreased to acceptable levels (below action levels referenced above) and the concentrations at the downstream site are not significantly elevated above baseline levels, the District shall notify the Department and request that the monitoring revert back to Tier 1 routine monitoring.

D.20.1.2 Sediment

After the soils have been flooded and saturated for some period of time (i.e., in excess of a month) and prior to discharge, sediment cores will be collected from five representative locations within the A-2 FEB. Sediment samples will not be collected at a downstream station because it is not feasible to collect sediment cores from the 0 to 4 cm horizon in the downstream canal. Efforts will be made to co-locate interior sediment stations with interior mosquitofish stations.

At each location or site, a minimum of three cores (number of cores in excess of three will be determined by amount of sediment required for analysis) from the 0 to 4 cm horizon are to be collected and composited as a single sediment sample.

To serve as baseline for future comparison, if future conditions warrant follow-up sampling of sediments (i.e., if Tier 2 were triggered), sediment samples will be analyzed for THg, methylmercury (MeHg), moisture content, total organic carbon (TOC), total sulfur (TS), and total iron (TFe). Additionally, these sediment samples will be analyzed and assessed for toxicants other than mercury as discussed below.

D.20.1.3 Water

Although mercury will be monitored and assessed prior to discharge based on tissue concentrations, because of the concern for potential acute toxicity, water will be collected from immediately upstream of the A-2 FEB inflow pump station and outflow gated culvert(s) and analyzed for toxicants other than mercury as discussed below. (Though the A-2 FEB may share some inflow and outflow locations with the A-2 FEB, the mercury/toxicant efforts will not be performed simultaneously given different construction schedules; therefore, none of the monitoring can be shared between the two FEBs.)

Table D.2.10 summarizes the monitoring requirements for Phase 1 - Tier 2: Field Sampling for Initial Startup Monitoring Prior to Discharge.

Table D.2.10: Phase 1 - Tier 2 Initial Startup Monitoring Prior to Discharge

Matrix	Location	Collection Method	Frequency	Parameter(LIST TO BE EDITED)
Mosquitofish	One (1) composite sample consisting of fish collected at multiple locations within A-2 FEB and one (1) composite sample downstream	Net or Trap	One-time	THg Arsenic, dieldrin, copper, and selenium
Sediment	Five (5) stations within A-2 FEB	Sediment Core	One-time	THg, MeHg, Moisture Content, TOC, TS, and TFe Arsenic, atrazine, dieldrin, copper, and selenium
Surface Water	Inflow and Outflow	Grab	One-time	Arsenic, atrazine, dieldrin, copper, and selenium

D.21 Selection of Toxicants Other Than Mercury

The following information sources have been reviewed for data regarding this project: Preliminary results from cultivates soil sampling conducted on A-2 FEB lands in January of 2013. Based on these analytical results, samples will be collected and analyzed for the parameters identified in **Table D.2.11** for each of the specified matrices.

Table D.2.11: Parameter list of toxicants other than mercury to be analyzed in specified matrix. (TO BE EDITED)

Analyze	Surface Water	Sediment	Fish Tissues
arsenic	X	X	X
atrazine	X	X	- *
copper	X	X	X
dieldrin	X	X	X
selenium	X	X	X

* parameter not analyzed

The District shall provide the Department with the results of these analyses as well as the appropriate action levels for comparison. If the following criterion is met for A-2 FEB, the District may initiate flow-through operational and routine compliance monitoring (for details on routine monitoring, see below).

- If ambient mosquitofish do not demonstrate excessive bioaccumulation that exceeds a critical tissue benchmark used to establish SQAGs or in site-specific risk assessments;
- If concentrations in sediments do not exceed an effects-based, numerical sediment quality assessment guideline (SQAGs for sediment dwelling organisms, MacDonald Environmental Sciences Ltd. and USGS, 2003);
- If concentrations in sediments do not exceed an established bio-accumulative based SQAG, if available (MacDonald Environmental Sciences Ltd. and USGS, 2003), a action level reported in the ESA or a level that was determined to be critical in a site-specific risk assessment;
- If water-column concentrations do not exceeded the state water quality standard (WQS) in Chapter 62-302, Florida Administrative Code (F.A.C.)

However, if the above referenced action level is exceeded, the District shall immediately (within 14 days of receiving quality assured data from the laboratory) collect a sample(s) to confirm the exceedance(s). In addition, the District shall consult with the Department to determine the most appropriate course of action and obtain authorization to initiate flow-through operation from A-2 FEB. At a minimum, the course of action will include implementation of Tier 2 Expanded Monitoring and Risk Assessment by the District during initial flow-through operations. The recommended course of action may also include additional measures as determined to be appropriate. When results of expanded monitoring demonstrate concentrations in each operating unit has decreased to acceptable levels (below action levels referenced above), and the concentrations at the downstream site are not significantly elevated above baseline levels, the District shall notify the Department and request that the monitoring revert back to Tier 1 routine monitoring.

D.21.1 Monitoring During Three-Year Stabilization Period

D.21.1.1 Phase 2 - Tier 1: Routine Monitoring During Stabilization Period

D.21.1.2 Water

An unfiltered surface water sample (n = 1) shall be collected in accordance with Chapter 62-160, F.A.C. at the inflow pump station(s) and immediately upstream of the outflow gated culvert(s) (Figure 1) on a quarterly frequency and analyzed for THg and MeHg (sulfate is being monitored under the EFA permit required water quality monitoring program). In addition, flow shall be monitored at the inflow and outflow to allow for load estimation to and from the project (it should be recognized that quarterly sampling would allow for only rough estimation of loads).

Based on the discussion above regarding toxicants other than mercury, a surface water sample will be collected quarterly immediately upstream of the inflow and outflow structures and analyzed for the parameters listed in Table 1 under surface water.

This data set will be assessed to determine if outflow concentrations exceed state water quality standards (WQS), and whether annual outflow loads of analytes are significantly greater than inflow loads, including atmospheric loading; load estimates will include confidence intervals that describe uncertainty in measures of flow and concentration (e.g., field and analytical precision) and resulting from interpolation (note: assessment protocol to be negotiated with permitting authority). Failure to satisfy these assessment measures would trigger Tier 2 Expanded Monitoring and Risk Assessment (see below).

Because of differences in the anticipated time frames under which sedimentary release are thought to occur (i.e., relative to MeHg that may have time lag associated with changes in biogeochemistry and microbial methylation driven by water quality, especially in sandy sediments), monitoring for other toxicants would cease after one year if action levels are not exceeded within that time.Fish Tissues

Because this project is not expected to provide hydrologic conditions or habitat that will support large-bodied fish, sunfish and largemouth bass will not be collected. Mosquitofish will be collected quarterly from multiple locations (Figure 1) within A-2 FEB, physically composited into one (spatially-averaged) sample (to total at least 100 fish), and analyzed for THg and other toxicants listed in Table 1 under fish (note, a single aliquot will be analyzed per composite). Additionally, mosquitofish (to total at least 100 fish) will be collected quarterly from a single station located in the receiving water of the project, immediately downstream of the outfall structure and analyzed for THg and other toxicants.

Table D.2.12 summarizes the monitoring requirements for Phase 2 - Tier 1: Routine Monitoring During Stabilization Period.

Table D.2.12: Phase 2 – Tier 1: Routine Monitoring During Stabilization Period

Matrix	Location	Collection Method	Frequency	Parameter
Surface Water	Two inflow and one outfall structure	Grab	Quarterly	THg, MeHg Arsenic, atrazine, copper, dieldrin, and selenium *
Mosquitofish	One (1) composite sample consisting of fish collected at multiple locations within A-2 FEB and one (1) composite sample downstream of G-13	Net or Trap	Quarterly	THg Arsenic, copper, dieldrin, and selenium *

* Monitoring for toxicants other than mercury will cease after one year if action levels are not exceeded.

Assessment

To detect and minimize any adverse effects as early as possible (and to provide a basis for identifying adaptive management options, if deemed necessary), the results of this monitoring will be assessed based on the criteria and time table described under Phase 2 – Tier 1 in the *Protocol*. Monitoring results will be provided to the Department in accordance with the reporting requirements described below.Phase 2 - Tier 2: Expanded Monitoring and Risk Assessment

In accordance with the *Protocol*, if Tier 1 data exceed the action levels identified under Phase 2 – Tier 2: Expanded Monitoring and Risk Assessment, the District shall notify the Department and after obtaining the Department's concurrence, shall expand monitoring and undertake all necessary steps consistent with the *Protocol*.Operational Monitoring

The monitoring plan and associated data will be re-evaluated on regular basis beginning after year 1 for other toxicants and after year 3 for mercury species to determine if criteria specified in the *Protocol* are being satisfied (following startup of A-2 FEB). Based on that assessment, and with the concurrency of the Department, monitoring and assessment efforts may be reduced (as identified in Phase 3 – Tier 1: Operational Monitoring from Year 4 to Year 9 of the *Protocol*) or eliminated altogether at the project level to be subsumed by regional monitoring (as identified in Phase 3 – Tier 3: Routine Operational Monitoring After Year 9 of the *Protocol*). However, if monitoring reveals anomalous conditions as described under Phase 3 – Tier 2: Expanded Monitoring and Risk Assessment, the District shall expand monitoring and undertake all necessary steps identified under Phase 3 – Tier 2 the *Protocol*.

D.21.2 Phase 3 – Tier 1: Routine Operational Monitoring from Year 4 to Year 9

D.21.2.1 Fish Tissues

Semiannually, mosquitofish will be collected from multiple locations within the A-2 FEB and from single station located in the receiving water of the project (**Figure 2-2**). Specifically, mosquitofish will be collected semiannually from multiple locations within the A-2 FEB, physically composited into one (spatially-averaged) sample (to total at least 100 fish), and analyzed for THg (note, a single aliquot will be analyzed per composite). Additionally, mosquitofish (to total at least 100 fish) will be collected semiannually from a single station located in the receiving water of the project, immediately downstream of the A-2 and analyzed for THg.

This data will then be used to track the following:

- THg levels in individual mosquitofish composite;
- Annual average THg levels in mosquitofish;

Table D.2.13 summarizes the monitoring requirements for Phase 3 – Tier 1: Routine Operational Monitoring from Year 4 to Year 9.

Table D.2.13: Phase 3 – Tier 1: Routine Operational Monitoring from Year 4 to Year 9

Project Code	Matrix	Location	Collection Method	Frequency	Parameter
A2FEB	Mosquitofish	One (1) composite sample consisting of fish collected at multiple locations within A-2 FEB and one (1) composite sample downstream of G-13	Net or Trap	Semiannually	THg

D.21.2.2 Phase 3 - Tier 2: Expanded Monitoring and Risk Assessment

Tier 2 monitoring and assessment is triggered if one of the following action levels is exceeded during operation:

- If annual average THg levels in mosquitofish progressively increased over time (i.e., two or more years) or any (semi-annual) mosquitofish composite exceeds the 90% upper confidence level of the basin-wide annual average or, if basin-specific data are lacking, exceeds the 75th percentile concentration for the period of record for all basins; or

The following steps will be taken if any action level in Tier 2 is triggered:

Step 1: Notify the Department;

Step 2: Resample fish species that triggered Tier 2;

If results of Step 2 (i.e., re-sampling) demonstrate that the anomalous condition was an isolated event, the Department will be notified that the project will revert back and continue with Tier 1 monitoring. Alternatively, if results of Step 2 reveal the anomalous condition was not an isolated event, proceed to Step 3.

Step 3: Expanding monitoring program as follows:

- Increase frequency of mosquitofish collection from semiannually to monthly.
- If Tier 2 was triggered by THg levels in fish at the downstream site, possibly due to excessive loading from the FEB outflow, then quarterly water-column sampling at the outflow station will begin. If necessary (i.e., if loading uncertainty is high), increase frequency of surface water collection to monthly (reducing temporal interpolation), or as appropriate for hydraulic retention time (HRT).
- If Tier 2 was triggered by THg levels in fish within only one of the operating units, further define spatial extent of problem by collecting multiple mosquitofish composites from within the operating unit exhibiting anomalous conditions.
- To evaluate possible trends in mercury methylation rates in sediments (i.e., to determine if methylation rates are increasing or decreasing), replicate sediment cores (0-4 cm) can be collected from the suspected methylation "hot spot" and reference locations within the component (for THg, MeHg, moisture content, total organic carbon (TOC), total sulfur (TS), and total iron (TFe)) over a given period of time (i.e., 2 to 4 months). At these same locations and collection times, collect pore

water samples and analyze for THg, MeHg, and sulfides, or if no acceptable pore water protocol has been developed, then acid-volatile sulfide (AVS) on solids shall be completed.

Projects shown to have (spatially) large or multiple MeHg "hotspots" should consider use of the Everglades Mercury Cycling Model (E-MCM) or comparable model as an assessment tool (i.e., to synthesize results of expanded monitoring).

Step 3 will also include the notification of the Department that anomalous conditions are continuing. The Department and the District may then develop an adaptive management plan using the data generated from the expanded monitoring program. This plan will evaluate the potential risks from continued operation under existing conditions (i.e., through a risk assessment for appropriate ecological receptors). If risk under existing operational conditions is deemed acceptable, then project monitoring would continue under a modified Tier 2 scheme to monitor exposure. On the other hand, if risk under existing operational conditions is deemed unacceptable, then the adaptive management plan would then proceed to determine potential remedial actions to (1) reduce exposure and risk (e.g., signage for human health concerns[1], reduce fish populations, reduce forage habitat suitability) and (2) affect mercury biogeochemistry to reduce net methylation (e.g., modify hydroperiod or stage, water quality).

In developing this adaptive management plan, the Department may conduct a publicly noticed workshop to solicit comments from the District, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the National Park Service, the Florida Fish and Wildlife Conservation Commission, and other interested persons.

The next step would then be to carry out such remedial or corrective action. If the remedial or corrective action is demonstrated to be successful, then the project would revert back to Tier 1 monitoring. Alternatively, if monitoring data indicate that the remedial action was unsuccessful in reducing fish tissue THg concentrations or downstream THg loading, the Department and the District would then initiate a peer-reviewed, scientific assessment of the benefits and risks of the project.

D.21.2.3 Phase 3 - Tier 3: Termination of Monitoring After Year 9

If fishes collected under Phase 3 - Tier 1 have not exceeded action levels by year 9, project-specific monitoring would be discontinued; future assessments would be based on regional monitoring.

The District shall notify the Department immediately if monitoring data indicate that any of the action levels are exceeded. In addition, the District shall submit an annual report to be incorporated into the SFER and submitted to the Department no later than March 1st of each year. The annual report shall summarize the most recent results of the monitoring as defined above and compares them with the cumulative results from previous years. This report shall also evaluate assessment performance.

[1] Note that assessment of potential human health impacts and corrective actions (i.e., signage) will require the involvement of the Florida Department of Health)

D.21.3 Adaptive Management Strategy

It is the intent that this monitoring plan will be carried out within the context of an adaptive management strategy that will allow for appropriate changes based on new, better understanding of mercury cycling, fate and transport as conveyed in the guidance contained in the *Protocol*.

PART 3. CEPP Hydrometeorological Monitoring Plan

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D.0 HYDROMETEOROLOGICAL MONITORING

D.1 Data quality objectives

Developing Data Quality Objectives (DQOs) is an integral and important part of a systematic planning process that is designed to ensure that the final results can be used for the purpose for which the data were generated. This systematic planning process for purposes of these discussions on environmental data quality is the quality system that each organization must develop, implement and evaluate on a continuing basis.

The data will be used to measure project performance, water quality-related goals and objectives and to comply with monitoring requirements of an operational permit. The DQOs to be considered include accuracy, precision, sampling frequency, availability, completeness, reporting frequency, and timeliness. These are addressed in CERP's *Quality Assurance Systems Requirements*, Chapter 6, Table 6.1, dated 7 December 2010. The DQOs are further outlined in Section 3.1.1 of this document.

D.1.1 Monitoring Data Elements/Indicators/Cost Estimate

Hydrometeorological and hydraulic monitoring will collect, at a minimum, groundwater and/or surface water stages measured at each of the new structures; gate openings at gated structures; and pump RPMs at pump stations (to be used in calculating flows). Specific gages are described in **Table D.D**.1, which provides summary information on the gages, parameters, sensor types, collection frequency, and pertinent notes to ensure the hydrometeorological monitoring is completed as needed. Data will be recorded at the noted structure locations within the project area, recorded and transmitted based on existing network coverage as possible. The hydrologic and meteorological data collection equipment used for this project would be installed as part of the construction contract or a separate contract with construction funding. Hydrometeorological parameters such as surface and ground water stages require accurate estimates of the water elevation height compared to a known reference. All new surface and ground water monitoring installations will be surveyed to a first order accuracy using the nearest geodetic benchmark. Reference elevations will be reported in both the NAVD 88 and NGVD 29 datums. Several of the structures are located within a close proximity to each other and/or existing gages, and therefore a reduction in the total number of new gages that are needed can be made. The particular gages that may be eliminated due to redundancy are noted in the table. A map of the structures with their proposed gaging requirements is presented below the table, in **Figure D.D**.1. Other gages used in the operations of the system as a whole (such as water levels in the Water Conservation Areas) are not shown on the map.

The USACE Jacksonville District receives data from various sensors and data collection platforms to monitor surface water flows and levels. Automated timed processes provide provisional near-real-time data required for water management operations. Additional data are also received through an interagency data exchange program among the SFWMD, the USGS, and ENP.

Including the addition of a project-wide contingency cost, the cost estimate for one year of hydrometeorological monitoring during Operational Testing and Monitoring Period (OTMP) is $2,490,000, and the monitoring will cost $195,000 annually during OMRR&R. These estimates and contingencies are also reported in Section 6 table 6-9 and in Annex D Table D.1.1.

Table D.D.1: CEPP Gaging Needs. Hydrometeorological Monitoring

This table lists the necessary gaging parameters to be collected as part of CEPP, which are in addition to current monitoring stations that will be leveraged for CEPP. The headwater and tailwater stage gages located directly upstream and downstream of the structures, respectively, along with the gate openings, are used in computing flows through structures, as well as assisting in determining the operations. The 15-minute frequency is the USACE required standard for these parameters. Breakpoint data for a pump is collected when changes to the RPMs are made, up to a frequency of 1-minute. The shaded table rows are for gages that may be unnecessary due to the proximity of other gages; potential alternate gages are listed in the notes.

Gage	Parameter	Sensor Type	Frequency	Notes
S-623 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-623 TW	Stage, tailwater			Use G-372 HW gage
S-623 Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-624 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-624 TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-624 Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-625 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-625 TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-625 Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-626 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-636 TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-626 Pump	Pump RPMs	Inc. in controls	Breakpoint	Located at pump
S-627 HW	Stage, headwater			Use S-628 HW gage
S-627 TW	Stage, tailwater			Use S-628 TW gage
S-628 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-628 TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-628 Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-620 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-620 TW	Stage, tailwater			Use S-7 HW gage
S-620 Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-621 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-621 TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-621 Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-622 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-622 TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-622 Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-8A HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-8A TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-8A Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-630 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-630 TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-630 Pump	Pump RPMs	Inc. in controls	Breakpoint	Located at pump
S-333N HW	Stage, headwater			Use existing S-333 HW gage
S-333N TW	Stage, tailwater			Use existing S-333 TW gage
S-333N Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-356 HW	Stage, headwater			Use existing S-356 HW gage
S-356 TW	Stage, tailwater			Use existing S-356 TW gage
S-356 Pump	Pump RPMs	Inc. in controls	Breakpoint	Located at pump
S-631 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-631 TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-631 Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-632 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-632 TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-632 Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-633 HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-633 TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-633 Gate	Gate position	Pos. Indicator	15-minute	Located on the gate
S-355W HW	Stage, headwater	SDI encoder	15-minute	Located near structure, platform installation
S-355W TW	Stage, tailwater	SDI encoder	15-minute	Located near structure, platform installation
S-355W Gate	Gate position	Pos. Indicator	15-minute	Located on the gate

Figure D.D.1: Map of Structures with Proposed Gages

D.1.2 Procedures and Methods

Measurements will be recorded in the manner outlined in CERP's *Quality Assurance Systems Requirements*, Chapter 6, Table 6.1, dated 7 December 2010.

To summarize, surface water stages will be measured using an SDI encoder at each monitoring location. The accuracy required is ±0.02 feet for critical sites and ±0.03 feet for non-critical site. The reported resolution will be 0.01 feet and the instrument range will be 0 20 feet. The precision will be ±0.01 feet. The sampling frequency will be 15 minutes, at 0, 15, 30, and 45 minutes past each hour (e.g. at 1500 hrs, 1515 hrs, 1530 hrs, etc).

Groundwater stages will be measured using an SDI encoder at each monitoring location. The accuracy required is ±0.03 feet. The reported resolution will be 0.01 feet and the instrument range will be 0 30 feet. The precision will be ±0.01 feet. The sampling frequency will be 15 minutes.

Rainfall will be measured with an accuracy of ±0.01 inches. The reported resolution will be 0.01 inches and the precision will be ±0.01 inches. The sampling frequency will be 15 minutes.

Gate positions will be measured using gate position indicators with an accuracy of ±0.05 feet, a reported resolution of 0.01 feet, and a gate position range of either 0-75 inches or 0-550 inches. The precision required is ±0.02% full stroke. The reporting frequency will be 15 minutes.

Pump RPMs will be measured with an accuracy of ±25 RPM and a reported resolution of 1 RPM. The pump RPM range will be 0-3,000 RPMs. The reporting frequency will be 1-360 samples per hour.

Computed flows will have an accuracy uncertainty limit of 95% C.I. The accuracy will be ±10% for inland spillways, ±15% for culverts, and ±15% for pumps. The velocity instrumentation will have a precision of ±0.01 feet/second. The reporting frequency will be 15 minutes.

The hydrologic and meteorological data collection instruments utilized for this project will be installed as part of the construction contract or under separate contract. Water stage measuring devices will be affixed to a platform in a manner to discourage vandalism and natural or unnatural intrusions (inclement weather, animals, etc). Water surface elevation measuring devices will use SDI encoders for measuring values. Gate positions will be measured using gate position indicators. Flow calculation equations that are used to compute flow on site with certain instrument types, such as a programmable data logger, will be developed under the supervision of the sponsoring agencies hydrology and hydraulics monitoring units during the execution of this monitoring plan.

D.2 Rationale for indicator selection

The indicators selected for inclusion are required under CERP's *Quality Assurance Systems Requirements*, Chapter 6, Table 6.1, dated 7 December 2010. The headwater and tailwater values are used, along with gate openings or pump RPMs, to determine the flow of water through the structure.

D.3 Sampling frequency and duration

The sampling frequency and duration is governed by CERP's *Quality Assurance Systems Requirements*, Chapter 6, Table 6.1, dated 7 December 2010.

Surface water stages recording frequency will be 15 minutes, at 0, 15, 30, and 45 minutes past each hour (e.g. at 1500 hrs, 1515 hrs, 1530 hrs, etc).

Groundwater stages recording frequency will be 15 minutes.

Rainfall recording frequency will be 15 minutes.

Gate positions recording frequency will be 15 minutes.

Pump RPMs recording frequency will be by break point, with a minimum of one (1) recording per hour up to 360 recordings per hour.

Computed flows computing frequency will be 15 minutes.

D.4 Assessment Process and Decision Criteria (triggers and thresholds)

Trigger elevations for surface water will take into consideration the design headwater and tailwater at the gages' respective structures to ensure that design limits are not reached. In addition, the decision criteria will be further refined as the operations of CEPP are developed.

D.4.1 Data Collection

D.4.2 Sample/Data Collection Standards and Ethics

No samples will be collected for hydrometeorological monitoring. Data will be collected following the required standards as described in this document.

D.4.3 Sample Submission

No samples will be collected for hydrometeorological monitoring.

D.4.4 Chain of Custody

No samples will be collected for hydrometeorological monitoring.

D.4.5 Quality Control Samples

No samples will be collected for hydrometeorological monitoring.

D.4.6 Data Validation

The Corps data validation process is subject to ER 1110-2-8155, *Hydrometeorological Data Management and Archiving*, dated 31 July 1996 and ER 1110-2-249, *Management of Water Control Data Systems*, dated 31 August 1994. The Corps data validation methods may be accomplished by automated or manual means. This process may include estimating values for missing or erroneous data.

The SFWMD procedures are described in their *2008 South Florida Environmental Report, Appendix 2-1: Hydrological Monitoring Network of the South Florida Water Management District.* The following paragraph is from a relevant section of that document.

"Several standard operating procedures (SOPs) were developed for data processing by the District...Many of these procedures and processes are automated. The Data Collection/Validation Preprocessing System (DCVP) database provides for the storage and extraction of preliminary time-series data for further inspection. Once data is extracted from DCVP, it is subjected to an initial QA/QC check in order to ascertain or improve data quality. This is accomplished through the use of the Graphical Verification Analysis (GVA) Program, a software tool which provides analysts with a graphical user interface in which to plot, edit, and apply quality tags and comments to data. The GVA application is used for the validation of the data. Once data has undergone analysis in GVA, it is uploaded into the DBHYDRO database, finalizing the preprocessing stage..."

D.4.7 Raw Data

Data collected by the SFWMD will be kept as raw archive files. The adjusted (QA/QCed) data will be stored as processed archive files. Data collected by the Corps is maintained in Oracle databases and further computations are applied to generate addition databases of computed data.

D.4.8 Data Processing

The Corps data validation process is subject to ER 1110-2-8155, *Hydrometeorological Data Management and Archiving,* dated 31 July 1996 and ER 1110-2-249, *Management of Water Control Data Systems,* dated 31 August 1994.

The SFWMD procedures are described in their *2008 South Florida Environmental Report, Appendix 2-1: Hydrological Monitoring Network of the South Florida Water Management District.*

Data processing should be approached with the same high accuracy standards for all sites/stations regardless of mandate or permit conditions. Flow and meteorological data must be summarized or derived through review, analysis, and interpretation before they can be placed in any meaningful context, then published. Data processing involves multiple steps: (1) data retrieval, (2) data review, (3) data verification and validation, (4) data analysis of raw time-series data to ensure data quality in support of environmental monitoring and assessment activities, (5) interpretation of analysis, and (6) archival.

D.4.9 Data Storage and Archiving

Data collected or obtained by the Corps will be stored and archived in accordance with ER 1110-2-8155, *Hydrometeorological Data Management and Archiving,* dated 31 July 1996. The Corps maintains Oracle databases where all collected and computed Water Management data is stored/archived.

For the SFWMD, after the data validation process (generally with one week), all data are archived in a SFWMD database (DBHYDRO) and maintained so that end users can retrieve and review all information relative to a sampling event. If data are not suitable for DBHydro, they will be entered into the CERP Integrated Database (CID) on CERPZone through the Morpho interface. Field notes are maintained on an internal server either by scanning actual field note pages as PDFs (Portable Document Format) or by uploading narratives from field computers as CSVs (Comma Separated Values). All analytical data and field conditions are sent to a database designated by the sponsors for long-term storage and retrieval. The sampling agency or contractor maintains records of field notes and copies of all records relative to the chain of custody and analytical data. It is the responsibility of each agency or contractor to maintain both current and historical method and operating procedures so that at any given time the conditions that were applied to a sampling event can be evaluated. For any contracted work, original documents are to be provided to the SFWMD by the project completion date.

D.5 Documentation

For all documents, the following standards should apply:

- Print text, do not use cursive handwriting.
- Dates should be recorded as MM/DD/YYYY.
- Time should be recorded in 24-hour format using local time.
- Logs and notes should be recorded on site and at the time of collection.
- Entries are to be made in waterproof ink.
- Samplers should be properly trained.

D.5.1 Field Notes

No field samples will be collected for hydrometeorological monitoring. Relevant field observations will be noted in a bound waterproof notebook that is project specific. The following information will be entered into the field notes: project name, frequency, trip type, date, collectors, responsibilities, weather, preservation/acids, labs submitted to, sample ID, site ID, time collected, and sample type. Additional comments on observations, equipment cleaning, maintenance, and calibration will also be recorded.

D.5.2 Field Instrument Calibration Documentation

Records of field instrument calibration will be kept and SFWMD or Corps SOPs for calibration will be followed.

D.5.3 Corrections

Corrections to header sheets, field notes, or calibration sheets will only be made by staff who participated in the production of the document. Changes will be made by striking through the error, writing the correction, initialing and dating the change. On occasion, a detailed explanation of the error may be required.

D.6 Quality Assurance and Quality Control

D.6.1 System for assessing data quality attributes

The standards as set forth under the Corps and the SFWMD's respective requirements will be adhered to and followed. These are described and/or referenced under Section 2.3 of this document.

D.6.2 Data quality qualifiers

The data quality standards are outline in Section 2.2 of this document.

D.6.3 Field Audits

The data quality standards for hydrometeorological data are determined under the Corps and SFWMD's respective guidances and will be followed.

D.7 Data Analyses and Records Management

The Corps process is subject to ER 1110 2 8155, Hydrometeorological Data Management and Archiving, dated 31 July 1996 and ER 1110 2 249, Management of Water Control Data Systems, dated 31 August 1994.

The SFWMD procedures are described in their 2008 South Florida Environmental Report, Appendix 2 1: Hydrological Monitoring Network of the South Florida Water Management District.

Please refer to Section 2.3 of this document for further information.

D.7.1 Data Quality Evaluation and Assessment

The data quality standards for hydrometeorological data are determined under the Corps and SFWMD's respective guidances and will be followed.

D.8 Adaptive Management Considerations

Where possible, CEPP hydrometeorological data will support adaptive management by contributing data needed to address CEPP uncertainties and future project adjustments. The adaptive management strategies that will leverage hydrometeorological data include but are not limited to optimizing water deliveries from FEB-2 (AM uncertainty ID#4), flows to improve soil conditions and restore ridge and slough areas south of the hydropattern restoration feature and in the Blue Shanty flowway (AM uncertainty ID#5, 6, 73), incremental restoration in WCA 3B (AM uncertainty ID#76, 77), and deliveries south to Everglades National Park and the Lower East Coast (AM uncertainty ID#32, 35,61, 62, 63,).

PART 4. CEPP Ecological Monitoring Plan

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D.0 INTRODUCTION TO THE CEPP ECOLOGICAL MONITORING PLAN

The Greater Everglades ecosystem has been significantly altered by human activities. Historically, freshwater flowed in a north-south direction from Lake Okeechobee to Florida Bay. This pattern has been altered by regional drainage of freshwater flow patterns and volumes that has resulted in the loss of ridge-slough pattern in the freshwater wetlands and an inland migration of saline conditions in both the groundwater and surface waters such that the expansion of moderate to high salinity zones have diminished the spatial extent of freshwater wetland habitats, and have allowed the landward expansion of saltwater and mangrove wetlands. Prior to the hydrologic changes described above, freshwater and mangrove marshes provide important habitat for wetland species and are indicators of healthy Everglades and coastal wetlands. Among other things, the hydrologic change to the system has caused a significant degradation of both the freshwater and the estuarine environments that has resulted in the loss of or reduction in populations of important estuarine species that once were abundant in the area, including Spoonbills, Wood Storks, and Alligators among other wildlife. Efforts of Central Everglades Planning Project (CEPP) focus on re-directing flow to re-establish more natural overland flow regimes that will provide appropriate hydropatterns and salinity regimes to re-establish and maintain key habitats within the Greater Everglades, including the Everglades National Park and Florida Bay.

The primary objective of the CEPP Ecological Monitoring Plan (CEPP-EMP) is to identify the monitoring necessary to inform decision-makers, CEPP partner agencies, and the public on achieving restoration success. In other words, to specify what monitoring is necessary to measure and detect the benefits of restoring patterns of freshwater flow, velocity, and water quality in the Central Everglades, Northern Estuaries, and Southern Coastal Systems, per the CEPP project objectives. This monitoring will be leveraged as much as possible to contribute to CEPP adaptive management. However, given the scope and scale of CEPP, in this project the ecological monitoring and the monitoring identified in the CEPP Adaptive Management Plan (Annex D, Part 1) are not one-and-the-same, because the CEPP-EMP focuses on CEPP's success at meeting *project objectives* (per WRDA 2007 guidance) while the monitoring specified in the Adaptive Management Plan focuses on addressing *project uncertainties* (per WRDA 2007 guidance) that may be more specific in their location and/or scale than the overall project objectives. Also, the Adaptive Management Plan focuses on project tweaks and adjustments that could be made relatively easily to improve project performance, and the monitoring described in that plan will inform such adjustments, whereas monitoring for overall project success in a project as large as CEPP may not provide the level of detail needed to answer the specific adaptive management questions. In summary, since the project objectives and the uncertainties are not redundant then neither is the monitoring, but the CEPP-EMP and CEPP AM Plan have been designed to inform each other as much as possible and it is encouraged that any future refinements of the Plans include continual improvements of the streamlining.

The CEPP-EMP will monitor ecosystem responses to changes in hydroperiod depth, duration, and velocity within the Central Everglades that are expected to provide ecological conditions suitable for expanded and intensified wildlife utilization through improvements in wetland habitat functional quality, and improvements in native plant and animal species diversity and abundance. Due to the uncertainties associated with any effort to restore the Greater Everglades, including the ENP and associated coastal communities, the performance targets and the measures of success can only be broadly stated. Nevertheless, these targets and measures need definition to design a monitoring program that is focused and efficient, thereby ensuring that it will provide the kind of information necessary to measure restoration success. The CEPP-EMP will be updated, at the latest, during CEPP pre-construction engineering and design to reflect more specific targets and measures of restoration success.

This second objective of the CEPP-EMP is to contain the monitoring and associated costs required under the U.S. Fish and Wildlife Biological Opinion (BO) and other agency permits that are needed to protect and conserve natural resources. The Biological Opinion and associated monitoring information for CEPP can be found in Annex A Fish and Wildlife Coordination Act and Endangered Species Act Compliance. Cost estimates for monitoring associated with the BO, including a project-wide contingency cost, are included in Section 6 Table 6-9, and in Annex D Table D.1.1.

The CEPP-EMP will be closely coordinated with the CERP RECOVER Monitoring and Assessment Plan (MAP) to ensure that measures and targets selected by the project teams are consistent with system-wide measures and to avoid duplication of efforts. Furthermore, the CEPP-EMP will ensure temporal and spatial coverage of monitoring parameters that are appropriate to detect changes at the project level. The EMP will fill gaps in the MAP monitoring parameters to address CEPP-specific needs by adding additional project-level parameters not included in the MAP. Thus, the CEPP-EMP will cover CEPP regions within the Greater Everglades with greater spatial and temporal resolution to detect ecological changes resulting from project-level implementation in order to evaluate project success.

The Everglades are periodically inundated or dried out, an environmental characteristic that provides a challenging environment for the plant and aquatic animal communities. Furthermore, measuring restoration and monitoring success are particularly challenging because the Everglades is inherently dynamic in space and time. Monitoring targets provided in this EMP are limited to the scope of CEPP, i.e., they are not full restoration targets for the Everglades restoration program but instead they are attributes that relate directly to the restoration that CEPP could provide and that can be measured in the time-frame specified in WRDA 2007 and USACE cost-sharing guidance (monitoring for ecological success can be cost-shared for up to 10 years only). Due to ever-increasing understanding of the complex Everglades and associated estuaries, and more detailed information that will be available during CEPP's design phase, the CEPP success monitoring targets may need to be refined during CEPP's design phase.

D.1 Structure of the CEPP Ecological Monitoring Plan

For each CEPP project objective, monitoring has been identified to measure progress toward success of meeting the objective. Table 1 summarizes the (1) monitoring attributes, (2) monitoring methodology and frequency, (3) monitoring cost estimates, (4) CEPP monitoring locations, (5) Current MAP monitoring component (6) Current monitoring by other agencies/universities and (7) Performance Measures and ecological indicators. The Ecological Monitoring Plan's main goal is to detect the expected improvements from CEPP features and operations.

The Greater Everglades portion of the CEPP-EMP focuses on three main geographic regions: 1) the northern WCA-3A Hydropattern Restoration Feature, 2) Blue Shanty Flowway, and 3) Shark River Slough, which includes freshwater and coastal wetlands (**Figure D.4.1**). The ecological monitoring will include environmental parameters associated with hydrology (flow, stage and hydroperiod), soil parameters associated with soil accretion and subsidence, wetland plant community, and wildlife.

D.2 Objective 1

Restore seasonal hydroperiods and freshwater distribution to support a natural mosaic of wetland and upland habitat in the Everglades System (Table D.4.1A)

Spatial patterning and topographic relief of the ridge-slough-tree island landscape are directly related water flow, including the timing, velocity, hydroperiod, and distribution of sheet flow, therefore the spatial patterning has been lost in most of the Greater Everglades with drainage and compartmentalization. At the landscape level, the loss of elongated patterns of ridges, sloughs, and tree islands in the direction of the flow is attributed to disrupted sheet flow and changes in water depth. Monitoring for this objective will test the hypothesis that resumption of sheet flow and water depth patterns will reverse the degradation of the ridge-slough-tree island landscape. Similarly, quantification of subsidence, accretion, and sediment transport are required to understand the role that flow direction, velocity, and water depth play in restoring and maintaining the ridge-slough-tree island landscape. Thus, for this objective, two attributes will be monitored: a) soil elevation and accretion along the ridge-slough-tree islands landscape and b) vegetation change along hydrologic gradients. Related hydrologic data will be leveraged from existing monitoring networks and the CEPP Hydrometeorological Monitoring Plan (Annex D, Part 3). The monitoring methodology includes the establishment of permanent transects and plots within 2 x 5 km cells denominated GRTS (Generalized Random-Tesselation Stratified). The placement of transects and plots, and specific measurement methodology, will be coordinated with existing GRTS locations in the Everglades that are part of the RECOVER MAP to avoid redundancy and leverage the existing program. This approach provides spatial balance to make better inferences about gradient changes at the landscape level and assumes the existing GRTS monitoring will continue for at least the time needed for CERP. The detailed field methodology to accomplish this objective will be described in more detail once CEPP is authorized.

D.3 Objective 2

Improve sheet flow patterns and surface water depths and durations in the Everglades system in order to reduce soil subsidence, frequency of damaging fires, and decline of tree islands and decrease salt water intrusion (Table D.4.1B)

This objective has two main components, one is associated with the effect of muck fire events on soil oxidation and subsidence, and the other component is linked to the change in freshwater delivery to coastal areas that has disrupted salinity patterns throughout Florida Bay leading to an overall increase in salt water intrusion along the coastal wetlands that has promoted the encroachment of mangrove plant community into the freshwater wetlands. Monitoring for this objective will test the hypothesis that both organic soil loss and accumulation are in equilibrium as a function of sheet flow and water depth patterns. Similarly, it is expected that improvement of water sheet flow will help to decrease the rate of mangrove expansion into the freshwater wetlands. To accomplish this objective, several attributes will be monitored including soil accretion and soil elevation in mangrove communities, porewater and soil salinity, and biological indicators such as algae and pink shrimp. The monitoring methodology includes the use of Sediment Elevation Tables (SETs) to measure soil accretion and subsidence, establishing transects to measure soil salinity, porewater and soil resistivity. The placement of SETs, and specific measurement methodology, will be coordinated with existing SETs locations in the Everglades that have been part of the RECOVER MAP to avoid redundancy and leverage existing data for comparison. To estimate spatial changes in the ridge-slough-tree island landscape and mangrove migration into the freshwater wetlands, vegetation mapping will be conducted, also in coordination with existing programs for efficiency. The detailed field methodology to accomplish this objective will be described in more detail once CEPP is authorized.

D.4 Objective 3

Reduce high volume discharges from Lake Okeechobee to improve the quality of oyster and SAV habitat in the Northern Estuaries (NE) (Table D.4.1C)

Using CEPP planning model output, areas have been identified within the northern estuaries where the most change is expected due to CEPP. In these areas salinity conditions will improve the habitat for oysters and SAV, which will be the attributes to measure for project success in meeting Objective 3. In addition, these areas present a clear opportunity for adaptive management because the monitoring data will readily inform potential project adjustments. Therefore, monitoring for Objective 3 is an example of overlapping monitoring needs for the CEPP-EMP and for the CEPP AM Plan. In the Adaptive Management Plan more detail is provided about the potential management actions that could be taken in response to the data. See the Adaptive Management Plan section on the northern estuaries.

D.5 Objective 4

Reduce water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization (Table D.4.1D)

Nesting wading birds are an iconic symbol of Everglades health and restoration, and there is relatively extensive knowledge about their habitat needs in the Everglades due to efforts of RECOVER, ENP, and other organizations. Successful nesting of wading birds requires habitat conditions, including wet season prey production and dry season prey availability, which depend on hydroperiods and well-timed water level recession rates. Over the past years a decrease in wading birds has been observed; this decrease of wading birds nesting colonies in the Greater Everglades including the ENP is attributed to declines in wet season prey production and dry season prey availability. Monitoring for this objective will test the hypothesis that restoration of multi-year hydroperiods in historically appropriate places in the Everglades will result in increased density of aquatic fauna and large fish. Attributes associated with this objective include monitoring aquatic prey populations during the wet season and dry season, and monitoring wading bird nesting success. Hydrologic data that indicate recession rates will be pulled from existing monitoring networks. Field methodology includes throw traps along designed transects established within GRTS cells. Since RECOVER is already monitoring these attributes in the Greater Everglades, their monitoring will be leveraged and the CEPP-EMP will only establish a monitor network in the coastal wetlands. The ability to leverage existing monitoring programs for efficiency assumes the existing monitoring will continue for at least the time needed for CERP. More detailed field methodology will be described once CEPP is authorized.

D.6 Objective 5

Restore more natural water level responses to rainfall to promote plant and animal diversity and habitat function (Table D.4.1E)

Florida's two native species of crocodilians, the American alligator and the American crocodile are important indicators of the health of the Everglades ecosystem because they are linked to two key aspects of the ecology of the Everglades: 1) crocodilians are directly dependent on prey density, especially aquatic and semi-aquatic organisms, and thus they provide a surrogate for status of many other species, and 2) alligators create "alligator holes" across the landscape that have proven to be a keystone feature of Everglades habitat due to the topographic relief that they provide. The alligator holes provide drier and wetter conditions for plants and animals that otherwise would not be able to survive. Monitoring for this objective will test the hypothesis that more natural hydrological patterns with dry downs no more frequent than once every 3-5 years will improve both alligator body condition and relative density of alligators. As part of this objective several biological attributes will be monitored including alligator-crocodiles density in the landscape, and their body condition. This monitoring compliments the bird nesting success monitoring to increase the ability to draw conclusions from both programs. Field methodology includes aerial transects as well as ground surveys that will be coordinated with past and existing crocodilian monitoring efforts for efficiency and comparisons. The detailed field methodology to accomplish this objective will be based on the past and existing methodologies, and will be described in more detail once CEPP is authorized.

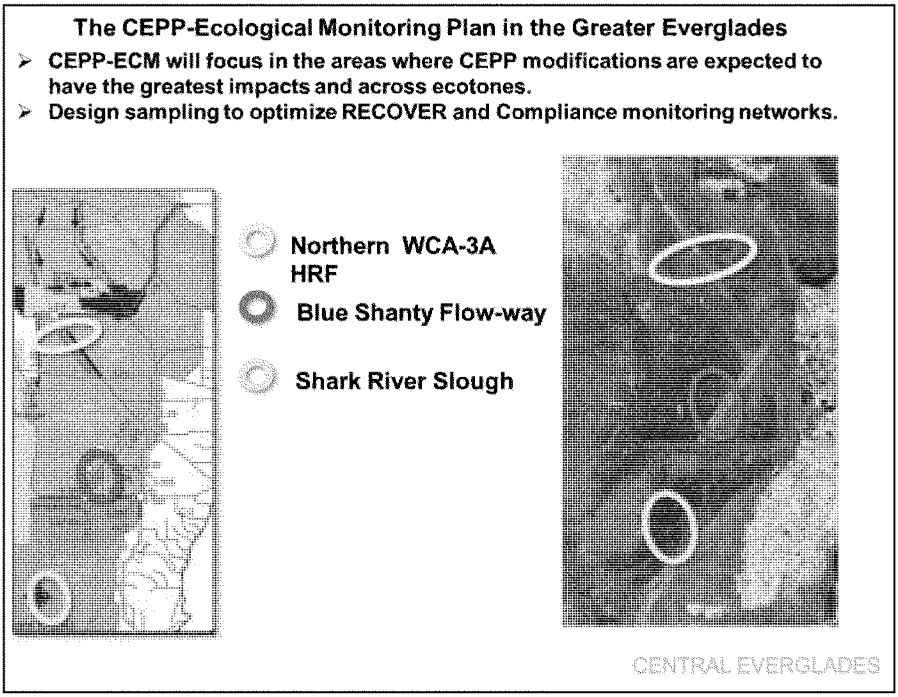

Figure D.4.1: The Greater Everglades, showing the regions where the most hydrological alterations are expected. The Northern WCA-3A, Blue Shanty Flow-way, and Shark River Slough regions are the focus of the Ecological Monitoring Plan (EMP).

Table D.4.1 (A, B, C, D, E): Table identifies CEPP objectives, associated monitoring need related to achieving CEPP project success, monitoring methodology, number of sampling transects and frequency, estimated annual CEPP project cost*, monitoring location, current monitoring available from other agencies and RECOVER and their monitoring costs (in some cases there is very little or no CEPP project cost because existing monitoring covers the costs), and associated performance measures or stoplight indicator (method of communicating ecological indicator status as described in the South Florida Ecosystem Restoration Science Coordination Group Stoplight Indicator Report) for context. ***Estimated Annual Costs are based on the best available information at the time of writing. They were calculated before a CEPP project-wide contingency was added to the total CEPP project cost estimate. Total costs including contingencies can be seen in Section 6 Table 6-9, and Annex D Table D.1.1. Estimated annual costs shown here may not occur each year; see 'frequency' column. It should not be assumed that project-wide contingency amounts will be available to fund monitoring.**

A

CEPP Objective	CEPP Monitoring attributes	Monitoring Methodology	Number of Transects / Plots per GRT's	Monitoring Frequency	Estimated Annual Cost	Specific CEPP Monitoring Locations	Current Monitoring (OTHER)	Current Monitoring (RECOVER/CERP)	Current Monitoring Annual Cost (RECOVER/CERP)	Performance Measures / Ecological Indicators	Monitoring Targets
Restore seasonal hydroperiods and freshwater distribution to support a natural mosaic of wetland and upland habitat in the Everglades System	Natural Mosaic of Wetlands: Ridge-Slough-Tree Islands Soil Elevation Pattern	Establish Permanent Transects to Measure Wetland Soil Elevation Pattern	Establish 2 GRTS panel in NE-WCA3A, WCA-3B, and 3 panels in NE-SRS. Five Transects within each GRTS panel	Each Transect Every Year	$100,000	NE-WCA3A,WCA-3B, NE-SRS	a) Daily, seasonal, annual hydroperiods (EDEN. SFWMD, ENP). b) Water Distribution (EDEN, SFWMD, ENP). c) Wetland Vegetation Mapping (RECOVER/MAP)	Landscape Pattern Ridge-Slough-Tree Island in GE	$96,276.00	Slough vegetation performance measure. related to tree island viability and restoration	Bi-Modal Ridge and Slough Patterning
		Comprehensive soil elevation survey: 30 new benchmarks	Synoptic Survey	First three years of CEPP for a Total of $300K	$30,000	NW-WCA3A, NE-WCA3A,Central WCA-3A,WCA-3B, NE-SRS and ENP					
	Vegetation change along hydrologic gradients- from slough to marl prairies, mangroves, and other adjacent habitats	Establish three GRTS panels	Three Transects per GRTS panel	Each Transect Every Year		NE-SRS, ENP	a) Daily, seasonal, annual hydroperiods (EDEN. SFWMD, ENP). b) Water Distribution (EDEN, SFWMD, ENP). c) Wetland Vegetation Mapping (RECOVER/MAP)	Marl-Praire Slough Gradients (Shark River Slough), Florida Bay SAV monitoring (FHAP)	$200,000	Slough vegetation performance measure. related to ELVes, marl prairie assessment tools	SAV % Cover 50-75; SAV Biomass 100-200 g m^{-2}
		Vegetation in plots along coastal gradient transects	Three Transects from SRS to estuaries; five transects from Taylor Slough to Florida Bay	Each Transect Every Year		ENP					

Continued on next page.

B

CEPP Objective	CEPP Monitoring attributes	Monitoring Methodology	Number of Transects / Plots per GERT's	Monitoring Frequency	Estimated Annual Cost	Specific CEPP Monitoring Locations	Current Monitoring (OTHER)	Current Monitoring (RECOVER/CERP)	Current Monitoring Annual Cost (RECOVER/CERP)	Performance Measures / Ecological Indicators	Monitoring Targets
Improve sheet flow patterns and surface water depths and durations in the Everglades System in order to reduce soil subsidence, frequency of damaging fires, and decline of tree islands and decrease of salt intrusion (relates to uncertainties 64)	Soil Elevation and Accretion Rates on Tree Islands and Mangrove Forests	Sediment Elevation Tables (SET's)	Three Plots within Ten Tree Island and Eight Mangrove sites	Annual	$160,000	NW-WCA3A, NE-WCA3A,Central WCA-3A,WCA-3B, NE-SRS, ENP Mangrove Forests	Soil Elevation and Accretion in Four Tree Islands and Four mangrove Sites in Taylor River-McCormick Creek-Trout Creek-Highway Creek (SFWMD)	No On-going Monitoring	$0	Soil accretion	2-4 mm yr^{-1} Accretion rates
	Saltwater Intrusion and nearshore-wetland salinity	Stage, Flow and Salinity: Porewater, Shallow Wells and Belowground Resistivity; nearshore Florida Bay & Whitewater Bay surface water	Three Transects within Shark River and Five transects within Taylor River	Five locations within each transect. Every 4 Months		ENP Shark River and Taylor Slough (White Zone)	Nearshore Florida Bay and Whitewater Bay surface water platforms (ENP Marine Monitoring)	No On-going Monitoring	$0	Florida Bay salinity Performance Measure	Florida Bay salinity range 25-30 PSU (Dry Season) and 5-15 PSU (Wet Season)
	Ridge-Slough-Tree Island Landscape Pattern	Hot Spot Vegetation Mapping	N/A	Every 3 Years (Total = $75,000)	$25,000	NW-WCA3A, NE-WCA3A,WCA-3B, NE-SRS	a) Daily, seasonal, annual hydroperiods (EDEN, SFWMD, ENP). b) Water Distribution (EDEN, SFWMD, ENP). c) Wetland Vegetation Mapping (RECOVER/MAP)	Veg. Mapping in ENP	$250,000	Ridge & Slough Landscape Pattern Target (MAP)	Tree Island Increase Areal extend
	Mangrove Migration Rate (White-Zone)	Hot Spot Vegetation Mapping	N/A	Every 3 Years (Total = $75,000)	$25,000	ENP Shark River and Taylor River (White Zone)		No On-going Monitoring		Mangrove productivity and growth	Mangrove expansion reduction by 5 %
	Forest Structure and species composition	4 Permanent Plots and 3 Transects per site	Ten Tree islands and 3 Mangrove Forests	Same Tree Islands and plots Every 5 Years	$70,000	NW-WCA3A, NE-WCA3A,Central WCA-3A,WCA-3B, NE-SRS, ENP Mangrove Forests		Tree Island Condition in Southern Everglades	$97,300	Forest structure and plant diversity	Tree Island Increase Areal Extend
	Biological Indicators: Algal Blooms	Grab samples with piement analysis	12 sites nearshore embayments and lakes	monthly	$60,000	Dowstream of SRS, Taylor Slough	Bimonthly SFWMD coastal Monitoring	No On-going Monitoring	$0	Algal Bloom Stoplight Indicator	No Algal Blooms
	Biological Indicator: Cattail Expansion		N/A				RECOVER-MAP	Mid-Shark Slough Monitoring On-going	$64,000		No specific target yet
	Biological Indicator: Pink Shrimp and epifauna	Throw traps in association with FHPAP SAV monitoring	N/A	Wet and dry season	$80,000	Whitewater Bay, Whipray Basin, nearshore central Florida Bay			$0	Juvenile Pink Shrimp Stoplight Indicator, Interim Goals Indicator	Semi-annual Density 5-17 m^{-2}

Continued on next page.

C

CEPP Objective	CEPP Monitoring attributes	Monitoring Methodology	Number of Transects / sampling points	Monitoring Frequency	Estimated Annual Cost	Specific CEPP Monitoring Locations	Current Monitoring (OTHER)	Current Monitoring (RECOVER/CERP)	Current Monitoring Annual Cost (RECOVER/CERP)	Performance Measures / Ecological Indicators	Monitoring Targets
Reduce high volume discharges from Lake Okeechobee to improve the quality of oyster and SAV habitat in the Northern Estuaries	SAV shoot count, density, and canopy cover and height	1 m^2 Quadrants	30 points per site	bi-monthly		Caloosahatchee River Estuary, St. Lucie Estuary,	a) Daily, seasonal, annual hydroperiods (EDEN, SFWMD, ENP). b) Water Distribution (EDEN, SFWMD, ENP). c) Wetland Vegetation Mapping (RECOVER/MAP)	West and East Coast Oysters	$250,000	SAV and Oyster Indicators	No specific target yet
	Shoot count, density, and canopy cover and height of Vallisneria sp	1 m^2 Quadrants	30 points per site	bi-monthly		Caloosahatchee River Estuary, St. Lucie Estuary,		West and East Coast Oysters			
	SAV, Vallisneria, and Oysters beds Mapping	Mapping		Every 5 Years		Caloosahatchee River Estuary, St. Lucie Estuary,					

D

CEPP Objective	CEPP Monitoring attributes	Monitoring Methodology	Number of Throws per sampling Units	Monitoring Frequency	Estimated Annual Cost	Specific CEPP Monitoring Locations	Current Monitoring (OTHER)	Current Monitoring (RECOVER/CERP)	Current Monitoring Annual Cost (RECOVER/CERP)	Performance Measures/Ecological Indicators	Monitoring Targets
Reduce water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization	Dry Season Prey Availability	1-m^2 Throw traps		Dry season		NW-WCA3A, NE-WCA3A,Blue-Shanty Flow-way, WCA-3B, SRS, ENP	a) Daily, seasonal, annual hydroperiods (EDEN, SFWMD, ENP). b) Water Distribution (EDEN, SFWMD, ENP). c) Wetland Vegetation Mapping (RECOVER/MAP)	Dry Season aquatic Fauna	$213,000	Fish and Macroinvertebrate Stoplight Indicator	Droughts events at higher than 3-8 years intervals
	Wet Season Prey Production	1-m^2 Throw traps		Wet season		NW-WCA3A, NE-WCA3A,Blue-Shanty Flow-way, WCA-3B, SRS, ENP		Wet Season Trophic Sampling	$316,000		
	Mangrove zone prey base production (Fish and Spoonbills)	9-m^2 drop-nets within sampling units	9 Drop-nets per sampling unit (12 sites)	Early Dry Season, Late Dry Season, and Wet Season	$60,000	Cape Sable, SRS and Taylor Slough	Audubon prey base monitoring in eastern Taylor Slough (C-111 Spreader Canal Project)	Audubon prey base monitoring in southeast Everglades	$200,000	Spoonbill Stoplight Indicator	Achieve nesting succes in 7 out of every 10 years

E

CEPP Objective	CEPP Monitoring attributes	Monitoring Methodology	Number of Transects per CEPP Location	Monitoring Frequency	Estimated Annual Cost	Specific CEPP Monitoring Locations	Current Monitoring (OTHER)	Current Monitoring (RECOVER/CERP)	Current Monitoring Annual Cost (RECOVER/CERP)	Performance Measures/Ecological Indicators	Monitoring Targets
Restore more natural water level responses to rainfall to promote plant and animal diversity and habitat function	Alligator-Crocodiles Density	Spotlight and capture surveys		Dry and Wet seasons	$80,000	SRS, ENP	a) Daily, seasonal, annual hydroperiods (EDEN, SFWMD, ENP) b) Water Distribution (EDEN, SFWMD, ENP). c) Wetland Vegetation Mapping (RECOVER/MAP) d) Crocodiles and wading bird monitoring in ENP (timing/location/success/# for bird spp) e) Monitoring Alligator nest in ENP	No On-going RECOVER Monitoring	$0	Crocodilian Stoplight Indicator	Count Density ≥1.7 Body Condition 2.11-2.27
	Adult Alligator-Crocodiles body condition	Capture surveys		Dry season				No On-going RECOVER Monitoring	$0		
	Juvenile crocodile growth and survivorship	Time series measurements of individuals		spring-summer	$55,000	Fl Bay: Cape Sable to Highway Creek		No On-going RECOVER Monitoring	$0		
	Number of nesting birds and species	aerial and ground surveys.		Monthly during the Breeding Season	$80,000	NW-WCA3A, NE-WCA3A,Blue-Shanty Flow-way, WCA-3B, SRS, ENP		Wading Birds (UF-USGS-FAU-Audubon). Monitoring includes LO, WCA's, ENP, BB, Florida Bay	$500,000	Wading Bird Stoplight Indicator	4,000 of nesting bird pairs of Great Egrets; 3,000 pairs of Wood Stork; 10,000 pairs of white ibis
	Timing of Bird Nesting	aerial transects and ground surveys.		Monthly during the Breeding Season							
	Location and Distribution of Bird nesting sites	aerial transectsand ground surveys.		Monthly during the Breeding Season							
	Bird Nesting Success	aerial transects and ground surveys.		Monthly during the Breeding Season							

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ANNEX E

REPORTS PROVIDED BY RECOVER

TO SUPPORT THE

CENTRAL EVERGLADES PLANNING PROJECT

PROJECT IMPLEMENTATION REPORT

EXECUTIVE SUMMARY

Annex E contains documentation of three reviews performed by the interagency REstoration COordination and VERification team (RECOVER) system-wide science team, per CERP Programmatic Regulations guidance. The reviews were:

- **RECOVER System-Wide Evaluation: Central Everglades Planning Project (CEPP)**
- **RECOVER Consistency Review: Project-Level Monitoring and Adaptive Management Plan**
- **RECOVER Review of the Central Everglades Planning Project (CEPP) Draft Project Operating Manual (DPOM)**

RECOVER SYSTEM-WIDE EVALUATION: CENTRAL EVERGLADES PLANNING PROJECT (CEPP)

The REstoration COordination and VERification team (RECOVER) system-wide evaluation of Central Everglades Planning Project (CEPP) performance provides the evaluation required for all Comprehensive Everglades Restoration Plan (CERP) projects under the 2003 programmatic regulations. This report is a broad-scale evaluation of ecological effects of the CEPP alternatives on Lake Okeechobee, the Northern Estuaries (Caloosahatchee and St. Lucie), Greater Everglades (Water Conservation Areas [WCA] and Everglades National Park [ENP]), and Southern Coastal Systems (Southwest coast, Florida Bay, and Biscayne Bay). The scope of the review covers all areas expected to be improved by CEPP, and all areas outside of the CEPP project boundary which fall within the overall CERP program area. The review includes the use of a broad range of evaluation tools, performance measures, and best professional judgment that reach beyond the tools and expertise of the traditional USACE planning process. The tools and professional backgrounds of the reviewers represent decades of experience studying and modeling the ecology of south Florida. The purpose of the review is three-fold: 1) to provide insight into whether some alternatives performed better ecologically than others, 2) to indicate whether alternatives may lead to unintended ecological conditions, and 3) to investigate the effects of CEPP alternatives that could potentially conflict with the goals of CERP on a regional scale. The following key findings are provided:

System-wide Performance - All areas affected by CEPP can be improved by the proposed alternatives. These include the northern estuaries, the greater Everglades, and the southern coastal systems. Overall, it appears that the alternatives that provide the most water to Everglades National Park provide the least water to Biscayne National Park, and vice versa, almost certainly due to the type of seepage management and operational protocols employed. In addition, some performance issues were recognized in the St. Lucie Estuary, WCA 2 and WCA 3B under alternative 4 that could potentially be improved with minor operational changes. These issues will be addressed in the Savings Clause and Assurances analyses and will continue to be addressed with adaptive management during CEPP's implementation and operation.

Adaptive Management - There was a determination that proceeding with an adaptive management approach can further increase the benefits of CEPP and positively influence the implementation of CEPP in sensitive areas. Adaptive management provides a means to learn during implementation and operations through monitoring and assessment in order to ensure restoration performance, while minimizing impacts and reducing risk overall.

Full CERP Implementation Consistency - Because modeling resources and capability did not allow for full system-wide CERP runs, RECOVER was unable to provide a complete understanding of how CEPP would function as part of full CERP implementation. CEPP project features formulated to achieve incremental system-wide restoration benefits in the near-term may not function as well once all of CERP is implemented as envisioned in the Water Resource Development Act of 2000. This may require adapting project features, such as the blue shanty levee, to achieve the full set of restoration benefits stated under CERP as additional CERP projects are implemented. Nonetheless, the CEPP project represents an important near term-incremental step towards restoration of the south Florida Everglades ecosystem.

Future CERP Increments – Future increments of CERP should consider the need for more storage, decompartmentalization, conveyance, and any associated seepage management to meet full CERP restoration goals for water quantity, quality, timing, and distribution.

Climate Change - The need for more reliable sources of storage may become more apparent as a result of anticipated changes in climate. The National Climate Assessment and Development Advisory Committee's National Climate Assessment 2013 draft report estimates the following potential effects as a result of climate change: increased evapotranspiration rates due to higher temperatures; changes in rainfall intensity, seasonal timing, and amounts; sea-level rise; and increased frequency of tropical storms. Future planning efforts should evaluate scenarios of these climatic drivers to determine plans that are robust enough to address climate variation. In addition, scientists and managers should continue monitoring and associated analyses to understand the effects of climatic drivers on system-wide indicators that are envisioned to be restored under CERP.

Lake Okeechobee - One of the CEPP project planning constraints was to remain within the existing water regulation schedule for Lake Okeechobee and thereby not impact the Lake's ecology. However, hydrologic modeling indicated that there are periods where the Lake's water level is held ~6-12 inches higher than the future without (FWO) levels, while remaining within the current schedule. The higher water events are expected to be rare enough to avoid additional long-term ecological impacts.

Northern Estuaries - Modeling of the hydrology, salinity, and associated ecology of the St. Lucie and Caloosahatchee Estuaries, referred to as the northern estuaries, showed a small reduction in fresh water discharges from Lake Okeechobee to the northern estuaries. Although the difference was not statistically significant, this change is moving 'in the right direction' for reducing peak flow events. Ecological projections for oysters and sea grasses, key species in the estuaries, indicated improvements with CEPP alternatives. Modeling indicated less fresh water entering the St. Lucie Estuary during low-flow times, when small amounts of fresh water are needed. CEPP operations and future increments of CEPP should seek to address this alteration to the base flow into the estuaries during dryer times. Future operations of the Indian River Lagoon-South project could be optimized to help provide these base flows.

Greater Everglades – RECOVER data and modeling showed improved ecological performance for fish, wading birds, and apple snails in northern and central WCA 3A and Shark River Slough for all alternatives. Improved hydroperiods and sheetflow in WCA 3A, WCA 3B, and Everglades National Park are expected to result in less soil oxidation, which promotes peat accretion necessary to rebuild the complex mosaic of habitats across the landscape. Hydrologic stages in WCA 2 are slightly decreased during dry years and may require adaptive management of operations to avoid performance issues. In comparing alternatives against each other, the differences between them were smaller. Alternative 1 may provide sheetflow to a larger area in WCA 3A, while alternatives 3 and 4 provide more water to Shark River Slough and the southern marl prairies, improving conditions for fish, alligators, tree islands and ridge and slough habitat. Overall, alternative 4 appears to make the most 'efficient' use of the limited new water that CEPP is adding to the Everglades according to the surface flow vectors, sheetflow information, wading bird and small fish performance indicator outputs. The use of the water is efficient because it provides a focused flow of water through the Blue Shanty Flowway and does a better job of rehydrating northeast Shark River Slough than any of the other alternatives. The wading bird results were mixed among the various alternatives, where wading bird nesting models indicated wood storks showed the most improvement with alternative 1 and 2, but the wood stork habitat suitability index tool indicated that alternatives 3 and 4 provided more favorable habitat. Concerns were expressed by some RECOVER scientist that the Blue Shanty Levee in alternative 4 could limit restoration of WCA-3B in the future. Suggestions were made to move the levee east or to remove it from the alternative altogether. Given these concerns, the PDT may use adaptive management to determine the need for, best use of, and best placement of the levee. A preference was also expressed to use passive structures rather than pumps in order to lower the costs of operations/maintenance and increase the natural aspects of Everglades restoration.

Southern Coastal Systems - The Southern Coastal Systems are the southernmost estuaries in Florida, which require fresh water inputs to reduce salinity levels and maintain ecologically favorable brackish conditions. All CEPP alternatives show decreased salinity compared to the FWO in Florida Bay, with associated ecological improvements for submerged aquatic vegetation (SAV) habitat and key species such as seatrout, pink shrimp, and crocodiles. Alternative 4, which yielded more flow through Shark River Slough, improves estuarine salinity conditions over the other alternatives. The differences among alternatives were much less than the differences when comparing each alternative to the FWO. Based on the hydrologic connections between Shark River Slough and the southwest coastal areas of Florida, there is high likelihood that the southwest coastal areas would experience significant ecological benefits from any CEPP alternative; however these could not be quantified during CEPP evaluations due to the lack of salinity and ecological models available in that area of the estuaries.

Biscayne Bay may have reduced fresh water flows in the dry season compared to ECB and FWO in the area of CERP's Biscayne Coastal Wetlands Project and Biscayne National Park, which could have adverse ecological effects. The RECOVER recommended and the CEPP team agreed to investigate this further during the Savings Clause and Assurances modeling and analyses.

RECOVER provided support throughout the development of CEPP's Recommended Plan from the earliest stages of CEPP's planning, including extensive tools and expertise. Forecasting tools included performance measure models and habitat suitability indices that were developed and approved by RECOVER interagency scientists previous to CEPP, which alleviated the need for CEPP to create and gain verification of new ecological models during its accelerated planning schedule. Expertise offered by RECOVER included input from scientists in 10 agencies and both Tribes of south Florida, consisting collectively of decades if not centuries of scientific knowledge of the Everglades, Lake Okeechobee, and the estuaries. The RECOVER system-wide evaluation of Alts 1-4, reported in this document, was a significant contribution to the development of the Recommended Plan because it indicated some areas of concern in the ecosystems under the alternative scenarios. The system-wide evaluation thereby guided the PDT to areas where refinements were needed, and refinement was undertaken during the optimization of the Recommended Plan to produce the final alternative.

RECOVER CONSISTENCY REVIEW: PROJECT-LEVEL MONITORING AND ADAPTIVE MANAGEMENT PLAN

RECOVER supports the CEPP Adaptive Management and Monitoring Plan and believes it uses the best available science and monitoring currently available. The key assumption in the CEPP Adaptive Management and Monitoring Plan is that all existing monitoring will continue in accordance with the MAP 2009. If any of the non-CEPP monitoring outlined in this plan is eliminated, CEPP will need to incorporate that monitoring into the project in order to meet the project goals. All monitoring will need to be re-evaluated over time to determine if it is working as intended, if additional monitoring is advisable, if monitoring should be expanded or reduced in scope, or terminated or replaced by another monitoring element as the data and the changing landscape of restoration priorities so warrant

RECOVER REVIEW OF THE CENTRAL EVERGLADES PLANNING PROJECT (CEPP) DRAFT PROJECT OPERATING MANUAL (DPOM)

The review memo documents RECOVER and the CEPP Project Delivery Team's attention to the CERP Programmatic Regulations guidance that provides for, but does not require, a RECOVER review of the Project Operating Manual (DPOM). The memo also documents recognition that the CEPP operating manual will undergo updates in the future. It is recommended that a detailed review of the DPOM be performed by RECOVER near the end of the project design phase, in order to gain input from scientists with the most current system-wide scientific knowledge at that time. RECOVER will continue coordination with U.S. Army Corps of Engineers and the South Florida Water Management District during future CEPP project operations manual updates as requested.

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E.0 TRANSMITTAL LETTER FOR RECOVER SYSTEM-WIDE EVALUATION OF CENTRAL EVERGLADES PLANNING PROJECT (CEPP)

REstoration COordination and VERification (RECOVER) Evaluation Team Regional Evaluation Report

Date: February 26, 2013
To: Project Managers and Planning Technical Leads
Central Everglades Planning Project

Dear Project Team Managers and Planning Technical Leads,

RECOVER has completed its regional evaluation of the Central Everglades Planning Project (CEPP) alternative plans and our final report is attached. RECOVER's evaluation of project alternatives fulfills the following requirements as prescribed by the Programmatic 2003 Comprehensive Everglades Restoration Plan (CERP) Regulations 33 Code of Federal Regulations 385.20 (e)(2):

1. Support project teams to achieve consistency with the CERP's goals and objectives;
2. Document the performance of the project alternative plans using RECOVER approved system-wide performance measures, project performance measures (when appropriate) and best professional judgment. RECOVER determines the ability of each alternative plan to meet the targets established for each performance measure and describes the resulting effects upon the natural system;
3. When appropriate, RECOVER evaluations include a qualitative analysis on how the project fulfills CERP goals and objectives;
4. Suggest improvements to the project, which if pursued could improve project performance or enhance benefits to the natural system;
5. Provide insight, if possible, and alert the project teams of any inconsistent modeling assumptions for the project as originally modeled in the CERP.

Recommendations discussed within the RECOVER regional evaluation report are more conceptual in nature. The Project Team may select to incorporate these recommendations into preliminary designs to improve project performance or may chose to carry them into future CERP project planning and implementation efforts.

RECOVER provided its regional evaluation to satisfy the need for timely reporting as part of the new CEPP planning process, while bringing forward as much system-wide science as possible. Because modeling resources and capability didn't allow for full system-wide CERP runs, RECOVER was unable to help provide a complete understanding of how CEPP would function with full CERP implementation. RECOVER was able to provide several highlights to the team on January 23, 2013, regarding beneficial performance of CEPP alternatives and performance issues to consider during design, construction, and operations of this project, as well as some recommendations on how to handle the uncertainty associated with full CERP implementation. These highlights are restated in the executive summary of the report.

Best regards,

RECOVER Council of Chairs: (Fred Sklar, Agnes McLean, Patti Gorman, Steve Traxler, Gretchen Ehlinger)

E.1 Introduction

E.1.1 Background and Purpose

This report documents the Restoration Coordination and VERification (RECOVER) team system-wide/regional evaluation of the Central Everglades Planning Project (CEPP) required by the CERP programmatic regulations 33 Code of Federal Regulations 385.20 (e)(2). RECOVER is an independent (from project delivery team [PDT]), interagency team made-up of scientists charged with helping PDT's ensure their project's plans, designs, and performance are fully linked to the goals and objectives of CERP. This report documents the performance of the project alternatives using RECOVER approved system-wide performance measures (PM), project hydrologic model output, other information sources and evaluation tools not approved by RECOVER, and best professional judgment. It also highlights the ability of each alternative to meet RECOVER system-wide/regional performance targets and documents expected effects on the natural system.

E.1.2 CEPP Goals and Objectives

CEPP goals and objectives are consistent with CERP's, as described in **Table E.1-1**– Goals and objectives of Restudy and CEPP in Section 01 of the PIR. CEPP focuses on delivering additional water which meets the state water quality requirements during the dry season to improve hydroperiods and sheetflow through the Central Everglades system. A storage is included as part of a flow equalization basin (FEB) to accept water form LO to reduce high volume discharges to estuaries and improve the quality of estuarine habitat (e.g., oyster and SAV).

Table E.1-1 Comparison of CEPP and CERP Objectives

RESTUDY GOAL: Enhance Ecological Values	
CERP Objective	*CEPP Objective*
Increase the total spatial extent of natural areas	
Improve habitat and functional quality	Restore seasonal hydroperiods and freshwater distribution to support a natural mosaic of wetland and upland habitat in the Everglades System
	Improve sheetflow patterns and surface water depths and durations in the Everglades system in order to reduce soil subsidence, the frequency of damaging peat fires, the decline of tree islands, and salt water intrusion
	Reduce high volume discharges from Lake Okeechobee to improve the quality of oyster and SAV habitat in the northern estuaries
Improve native plant and animal species abundance and diversity	Reduce water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization
	Restore more natural water level responses to rainfall to promote plant and animal diversity and habitat function

RESTUDY GOAL: Enhance Economic Values and Social Well Being	
Increase availability of fresh water (agricultural/municipal & industrial)	Increase availability of water supply to the Lake Okeechobee Service Area
Reduce flood damages (agricultural/urban)	
Provide recreational and navigation opportunities	
Protect cultural and archeological resources and values	

Project goals and objectives included constraints to ensure that the proposed project would not reduce the level of service for flood protection, protect existing legal users, and meet applicable water quality standards for the natural system. This is consistent with the Yellow-book constraints.

E.1.3 Model Assumptions and Project Alternatives

As part of the RECOVER regional evaluation, the future without project (FWO) alternative was compared to several alternatives aimed at improvements in storage, decompartmentalization, sheetflow enhancement, and seepage management as proposed in the following CERP components:

- Everglades Agricultural Storage Reservoirs (G)
- Flow to Northwest and Central Water Conservation Area 3A (II and RR)
- Water Conservation Area 3 Decompartmentalization and Sheetflow Enhancement (AA, QQ and SS)
- Dade-Broward Levee/Pennsuco Wetlands (BB)
- Bird Drive Recharge Area (U)
- L-31N Improvements for Seepage Management and S-356 Structures (V and FF)
- Everglades Rain-Driven Operations (H)

Key Assumptions regarding the FWO include:

- Lake Okeechobee Regulation Schedule Study (2008) for Lake Okeechobee operations.
- 1st and 2nd generation CERP projects: C-43 and Indian River Lagoon South (C-44) storage reservoirs are in place to help reduce high Lake Okeechobee and basin flows to the estuaries, as well as provide low flows to stabilize salinities during the dry season.
- Additional Stormwater Treatment Areas and one Flow Equalization Basin (FEB) are in place as part of the state's water quality strategies to meet applicable state water quality standards.
- 1st and 2nd Generation CERP projects: Site 1 impoundment and Broward County Water Preserve Area projects are in place for both seepage management and sheetflow enhancement benefits, as well as secondary nutrient reduction benefits.

- 2nd generation CERP projects: C-111 Spreader Canal and Biscayne Bay Coastal Wetlands to help manage seepage in the southern end of the south Dade conveyance system, spread water across coastal wetlands and stabile nearshore salinities in Biscayne Bay.
- Everglades Restoration Transition Plan (ERTP) regulation schedule is in place for water conservation area 3A
- The following non-CERP projects are in place: Modified water deliveries 1-mile bridge on the eastern portion of Tamiami Trail, the 8.5 square mile levee and south Dade C-111 detention areas.

Project Alternatives:

Project alternatives were formulated for storage and operations above the redline (L-4, L-5, L-6 canals), which affect the Northern Estuaries and Lake Okeechobee. Project alternatives were formulated for conveyance, decompartmentalization, and seepage below the redline, which affect the Greater Everglades and Southern Coastal Systems. Ultimately four project alternatives (alternative 1, 2, 3, and 4) were compared to the FWO, and are depicted in **Figure E.1-1** and **Figure E.1-2**. A detailed description of the alternatives can be found in Section 3 of the Project Implementation Report (PIR). The majority of the project features considered in each CEPP alternative are consistent with an incremental version of CERP components or projects. However, two features, the FEB and Blue Shanty Levee, are new compared to what was originally envisioned for CERP. Limited modeling resources and capability did not allow for full system-wide CERP runs and RECOVER was unable to provide a complete understanding of how CEPP alternatives would function with full CERP implementation. Project features formulated to achieve incremental system-wide restoration benefits in the near term may not function as well with full CERP implementation as envisioned in the 2000 Yellow-book Plan. This may require adapting project features in the future, such as the blue shanty levee and/or pursuing additional sources of storage in addition to the FEB, to achieve the full set of restoration benefits envisioned under CERP. Ultimately, the CEPP project alternatives represent an important near term incremental step towards restoration of the south Florida Everglades ecosystem.

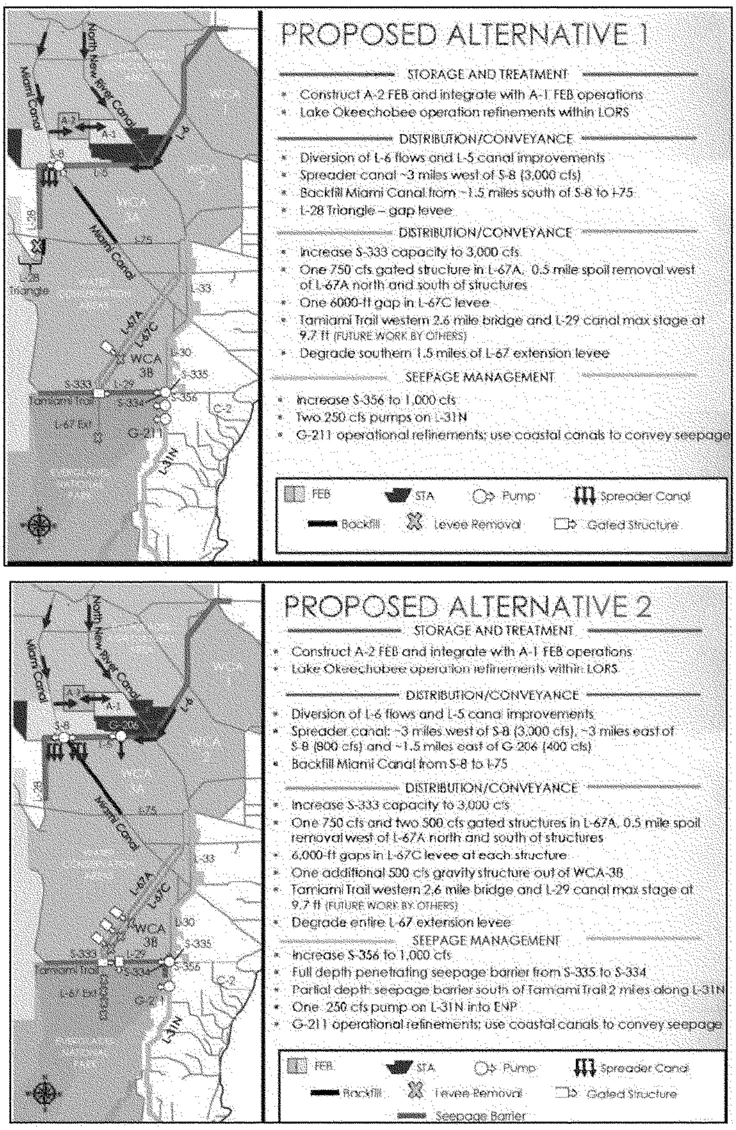

Figure E.1-1– CEPP Project Alternatives. Project features considered in project alternatives 1and 2 that were evaluated in comparison to the future without project in this RECOVER system-wide evaluation report.

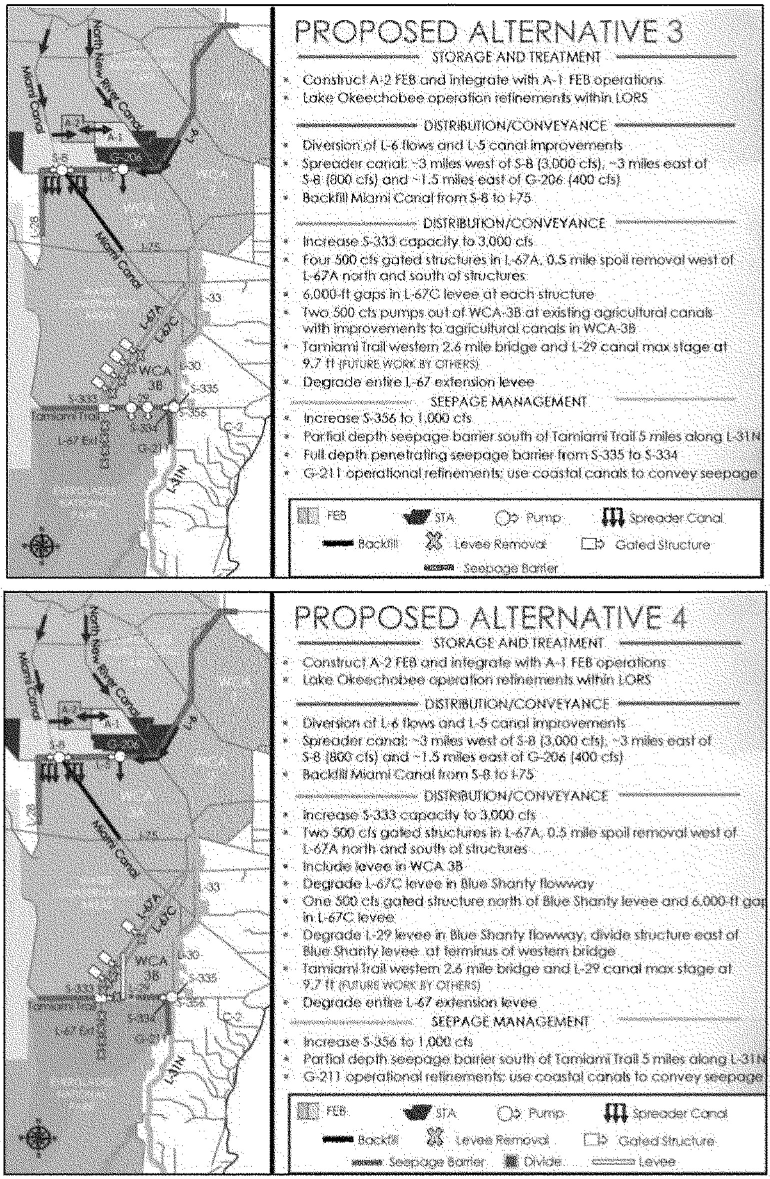

Figure E.1-2 – CEPP Project Alternatives. Project features considered in project alternatives 3 and 4 that were evaluated in comparison to the future without project in this RECOVER system-wide evaluation report.

E.1.4 Uncertainty

Model uncertainty can be characterized in several forms (RECOVER, 2002), but generally they fall into two categories: knowledge uncertainty or natural variability uncertainty. Knowledge uncertainty relates to errors in how a particular species or parameter will respond to various environmental and habitat conditions. Knowledge uncertainty can be measured using calibration statistics for the hydrologic models which can be propagated to the ecological models that use hydrologic output. The limits of a model's representation of actual factors or conditions can be described in model documentation reports. Natural variability relates to the temporal and spatial uncertainty with each input and output in the model and is further complicated by climate change nonstationarity. The significance of both types of model uncertainty is that it can pose a risk to identifying and implementing the best project plan to achieve restoration goals and objectives. Scenario analysis can be used to evaluate variations of an alternative which is more robust (perform better under a range of future conditions) to help minimize the risk associated with natural variability uncertainty. Adaptive management is another tool that can help reduce uncertainty associated with implementing the best alternative plan and operations to meet restoration performance goals.

Knowledge Uncertainty

Planning Uncertainty

The RECOVER regional evaluation made assumptions about which projects would be implemented for the FWO and CEPP alternatives (See section 2.2). If any of these projects are delayed or are not implemented, the results for each alternative could change. This uncertainty is consistent for all project planning alternatives for any restoration project and is minimized by only including projects that have a signed Chief of Engineers Report or those that have been authorized by Congress or state governing bodies.

Model Uncertainty

The hydrologic models used for CEPP evaluation are the Regional Simulation Model Basins Model (RSMBN) and Regional Simulations Model for Glades Lower East Coast Service Area (RSMGL). The RSMGL model has reasonable performance accuracy as indicated by the calibration and validation report (See Appendix H). RSMGL is calibrated using historical stage data from January 1, 1984 to December 31, 1995. Of the 336 gages used for stage calibration, 100% of the gages meet the acceptability criterion for both bias (+/- 1.0 ft) and RMSE (+/- 2.0 ft). None of the gages violated the pre-set bias and RMSE threshold considerations. Overall, the mean and the standard deviation of absolute bias for the calibration period were 0.21 ft and 0.18 ft, respectively. Similarly, the mean and standard deviation values of RMSE for the calibration period were 0.54 ft and 0.25 ft, respectively. Historical stage data from January 1, 1981 to December 31, 1983, and January 1, 1996 to December 31, 2000 are used for model validation. In general, the model performed extremely well during the two validation periods. For each validation period, these percentages changed to 98.4% and 99.4 %, respectively. Overall, the mean and the standard deviation of absolute bias for the validation period were 0.26 ft and 0.29 ft, respectively. Similarly, the mean and standard deviation values of RMSE for the validation period were 0.59 ft and 0.35 ft respectively. A full description of model accuracy is contained in Appendix H – Benefit Model for each indicator region used in the RSMGL model.

Performance Measure and Ecological Planning Tool Uncertainty

The CEPP regional evaluation is based on technical evaluation performed by each RECOVER regional team. This evaluation is performed using both RECOVER approved performance measures, as well as other information (i.e., performance measures in development, corresponding assessment data, and other reports) that have not yet completed RECOVER scientific review and approval. RECOVER performance measure uncertainty is typically described in the RECOVER documentation sheets found at www.evergladesplan.org/pm/recover/eval_team_perf_measures.aspx. Those performance measures that have been reviewed and approved by RECOVER have more certainty based on scientific agreement, as opposed to other evaluation methods and tools that have not been reviewed and approved by RECOVER and are still being further developed and vetted, such as the ecological planning tools used in this evaluation. The ecological planning tools used as other information sources have model documentation reports that explain their accuracy and uncertainty, which are referenced in this report, where available.

Knowledge Uncertainty

The performance measure and ecological planning tools models are simplifications of the real relationships between hydrology and a particular indicator of interest. Errors can result based on known and unknown responses of species and habitats to various environmental and other habitat conditions. This type of uncertainty is inherent with any ecosystem restoration project and is minimized by using the best available science to develop and interpret model results. In addition, uncertainty is addressed by proceeding with project implementation through an adaptive management approach that tests hypotheses about the best project design and operations to achieve desired results.

Climate Change Uncertainty

The RSM model uses historic 41 year period of record (1965-2005) of rainfall and hydrology to simulate interaction of surface water/groundwater, evapotranspiration, and water management (movement of water through canals, structures, seepage, and overland flow or estuarine flow) to estimate the flow, water depths and durations, and salinities in the estuaries. Project infrastructure (e.g., canals, water control structures) and operations are portrayed in abstraction that generally mimic the intent of the project features while not matching the exact mechanisms by which these operations would be achieved in the actual conditions. Climate change nonstationarity means that the past climatic conditions (41 year period of record for the hydrologic models) are not indicative of future climatic conditions. To address this concern, some of the model evaluations and performance measures recommend looking at extreme years (Dry, Wet) in addition to average conditions to better understand, which alternatives are more robust to varying climatic conditions.

E.1.5 Evaluation Process and Organization

RECOVER regional teams (Northern Estuaries, Lake Okeechobee, Greater Everglades, and Southern Coastal Systems) held technical meetings to evaluate project alternatives using approved project performance measures, other best available scientific information, and best professional judgment. These evaluations were performed at a regional level to help in understanding the regional hydrologic and ecologic performance implications of each alternative. This RECOVER system-wide evaluation report is organized by four regional areas which are potentially affected by the project : 1) Lake Okeechobee; 2) Northern Estuaries – St. Lucie and Caloosahatchee River Estuaries; 3) Greater Everglades – Water Conservation Areas and Everglades National Park; and 4) Southern Coastal Systems – Florida

Bay, Biscayne Bay, and Southwest Florida Coast. A summary of this RECOVER system-wide evaluation and recommendations are included in the executive summary. Background information on CEPP project goals, objectives, assumptions, and alternatives is included in this section. The following sections describe the evaluation process used for each region.

E.2 Lake Okeechobee Regional Report

RECOVER System-wide Regional Evaluation

Central Everglades Planning Project

Steve Schubert, Andy Rodusky, (RECOVER Lake Okeechobee Regional Coordinators)
And Bruce Sharfstein (SFWMD)

E.2.1 Executive Summary

To promote understanding for stakeholders, managers, and Central Everglades Planning Project (CEPP) Project Delivery Team (PDT) members, here are the key findings:

1. Two of four performance measures (Extreme High Lake Stage and Extreme Low Lake Stage) showed no difference between the Existing Condition Baseline (ECB), Future With Project (ALTS), and Future Without Project (FWO) simulations.
2. One performance measure (Above Stage Envelope Score) indicated the simulated FWO was better than the simulated ALTS or ECB, but one performance measure (Below Stage Envelope Score) indicated the opposite. The above stage envelope score is considered to have more potential to be ecologically damaging of the two scenarios for the lake.
3. Based on the daily time series, the simulated runs for the ECB, FWO, and ALTS were very similar much of the time;
4. However, for approximately 5 percent of the period of simulation there were seven separate multiple-day events of such duration (ranging from 79 to 250 consecutive days) above 15.0 feet lake stage where we would expect some negative effects from the ALTS to the aquatic vegetation habitat (including macroinvertebrates and fish that utilize the vegetation) in the lake. Temporary reductions in shallow-water foraging habitat for shorebirds and short-legged wading birds could also occur during these times.

E.2.2 Introduction

This report evaluates model predictions of freshwater flows for the northern component of the Central Everglades Planning Project (CEPP), also known as the Flow Equalization Basin (ALTS) "north of the red line," and compares them to a "future without project" (FWO) condition and the "existing condition baseline" (ECB) for Lake Okeechobee. The performance measures used in this evaluation include excessive high lake stage (>17.0 feet), excessive low lake stage (< 10.0 feet), and stage envelope (12.5 feet to 15.5 feet) which are all described in the Lake Stage Lake Okeechobee Performance Measure document (RECOVER 2007a) available on the RECOVER web pages at http://www.evergladesplan.org/pm/recover/perf_low.aspx. Also included are evaluations of flood protection criteria and minimum water level and duration. We did not evaluate the mean annual flood control releases metric for the Caloosahatchee River, C-44 Canal, or L-8 Canals because those data were not provided.

E.2.3 Performance Measures

The Comprehensive Everglades Restoration Plan (CERP) goals for Lake Okeechobee are no frequent or prolonged (2 to 4 months) departures of lake stage outside of the prescribed lake stage envelope and only rare occurrences of the extreme high and low stage events. To meet the specific water demands of the CEPP, we anticipated that the lake stages would need to be higher on average, so our evaluation was based more on the CEPP goal of "do no harm."

Published research, summarized in Havens (2002), documented the benefits of seasonally variable water levels for the plant and animal communities of Lake Okeechobee. The ideal water levels ranged from 12.5 feet National Geodetic Vertical Datum (NGVD) during the months of June-July to 15.5 feet NGVD during the months of November-January. Falling water levels in late winter to spring benefit wading birds by concentrating prey resources in the littoral zone where those birds forage (Smith et al. 1995). Water levels near 12.5 feet NGVD benefit submerged plants and bulrush by providing optimal light levels for photosynthesis in the summer months (Havens et al. 2004). Variation in the prescribed range results in annual flooding and drying of upslope areas of the littoral zone, which favors development of a diverse emergent plant community (Richardson and Hamouda 1995, Keddy and Fraser 2000).

Subsequent to the development of these performance measures, observations indicated that 15.0 feet might be better than 15.5 feet, especially following the implementation of the Lake Okeechobee Regulation Schedule (LORS) in April 2008. At 15.0 feet, there is minimal vertical stacking of water in the northwest marsh and inundation is very similar to pre-levee conditions for the short hydro-period marsh and prairie in this area. Also at 15.0 feet, there are approximately 1,000 acres of foraging habitat for short-legged wading birds (i.e., 1 to 6 inches deep). However, at 15.5 feet, the littoral zone is too deep for these birds, and there is almost no exposed lake bottom for shorebirds. The LORS tends to hold lake levels lower than its predecessor schedule (Water Supply and Environment); therefore, when the lake rises above 15.0 feet under LORS, it is potentially more damaging. For example, under lower lake stages, the area around the toe of the levee tends to shift to more upland vegetation, so that when it becomes inundated (at 15.5 feet, or greater) it becomes a source for nutrients and organic carbon as terrestrial vegetation dies, which may also create low dissolved oxygen conditions and fish kills; negative effects which may not be balanced by the eventual development of a wetland vegetation community if the temporal component of inundation is too short.

Research has also been published on the adverse impacts of extreme high and extreme low water levels on the littoral and nearshore areas of Lake Okeechobee (Havens 2002). Extreme high stage, above 17 feet NGVD, allows wind-driven waves to uproot emergent and submergent plants in the littoral and nearshore regions. In addition, high lake stage permits the transport of suspended solids from the open water region, where unconsolidated sediments are thickest, to sand and peat dominated nearshore and littoral regions. Transport of suspended solids to the nearshore and littoral regions reduces water clarity and light penetration, resulting in less submerged aquatic vegetation growth (James and Havens 2005). At extreme high lake stage, the transport of nutrient-rich water from the open water region to the littoral region may increase phytoplankton biomass and algal bloom frequency (RECOVER, 2007b). It may also reduce periphyton biomass, result in a less desirable community structure (e.g., increased cyanobacteria), and induce shifts in plant dominance to more undesirable taxa, such as the expansion of cattail. Overall, high lake stages can result in reduced growth and germination of submerged plants, reduced reproduction of fish, and reduced diversity and increase of pollution-tolerant macroinvertebrates. Detailed research results regarding high stage impacts on the lake's plant and animal communities are in Maceina and Soballe (1990), Havens (1997), and Havens et al. (2001).

Conversely, extreme low stage, below 10 feet NGVD, results in desiccation of the entire littoral zone, the shoreline fringing bulrush zone, and the majority of the nearshore region that supports submerged plants. Extreme low stage also encourages invasive exotic plants such as torpedograss and melaleuca to establish in areas of the littoral zone where they did not formerly occur, displacing native vegetation. Recovery from prolonged low stage events below 10 feet NGVD is slow, requiring multiple years of appropriate stage regime to recover, as documented for submerged plants by Havens et al. (2004), for sport fish such as largemouth bass (Havens et al. 2005) and from field observations from 2007 to present.

E.2.4 Evaluation

Above Lake Stage Envelope

The above lake stage envelope performance measure evaluates both the magnitude and duration that alternative plans exceed the optimal stage envelope. **Figure E.2-1** shows an example of the performance of both alternatives and the existing baseline conditions for calendar year 2003, compared to optimal conditions. Optimal conditions are met when lake levels occur between 12.0 and 15.5 ft as represented in **Figure E.2-1**. For the period of simulation, the standardized scores ranged from 82.50 for FWO to 73.48 for ALTS out of a perfect score of 100 (**Figure E.2-2**). The value for the ECB was 75.74. Based on this measure the ALTS had the poorest performance.

To better understand the standardized scores, we evaluated years where the greatest differences between hydrographs occurred (**Figure E.2-1**). In 2003, the ALTS lake stage was 6 to 12 inches higher than it was for the FWO for the entire year. However, although this performance measure may indicate a difference in lake stage, it did not always translate to a difference in hydrograph score. For example, in simulated January and February 2003, although the modeling indicated the lake was deeper under the ALTS than the FWO, the alternatives for both months were within optimal conditions. Contrast that to simulated June, July, and August 2003, where neither alternative performed optimally, but FWO was ~12 inches lower than ALTS and therefore, received a better overall score.

Below Lake Stage Envelope

The below lake stage envelope performance measure evaluates how many times the alternative plans result in a stage envelope below the optimal level. The standardized score is derived from a combination of the magnitude and duration of exceedances. A perfect score would be 100. The results ranged from 42.41 (ALTS) to 34.29 (FWO) (**Figure E.2-3**) indicating that the ALTS performed better than the FWO. The ECB was in between with a score of 40.32.

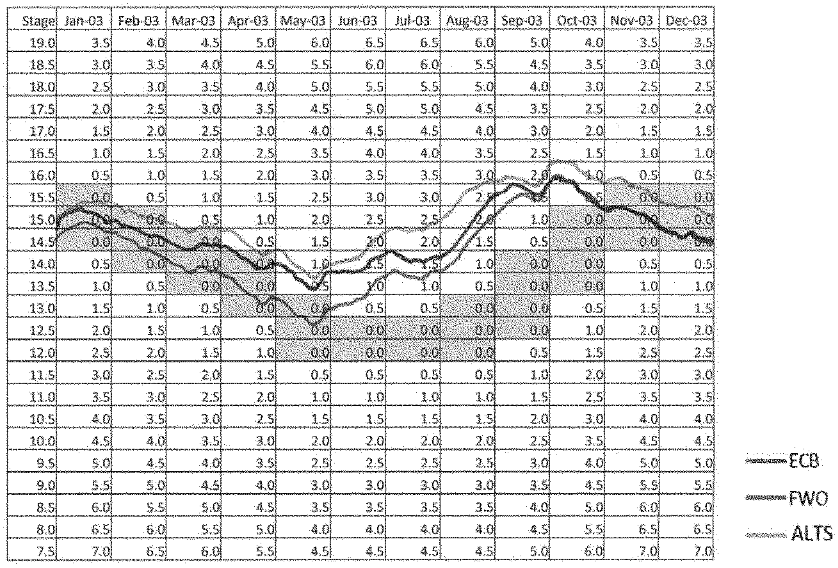

Figure E.2-1. Lake Okeechobee stage duration curve for 2003 under Existing Conditions (ECB), Future Without Project (FWO), and Future With Project (ALTS). Optimal conditions are represented by the blue band between 15.5 and 12.0 feet.

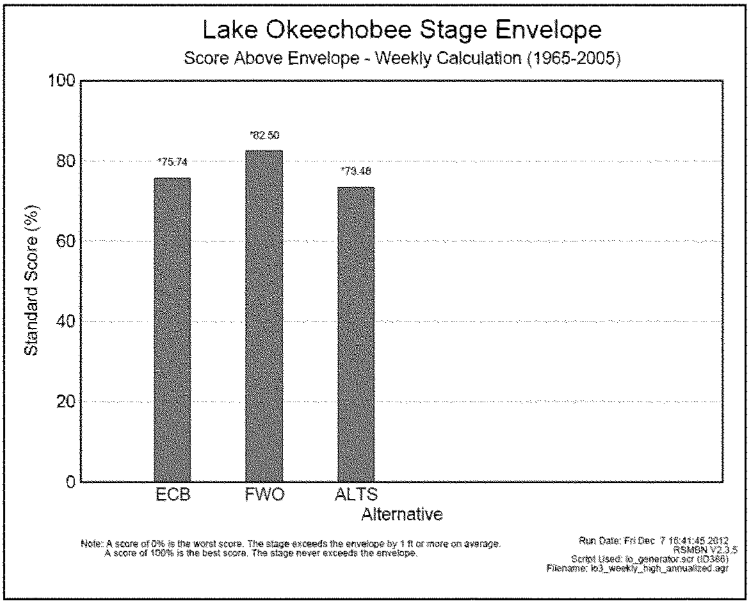

Figure E.2-2. Lake Okeechobee above stage envelope scores.

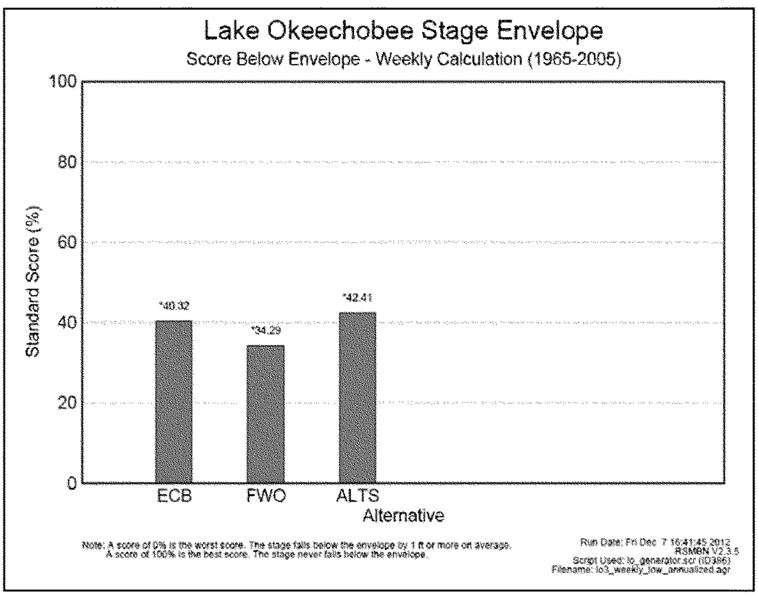

Figure E.2-3. Lake Okeechobee below stage envelope scores.

Above Extreme High Lake Stage

The above extreme high lake stage performance measure evaluates the amount of time lake stage is in excess of 17 feet NGVD. The scores ranged from 99.11 for FWO and ECB to 97.78 for ALTS (**Figure E.2-4**). These results indicated no significant difference between alternatives.

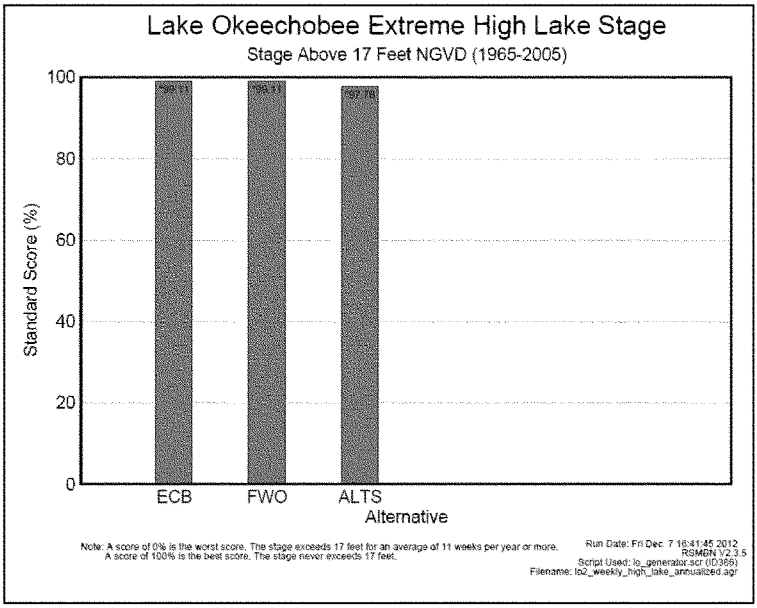

Figure E.2-4. Lake Okeechobee extreme high lake stage scores.

Below Extreme Low Lake Stage

The below extreme low lake stage performance measure evaluates the amount of time lake stage is below 10 feet NGVD. The scores ranged from 87.48 (ALTS) to 86.02 (FWO) (**Figure E.2-5**). Because of uncertainty in model simulations, it is difficult to define if these are significantly different outcomes statistically or environmentally.

Stage Duration Curve

Figure E.2-6 shows the stage duration curves for the FWO, ALTS, and ECB. The ideal curve would be very flat between lake stages 12.5 to 15.0 feet and steep outside this range. The curve showed a similar pattern for FWO, ALTS, and ECB when the lake was below 12.6 feet. This might be expected given the proposed operation of the CEPP to stop lake releases (under ALTS) if lake levels drop to 12.6 feet (in effect from January 1 to August 31).

For the remainder of the curve the ALTS holds the lake higher than the FWO. This was also expected because modelers held the lake higher to offset the additional water demand of the CEPP, which calls for sending an annual average 200,000 acre-feet south to the Everglades. For the critical time where the preferred lake stage is between 12.5 and 15.5 feet, the ALTS performed better by holding the lake in that range for slightly more time (this was also reflected in the "score below envelope" metric in **Figure E.2-3**). At damaging high stages (15.5 to 17.0 feet), the ALTS performs slightly worse by holding lake stage higher for a longer amount of time.

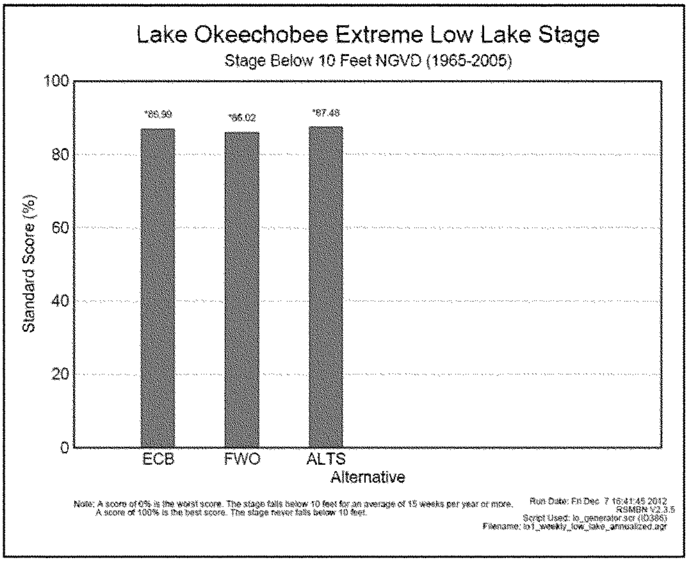

Figure E.2-5. Lake Okeechobee Extreme Low Lake Stage Scores.

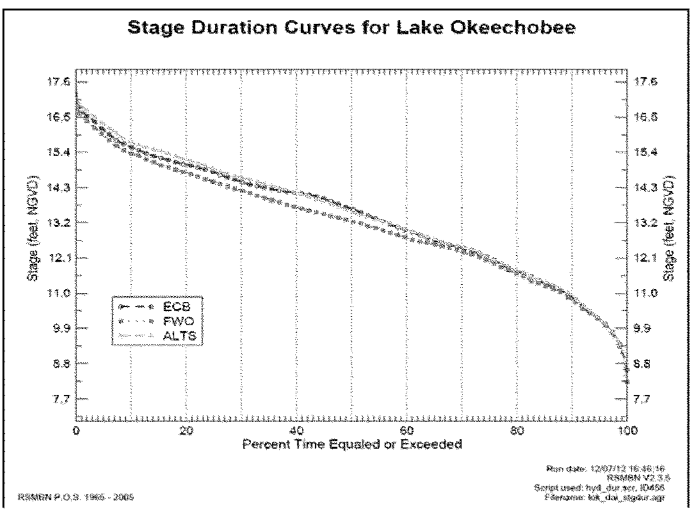

Figure E.2-6. Lake Okeechobee Stage Duration Curve.

Flood Protection Criteria

The flood protection criteria evaluate the number of days the lake stage is above 16.5 feet NGVD from August 1 to September 15 as well as the maximum water levels in the 41-year period of simulation. While both alternatives exceeded the 16.5 feet stage at various times of the year, only the ALTS exceeded it (for seven days in September 1995; maximum stage = 16.52 feet) during the appropriate time of year. During this period, the FWO maximum simulated stage was 16.14 feet. We do not believe this to be a substantial difference for this short duration.

The maximum water levels during the entire period of simulation for the ECB and both alternatives (achieved on April 1, 1970) were as follows: 17.54 feet (ECB), 17.64 feet (ALTS), and 17.50 feet (FWO). For these criteria, the simulated FWO performed better than the ALTS numerically, although it is not apparent that this 0.14 foot difference is meaningful.

Minimum Water Level and Duration Measure

The minimum water level and duration measure compares the number of times that the simulated water level was below 11.0 feet NGVD for more than 80 consecutive days in the 41-year simulation. Note that this is different from the revised MFL (minimum flows and levels) performance measure as it is purely hydrologic and does not take into account the legal definition of how MFL exceedances and violations are counted. The ECB, FWO, and ALT exceeded this measure six times. For the simulated 1974, 1977, and 1981 events, the numbers of days between the ECB and two alternatives were similar. However, in 1989, the ECB and ALTS simulations were comparable (151 and 148 days, respectively), and outperformed the FWO (which was below 11.0 feet for 191 days). In 1990, the ALTS (164 days) performed better than both the ECB (188 days) and the FWO (189 days). In 2001, the ECB (229 days) outperformed both the FWO (272 days) and the ALTS (263 days). We expected that the ALTS would perform better under this metric because the lake operations were changed under the ALTS simulation to hold lake stages higher when possible to make water more available to the CEPP. As recent data have indicated (actual conditions 2005 to 2012), a lower lake stage is not as harmful to the Lake's ecology as high water stages (RECOVER 2009, 2012). Therefore, this performance measure could be refined to enable an actual determination of minimum water level violations, which would include an *x* times in *y* years component. As it stands now, the ECB, FWO, and ALTS had the same number of exceedances, but the ALTS had fewer days below the threshold within two of the six events (i.e., performed slightly better).

E.2.5 Other Information Sources

Ranking of Alternatives

We weighted the scores for each alternative by performance measure as follows:

- Standard Score Above 17 feet NGVD (50%)
- Standard Score Below 10 feet NGVD (25%)
- Standard Score Above Stage Envelope (15%)
- Standard Score Below Stage Envelope (10%)

We based our rationale for weighting on the assumption that water levels above 17.0 feet are the most ecologically damaging. Water levels less than 10.0 feet are also ecologically damaging, but less so, therefore, they were weighted less. Similarly, the standard scores for both above and below the stage envelope were weighted the least. We then summarized the weighted averages (**Figure E.2-1**).

We did not include scores for Flood Protection Criteria or the Minimum Water Level and Duration Measure because the differences between alternatives were either statistically negligible or ecologically meaningless. Numerically, the FWO performed the best with a score of 86.86, but due to the sensitivities and uncertainties of the modeling and the performance measures, this analysis shows no difference between the ECB, FWO, or alternatives.

Table E.2-1. Individual scores and weighted averages for both CEPP alternatives and the existing condition baseline for each Lake Okeechobee performance measure [scores could range from 0 (worst) to 100 (best)].

Performance measure	ECB	Alternatives	FWO
Extreme high (above 17 feet)	99.11	97.78	99.11
Extreme low (below 10 feet)	86.99	87.48	86.02
Stage envelope Above Below	75.74 40.32	73.48 42.41	82.50 34.29
Weighted Average	**86.70**	**86.02**	**86.86**

Additional Analysis of the Daily Time Series

Due to a general lack of differences between the performance measures of either alternative, we examined the daily time series over the period of simulation (1965-2005) in order to assess whether or not the CEPP, as proposed, had an effect on water stages in Lake Okeechobee. We used 15.0 feet rather than 15.5 feet as our benchmark for ecological damage due to recent observations as discussed earlier in Section 3.3. **Figures E.2-7** through **Figure E.2-14** show the daily, simulated hydrographs for the ECB, FWO, and ALTS.

We identified seven events where the simulated ALTS hydrograph performed worse (*i.e.*, potentially more ecologically damaging because the stage was greater for a substantial amount of time) than the simulated FWO. It is difficult to say whether substantial ecological damage would occur if these simulations reflected "real world" conditions because we do not have evaluation tools that are precise enough to parse out the differences. We can infer from on-going vegetation studies in Lake Okeechobee that the following events have, at least, the potential to negatively affect submerged aquatic vegetation; however, because it may take 6 months to 3 or 4 years for vegetation shifts to result from differing conditions, and because of other compounding factors (turbidity, nutrients, and storms) we cannot offer better conclusions. The seven events are as follows.

From July 20, 1968 to January 13, 1969 (178 days), the ALTS was above the 15.0 feet threshold, but the FWO was not. During this period, there were 44 days when the ALTS was 6 inches to 10 inches higher than the FWO and 117 days of difference greater than 10 inches (maximum stage was 16.06 feet) (**Figure E.2-7**).

The ALTS simulation was also greater than 15.0 feet for 222 days (August 25, 1978 to April 3, 1979), while the FWO simulation exceeded this stage for only 98 days during this period. Furthermore, the ALTS exhibited a 6-inch to 8.3-inch difference for 88 days over the FWO (**Figure E.2-8**).

The ALTS simulation was greater than 15.0 feet for 109 days (October 11, 1983 to January 27, 1984), while the FWO simulation did not exceed 15.0 feet (range = 14.39 to 14.87 feet). Additionally, the ALTS simulation was 6 inches to 8.63 inches higher than the FWO (**Figure E.2-10**).

From August 28, 1991 to December 11, 1991 (106 days), the ALTS simulation was again greater than 15.0 feet (maximum = 15.62 feet). Over this same period, the FWO simulation was greater than 15.0 feet for 50 days (maximum = 15.20 feet). The alternatives were 6 inches to 8.4 inches higher than the FWO for 46 days (**Figure E.2-12**).

The ALTS exceeded 15.0 feet from August 29, 1992 to May 5, 1993 (250 days; maximum 15.88 feet), while the FWO exceeded 15.0 feet for only 84 days (maximum = 15.39 feet). Additionally, the ALTS simulation was 6 inches to 9.77 inches higher than the FWO for 199 days during that period (**Figure E.2-12**).

From December 23, 2002 to March 11, 2003 (79 days), the ALTS simulation was again greater than 15.0 feet. Over this same period, the FWO simulation was greater than 15.0 feet for only 10 days (maximum = 15.05 feet). The ALTS was 6 inches to 11.65 inches higher than the FWO (**Figure E.2-14**).

From July 24, 2003 to January 12, 2004 (173 days), the ALTS simulation was greater than 15.0 feet and achieved a maximum elevation of 16.48 feet. Over this same period, the FWO simulation was greater than 15.0 feet for 100 days (maximum = 16.22 feet). The ALTS was 6 inches to 10 inches higher than the FWO for 78 days and 10 inches to 15.16 inches higher than the FWO for an additional 43 days (**Figure E.2-14**).

We also identified times when the 17.0 feet threshold was exceeded by both the ALTS and the FWO (although for less time for the FWO). For example, from March 27, 1970 to April 12, 1970, the ALTS simulation exceeded the 17.0 feet threshold for 17 days (maximum stage = 17.64 feet) (**Figure E.2-7**). The FWO exceeded 17.0 feet during this same period for 15 days (maximum stage = 17.50 feet). A similar event happened from October 18, 1995 to November 7, 1995 (**Figure E.2-12**). Conversely, from November 2, 2005 to November 17, 2005, the ALTS exceeded 17.0 feet (maximum = 17.24 feet), while the FWO only reached a maximum elevation of 16.69 feet (**Figure E.2-14**). None of these events, even though they exceeded 17.0 feet, indicated a measurable ecological difference between the ALTS and FWO simulations. In essence, both alternatives performed poorly and no additional substantial ecological damage would likely have occurred under simulated ALTS conditions (when compared to FWO conditions) during these periods.

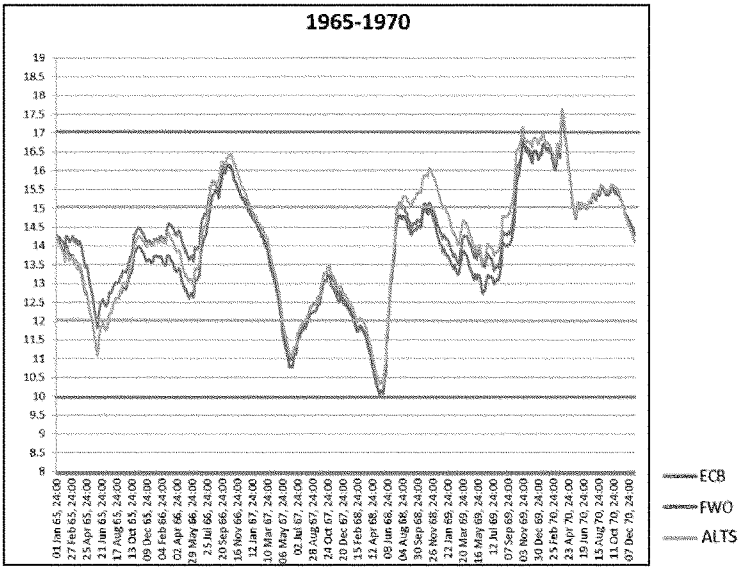

Figure E.2-7. Daily Time Series Stage Hydrographs for Lake Okeechobee as simulated for the ECB, ALTS, and FWO from 1965 to 1970.

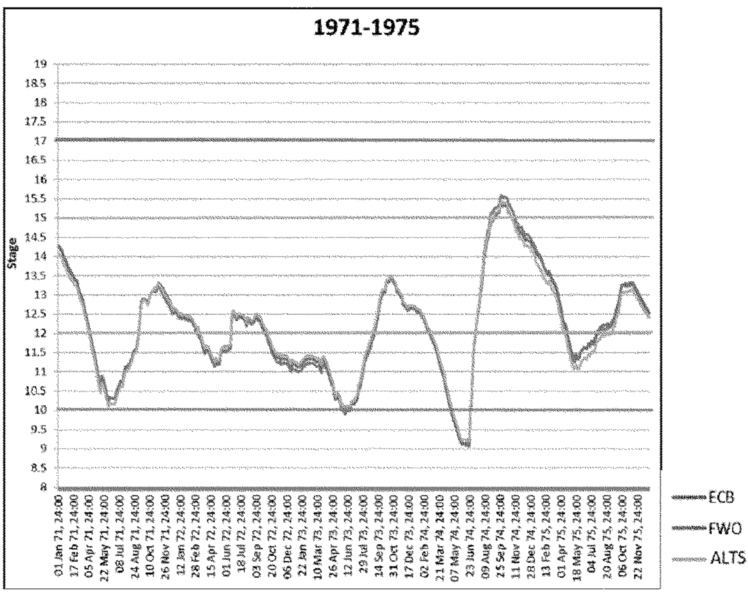

Figure E.2-8. Daily Time Series Stage Hydrographs for Lake Okeechobee as simulated for the ECB, ALTS, and FWO from 1971 to 1975.

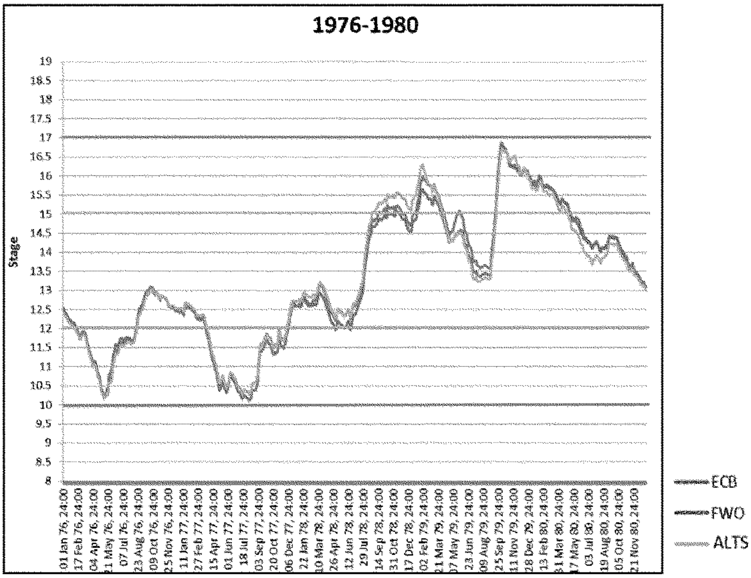

Figure E.2-9. Daily Time Series Stage Hydrographs for Lake Okeechobee as simulated for the ECB, ALTS, and FWO from 1976 to 1980.

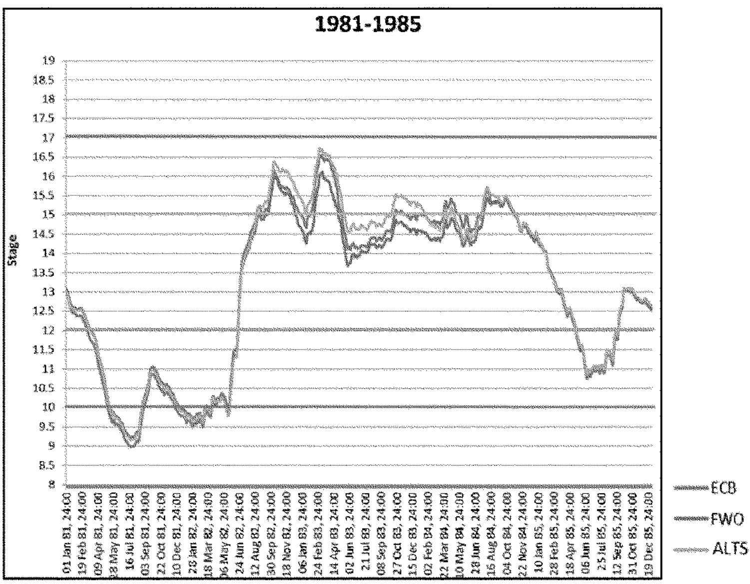

Figure E.2-10. Daily Time Series Stage Hydrographs for Lake Okeechobee as simulated for the ECB, ALTS, and FWO from 1981 to 1985.

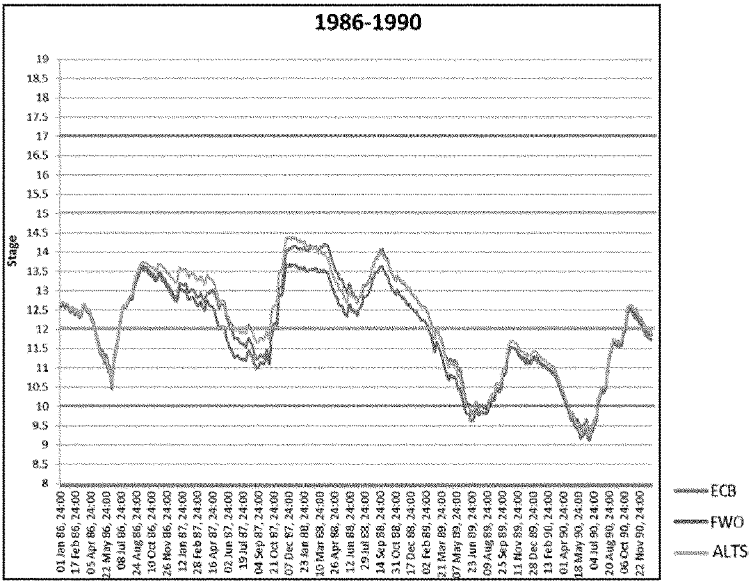

Figure E.2-11. Daily Time Series Stage Hydrographs for Lake Okeechobee as simulated for the ECB, ALTS, and FWO from 1986 to 1990.

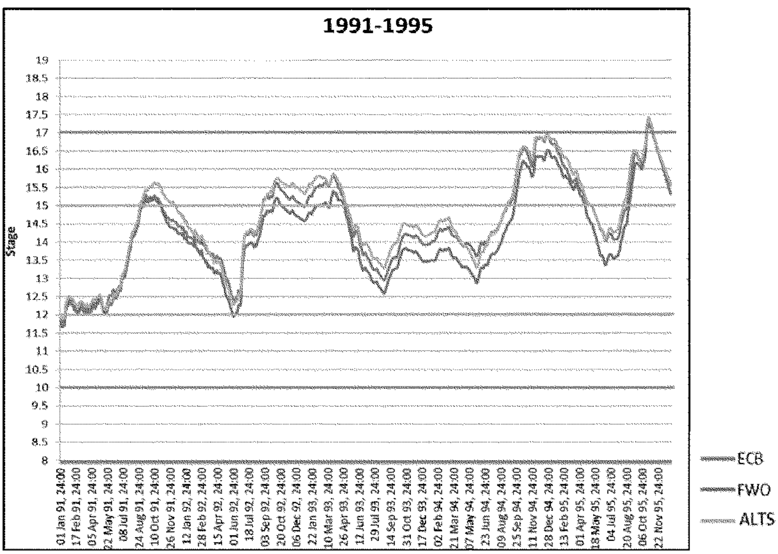

Figure E.2-12. Daily Time Series Stage Hydrographs for Lake Okeechobee as simulated for the ECB, ALTS, and FWO from 1991 to 1995.

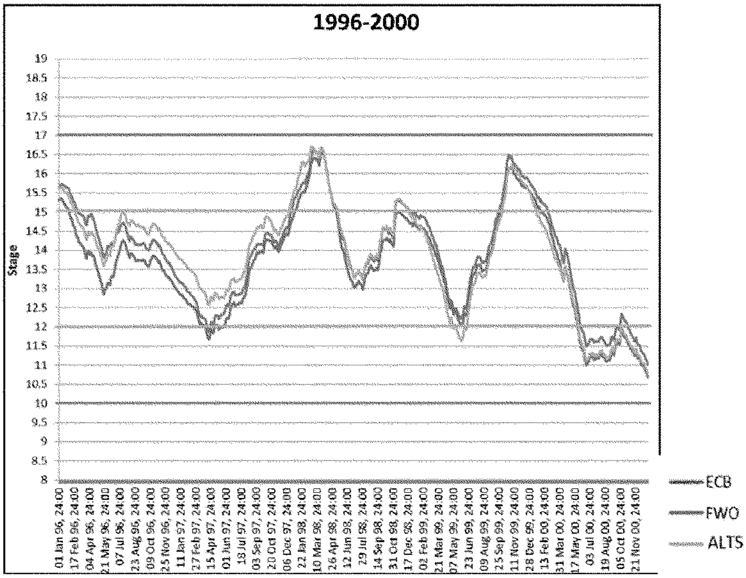

Figure E.2-13. Daily Time Series Stage Hydrographs for Lake Okeechobee as simulated for the ECB, ALTS, and FWO from 1996 to 2000.

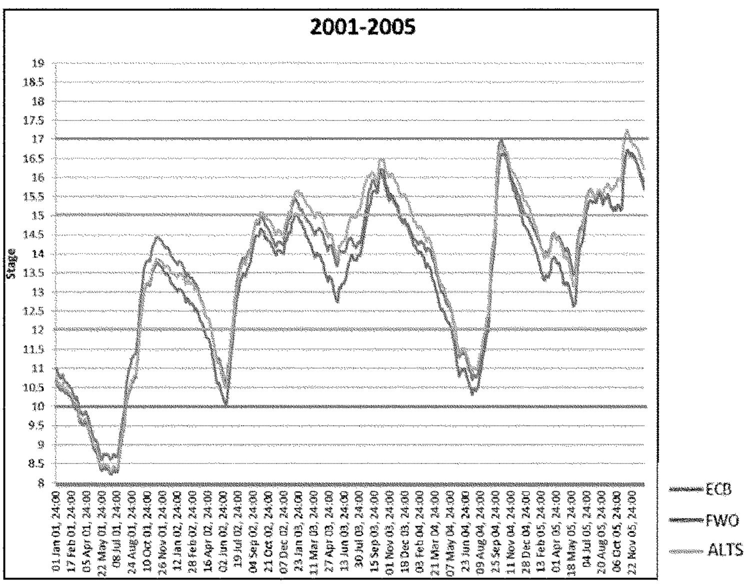

Figure E.2-14. Daily Time Series Stage Hydrographs for Lake Okeechobee as simulated for the ECB, ALTS, and FWO from 2001 to 2005.

While the previous discussion identified events where the ALTS may have performed worse than the FWO, there was at least one event where the ALTS may have performed better. On May 25, 1987, the simulated FWO dropped below 12.0 feet (the low side of the preferred stage envelope), and stayed below 12.0 feet until October 22, 1987 (150 days; minimum stage = 10.97 feet). The simulated ALTS dropped below 12 feet for 91 days (minimum stage = 11.64 feet) (**Figure E.2-11**). Under these conditions, more of the littoral zone would have been flooded under the ALTS. For example, at 12.0 feet, approximately 26,000 acres of littoral zone are flooded but at 11.5 and 11.0 feet approximately 17,000 and 6,000 acres, respectively, are flooded. Periodic drying of the littoral zone may be beneficial to lake ecology through oxidation of undesirable organic soils (i.e., muck), but prolonged desiccation can negatively affect apple snail survival and cause unwanted shifts from aquatic plant to upland plant species. The duration of this simulated event could have affected native apple snails. According to Darby (2006), adult apple snails show the following desiccation tolerances: a 3-month dry-out will kill 21 percent of the population; a 4-month dry-out will kill 50 percent of the population; and a 4.5-month dry-out will kill 63 percent of the population. Juvenile snails have even less tolerance to desiccation -- for example, a 3-month dry-out will kill 40 percent a population of six-week old apple snails (10-15 mm in size). The simulated FWO was between 11.0 and 11.5 feet for 4 months.

E.2.6 Summary and Conclusion

Throughout the period of simulation, there were times when there was little or no difference between the ALTS and FWO (**Figure E.2-8**). Other times (simulated 2003 in **Figure E.2-14**); the potential for ecological differences was greater. Two of the performance measures (extreme low and extreme high stage) indicated no difference over the period of simulation. For the Above Stage Envelope performance measure, the ALTS did not perform as well as the FWO, but for the Below Stage Envelope performance measure, the ALTS performed better than the FWO. This was expected because the changes to the lake's operational rules for the ALTS simulation required the lake to be held higher to meet the added ALTS water demand. It is difficult to predict "real world" ecological differences based on simulated hydrographs, primarily because operational changes can be tweaked almost infinitely (under both simulated and actual conditions). For example, the lake stage was held higher under ALTS to provide more water for the CEPP. Lake stages could potentially be held higher to provide dry season flow benefits to the Caloosahatchee Estuary. The "devil is in the details" related to operational rules that no one knows will be in effect when the project is ready to be operational. Notwithstanding these unknowns, it does seem likely based on the scores for the Above Stage Envelope performance measure that aquatic vegetation would be more impacted under ALTS conditions because high lake stage is thought to be more damaging to the SAV and emergent plant communities compared to low lake stages.

To further test the expectation that the CEPP should "do no harm" to ecological conditions in Lake Okeechobee, the daily time series for specific occurrences where differences were indicated were evaluated. Based on analysis of seven discrete events, the ALTS performed slightly worse for Lake Okeechobee than the FWO. This was manifested in the simulations as higher lake stages (above 15.0 feet NGVD) for a greater amount of time. For example, analysis of these events identified 1,117 total days where the ALTS was above 15.0 feet but the concurrent FWO hydrograph was above 15.0 feet for only 342 days. This difference appears small when you consider the entire number of days in the period of simulation (14,975 days); however, also it should be noted that "rare" or "extreme" events (e.g., droughts, hurricanes, tropical storms, etc) can cause lasting negative effects on the lake. And while these simulated hydrographs may not rise to that level of severity, it is not possible to conclude that multi-year negative effects would not result. This is primarily because it can take up to 3 or 4 years for aquatic vegetation habitat to recover from effects of unsuitable hydrology or water quality in Lake

Okeechobee. An additional biological response to these simulated events could be temporary loss of shorebird and short-legged wading bird foraging habitat (especially during fall-winter migrations). Of the seven events identified, the simulated 1968, 1983, and 1992 events had the largest potential for harm to lake ecology. An event in the summer of 1987 was also identified where the simulated ALTS performed better by keeping more of the littoral zone inundated than did the FWO.

Continued research is necessary to better understand the specific water depth and duration thresholds associated with potential declines in habitat, ecosystem health, and water quality. The current performance measures are based on an assumption of linear increase in risk of ecological damage between the optimal conditions and the most severe condition, which is the most conservative approach to take until there are data to support a more complex relationship. Adaptively managing lake stages can promote lake health and maximize the lake's contribution to the estuaries and Greater Everglades marshes. Refinement of the performance measures and their index models would in turn assist future development and refinement of lake schedules.

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E.3 Northern Estuaries Regional Report

RECOVER System-wide Regional Evaluation

Central Everglades Planning Project

Peter Doering, Gretchen Ehlinger, and Liberta Scotto (RECOVER Northern Estuaries Regional Coordinators), Christopher Buzzelli, Zhiqiang Chen, Patti Gorman, and Yongshan Wan (South Florida Water Management District)

E.3.1 Executive Summary

To promote understanding for stakeholders, managers, and Central Everglades Planning Project Delivery Team members, here are the key findings from the Northern Estuaries evaluations of the CEPP alternatives:

Caloosahatchee River Estuary
In comparing both low flows (less than 450 cfs) and high flows (greater than 2,800 cfs) over the S-79 structure westward, the A-2 Flow Equalization Basin (Central Everglades Planning Project) was not statistically different from the Future Without Project condition but the flow over 2,800 cfs reductions moved in the right direction for improved estuarine health. However, it was statistically better than the Existing Condition Baseline.

St. Lucie River Estuary
In comparing low flow from Lake Okeechobee thru a combination of structures to the St. Lucie River, A-2 Flow Equalization Basin (Central Everglades Planning Project) was statistically different from both the Existing Condition Baseline and Future Without Project. There are a greater number of days when low flow targets are not met with implementation of the CEPP project. This would increase salinity levels in the estuary during extended dry periods resulting in potential stress to mid-estuary oyster populations due to increased predation and disease.

In comparing high flow events to the St. Lucie River, A-2 Flow Equalization Basin (Central Everglades Planning Project) was statistically better than both Existing Condition Baseline and Future Without Project. The number of high flow events were reduced by approximately 3.5 percent (18 months) with the project as compared to Future Without Project.

E.3.2 Introduction

The magnitude, timing and distribution of freshwater inflow to the St. Lucie River Estuary (SLE), and the Caloosahatchee River Estuary (CRE) have been disrupted by a number of anthropogenic alterations of the landscape. These include over drainage of coastal watersheds and artificial connections to Lake Okeechobee for flood control purposes. Projects included in the Comprehensive Everglades Restoration Plan (CERP) of which the Central Everglades Planning Project (CEPP) is one, are intended to achieve a more ecologically suitable pattern of freshwater inflow to these systems.

This report evaluates the Regional Simulation Model Basins (RSMBN) predictions of freshwater flows to these two estuaries from the northern component of the CEPP, also known as the A-2 Flow Equalization Basin (ALTS). These simulations assume the current Lake Okeechobee Regulation Schedule (2008LORS) is in effect. To assess the effects of the CEPP, output from three modeling scenarios is contrasted. The Existing Condition Baseline (ECB) represents the present configuration and operation of the water management system. The Future Without Project (FWO) scenario simulates a future configuration of the water management system without the CEPP but with a number of other projects that should benefit the overall system. From an estuarine perspective it is important to note that the FWO scenario includes two CERP projects that restore freshwater inflows to the two estuaries: the Indian River Lagoon – South affecting the SLE and the C-43 West Basin Storage Reservoir affecting the CRE. Lastly, the ALTS scenario is essentially the FWO with the addition of selected CEPP components. The evaluation of these three scenarios is based on an assessment of a number of hydrologic and salinity performance measures as well as an analysis of the simulated performance of selected estuarine resources including seagrasses and oysters.

E.3.3 Performance Measures and Evaluation Approach

The model output for each scenario consists of a 41-year time series (1965–2005) of daily freshwater inflows to each estuary. For the CRE, flows at the Franklin Lock and Dam (S-79) at the head of the estuary were provided. These flows integrate the effects of discharges from Lake Okeechobee (S-77) and the Caloosahatchee River (C-43) basin. For the SLE, model output is a time series of total freshwater inflow. This includes flows at the S-80 structure, which integrates the discharge from Lake Okeechobee (S-308), and the C-44 basin as well as an estimate of inflows from other basins in the watershed.
The Restoration Coordination and Verification Program's (RECOVER's) Northern Estuaries Module Team developed a number of hydrologic and salinity performance measures located at the following web link: http://www.evergladesplan.org/pm/recover/perf_ne.aspx.

Hydrologic Performance Measures

Hydrologic performance measures for the CRE and SLE are based on the frequency distributions of mean monthly (CRE) or mean 14-day freshwater (SLE) inflows in the 41-year period model output. The number of mean monthly or 14-day flows in discrete flow ranges is evaluated. Each range has a finite range of values associated with it. Range categories are defined by the ecological effects that they produce, and represent a gradient of benign to harmful impacts on the estuaries. Simulated alternative conditions with a lower frequency of flows in harmful ranges are considered to cause less damage to estuarine flora and fauna and are considered the better alternative.

E.3.4 Evaluation

Caloosahatchee River Estuary

The CRE is evaluated based upon the number of mean monthly flows that fell into specified flow classes during the 492 month, 41-year period of record for each simulation scenario (**Table E.3-1**). Flows less than 450 cubic feet per second (cfs) are considered harmful since these flow levels allow salt water to intrude, raising salinity above the tolerance limits for communities of submerged aquatic plants (tape grass [*Vallisneria americana*]), in the upper estuary. Flows greater than 2,800 cfs cause mortality of marine seagrasses (shoal grass [*Halodule wrightii*]) and the Eastern oyster (*Crassostrea virginica*) in the lower estuary and at flows greater than 4,500 cfs, seagrasses begin to decline in San Carlos Bay (**Figure E.3-1**). RECOVER's review of the CEPP is focused on freshwater discharges from the C-43 canal at the S-79 structure. A CERP goal is to reestablish a salinity range most favorable to juvenile marine fish, shellfish, oysters and submerged aquatic vegetation (SAV) by reducing high volume and minimum discharge events to the estuary.

The CERP system-wide performance measure for Northern Estuaries salinity envelopes targets a mean monthly inflow for the CRE between 450 and 2,800 cfs during all months (RECOVER 2007). For analysis, high flow events were combined into one flow category (greater than 2,800 cfs). A reduction in the number of high flow (damaging) events represents improvement over the base conditions. A reduction in the number of times the flow goes below 450 cfs, which causes salinity in the upper estuary to get too high also represents improvement.

Table E.3-1. Mean monthly flow classes for the CRE and the anticipated ecological effects.

Mean Monthly Inflow at S-79	Ecological Response	Ranking Criteria
< 450 cfs	Damage to upper estuary tape grass	Fewer is better
450–2800 cfs	Tolerable range	More is Better
2800—4500 cfs	Damage to estuary	Fewer is Better
> 4500 cfs	Damage to estuary and bay	Fewer is Better

The distribution of mean monthly flows for the three scenarios is given in **Table E.3-2**. Analysis of the data yielded a statistically significant chi-square (X^2=137.6, df=4, p<0.001). Additional comparisons indicated that ALTS and FWO were statistically different from ECB (X^2 > 80, df = 2, p < 0.001 in both cases), while FWO and ALTS were similar (X^2=1.35, df=2, p=0.509).

Table E.3-2. Distribution of S-79 mean monthly flows over a simulated 41-year period of record.

Distribution of Mean Monthly Flows at S-79			
Mean Monthly Inflow at S-79	CEPP Scenario		
	ECB	FWO	ALTS
< 450 cfs	116	27	26
450–2800 cfs	282	384	398
> 2,800 cfs	94	81	68

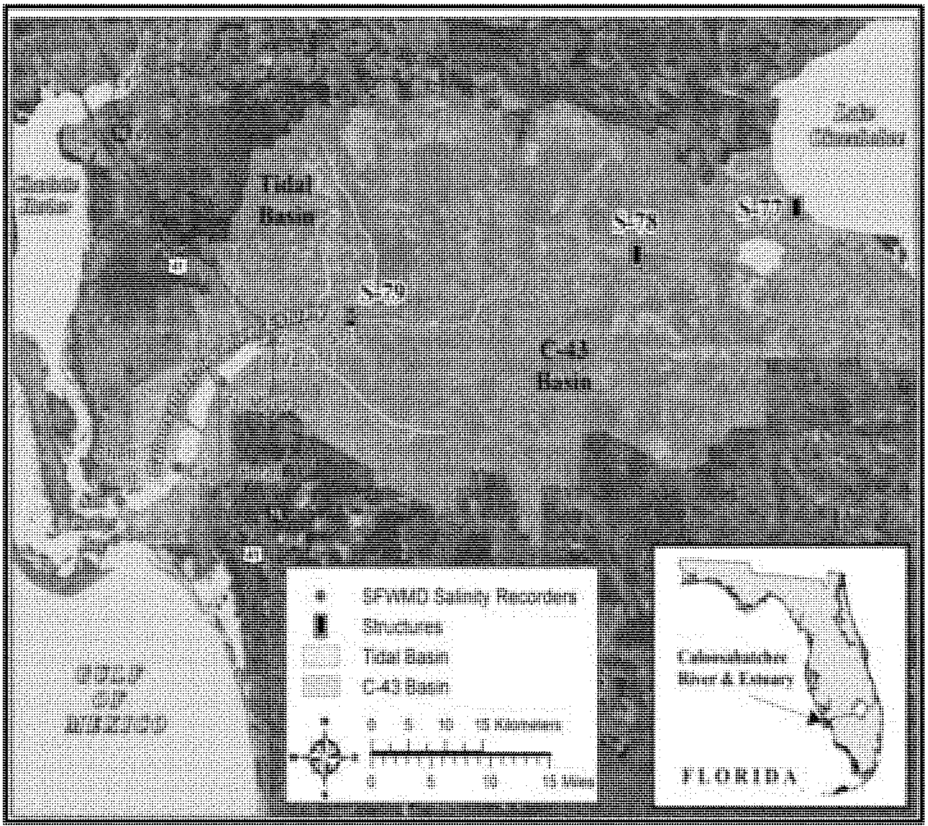

Figure E.3-1. Caloosahatchee River Estuary. (Note: SFWMD – South Florida Water Management District.)

Inspection of the data reveals that differences between the ECB and the other two scenarios may be explained by a reduction in the frequency of low flow violation events. Because the C-43 West Basin Reservoir provides base flows to the CRE during the dry season, its inclusion in the FWO and ALTS conditions accounts for the observed reduction or system improvements. Despite lack of a statistical difference, it should be noted that when compared to the FWO, the ALTS condition has 13 fewer high flow months.

St. Lucie Estuary

RECOVER's review of the CEPP focused on total freshwater inflow. This includes flows at the S-80 structure, which integrates the discharge from Lake Okeechobee (S-308), and the C-44 basin as well as an estimate of inflows from other basins in the watershed. The general goal of the CERP is to maintain a salinity range favorable to fish, oysters and SAV, which necessarily requires addressing high volume, long duration discharge events from Lake Okeechobee, the C-23, and C-24 watersheds. A specific goal is to restore oyster populations in the area between the Roosevelt (US-1) and A1A bridges (**Figure E.3-2**).

The CERP system-wide performance measure for Northern Estuaries salinity envelopes proposes a full restoration target of a mean monthly inflow into the SLE from all sources including groundwater and all surface water tributaries below 350 cfs for 31 months in a 36-year period, no more than 28 high flow events greater than 2,000 cfs based on a 14-day moving average and no regulatory discharge events of flows greater than 2,000 cfs from Lake Okeechobee based on a 14-day moving average (RECOVER 2007). For simplicity, we have evaluated frequencies of mean 15-day freshwater inflows by dividing each month in the 41-year period of record into two periods. Based on the salinity tolerances of oysters, flows less than about 350 cfs result in higher salinities at which oysters are susceptible to increased predation and disease. Flows in the 350–2,000 cfs range produce tolerable salinities. Flows greater than 2,000 cfs result in low, intolerable salinity within the estuary. Seagrasses in the Indian River Lagoon are damaged when flows exceed 3,000 cfs (**Table E.3-3**). For analysis, the two highest flow classes were combined into one category (greater than 2,000 cfs).

Table E.3-3. Mean 15-day flow classes for the SLE and their expected ecological effects.
(Total combined flows for S-80, C-44, C-23 and C-24.)

Mean Monthly Total Inflow	Ecological Response	Ranking Criteria
< 350 cfs	Salinity too high for optimal oyster health	Fewer is Better
350–2,000 cfs	Tolerable range	More is Better
2,000–3,000 cfs	Damage to estuary	Fewer is Better
> 3,000 cfs	Damage to SLE and Indian River Lagoon	Fewer is Better

Table E.3-3 indicates the flow classes used to evaluate CERP effects on the SLE. The distribution of mean 15-day flows for the three scenarios is given in **Table E.3-4**. Analysis of these flows yielded a statistically significant difference between scenarios (chi-square value $X^2=29.7$, df=4, p<0.001). Additional comparisons revealed that ALTS was significantly different from both ECB and FWO ($X^2>18$, df=2, p<0.001 in both cases). Inspection of the data suggests that these differences are due to a greater number of low flow periods (< 350 cfs), trending away from restoration, and a lower number of high flow periods (> 2,000 cfs), trending toward restoration. No statistical difference between ECB and FWO was detected ($X^2=1.05$, df=2, p=0.591).

Table E.3-4. Distribution of 15-day flows over the 41-year simulated period of record.

Distribution of 15-day Combined Structure Flows			
CEPP Scenario:	**ECB**	**FWO**	**ALTS**
< 350 cfs	307	314	403
350–2,000 cfs	503	513	460
> 2,000 cfs	174	157	121

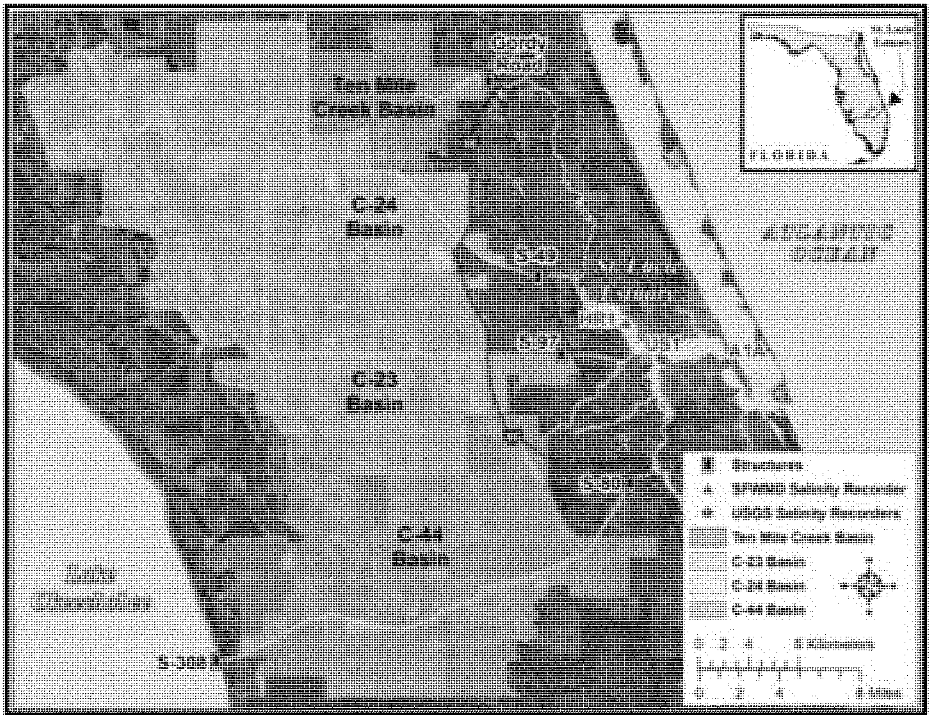

Figure E.3-2. St. Lucie River Estuary.
(Note: SFWMD – South Florida Water Management District; USGS – United States Geological Survey.)

Salinity Performance Measures

The RSMBN model used to simulate the three scenarios evaluated here does not estimate salinity in either the SLE or CRE. Multivariate time series salinity models developed for the estuaries were applied for this analysis. The models consist of an autoregressive term representing the system persistence and an exogenous term accounting for driving factors including freshwater inflow, rainfall, and water surface elevation that cause salinity to vary as observed in the field (Wan 2012, Qiu and Wan in review). The models predict, and are calibrated against, daily salinities (r^2 = 0.89–0.95 between measured and simulated salinity data for model calibration). A total of 18 simulations were conducted to estimate daily average salinity during the 41-year period of record at given locations. The selected locations include I-75, Fort Myers, Cape Coral, Shell Point in the CRE, US-1 in the SLE, and Boy Scout Island in the Indian River Lagoon. The simulated salinity data were used for evaluation of salinity and ecological conditions.

Caloosahatchee Estuary

The CERP system-wide performance measure for Northern Estuaries salinity envelopes does not specify a salinity envelope at a particular location in the CRE (RECOVER 2007). Rather, the document refers to generalized beneficial salinity conditions and ranges. Tape grass, which is found in the upper estuary, requires low salinities less than 10 practical salinity units (psu). Seagrasses at the mouth of the CRE need high salinities greater than 20 psu. For the area around Shell Point and San Carlos Bay, a flow of 500–2,000 cfs results in salinities of 16–28 psu at all stations, conditions that are favorable to sustain and enhance CRE oyster populations. A time series of daily average salinity was evaluated at three locations in the CRE: Fort Myers, the Cape Coral Bridge and Shell Point. The three scenarios were compared by evaluating the number of days in particular salinity ranges. At Shell Point and Cape Coral, the salinity classes implied by the RECOVER salinity performance measure, 0–15.99 psu, 16–28 psu, and greater than 28 psu, were used (**Table E.3-5**). The Cape Coral Bridge is thought to be near the upstream limit of persistent oyster populations. Scenarios with a greater number of days within the salinity envelope (16–28 psu) were considered more beneficial and less harmful to estuarine flora and fauna.

Table E.3-5. Salinity envelopes used to evaluate the CEPP and their expected ecological effects.

Salinity Range (psu)	Ecological Response	Ranking Criteria
	Fort Myers	
0 – 9.99	Tolerable for Tape grass	More is Better
10 – 14.99	Tape grass ceases to grow	Fewer is Better
≥15	Tape grass mortality	Fewer is Better
	Shell Point	
0 – 16	Stress and mortality	Fewer is Better
16-28	Optimal range for Oysters	More is Better
>28	Increased oyster predation/disease	Fewer is Better

At Fort Myers, a salinity envelope based on the salinity tolerances of tape grass was employed to evaluate the three scenarios (**Table E.3-6**). The 10-psu salinity value referenced in the RECOVER performance measure represents the generally accepted upper limit for a sustainable population (French and Moore 2003). Laboratory experiments summarized by Doering et al. (2002) indicated that growth of tape grass ceases at salinities between 10 and 15 psu. At salinities greater than 15 psu, mortality ensues.

Table E.3-6. Distribution of daily average salinity at Fort Myers.

CEPP Scenario	Distribution of Daily Average Salinity		
	ECB	FWO	ALTS
0 - 9.99 psu	10,545	10,575	10,312
10 - 14.99 psu	2,192	4,038	4,249
≥ 15 psu	2,238	362	414

At Fort Myers, statistical differences between the three scenarios were detected (**Table E.3-6**; X^2=3010, df=4, p<0.001). Pairwise comparisons indicated that the ECB was significantly different from both the FWO and ALTS (X^2>1900, df=2, p<0.001 in both cases). Inspection of the data indicates that much of this difference is due to a greater number of days at salinities between 10 and 15 psu and fewer days at greater than or equal to 15 psu. The C-43 West Basin Reservoir CERP project is a feature of both the FWO and ALTS. Discharges from the reservoir during the dry season may account for the reduction of high salinity (greater than or equal to 15 psu) days. These results indicate that under the FWO and ALTS, areas upstream of Fort Myers would experience salinities more conducive to the growth of tape grass.

The distribution of salinity under the ALTS was also significantly different from the FWO (X^2=112.4, df=2, p<0.001). Inspection of the data indicate that much of this difference is due to a reduction in the number of days at salinities between 0 and 9.99 psu and increases in the number of days at higher salinities greater than 10 psu. While statistically significant, these relatively small differences are unlikely to have a significant ecological effect on the upper CRE.

At the Cape Coral Bridge and Shell Point (**Table E.3-7 and Table E.3-8**), statistical differences between the three scenarios were also detected (X^2=812.2 for Cape Coral, X^2=333.5 for Shell Point, df=4, p<0.001). At both sites pairwise comparisons of the different scenarios revealed that all were statistically different from each other (X^2>37, df=1, p<0.001 in all cases). The ALTS had the greatest number of days within the 16–28 psu envelope, the FWO had an intermediate number, and the ECB had the least. By contrast, the order with respect to the number of days below 16 psu was ALTS < FWO < ECB. These patterns in salinity reflect the pattern in reduction of high flow months in the hydrologic performance measure.

Table E.3-7. Distribution of daily average salinity at the Cape Coral Bridge.

CEPP Scenario	Distribution of Daily Average Salinity		
	ECB	FWO	ALTS
< 16 psu	8596	8461	8025
16–28 psu	5640	6404	6772
> 28 psu	733	110	178

Table E.3-8. Distribution of daily average salinity at Shell Point.

CEPP Scenario	Distribution of Daily Average Salinity		
	ECB	FWO	ALTS
< 16 psu	2,490	2,104	1,728
16–28 psu	8,569	9,717	9,870
> 28 psu	3,916	3,155	3,377

St Lucie Estuary

The CERP system-wide performance measure Northern Estuaries salinity envelope target at the Roosevelt (US-1) Bridge (12–20 psu) was used in the analysis of daily average salinity for the SLE. The goal for the CERP is to reestablish a salinity range most favorable to marine fish, shellfish, oysters, and SAV. This is estimated to be 12–20 psu at the Roosevelt (US-1) Bridge. The number of days above, within, and below this envelope over the entire period of record provided a useful metric to compare the three scenarios (**Table E.3-9**).

Table E.3-9. Salinity envelope at the Roosevelt (US-1) Bridge used to evaluate the CEPP and the expected ecological effects.

Salinity Range	Ecological Response	Ranking Criteria
0–11.99 psu	Stress and mortality	Fewer is Better
12–20 psu	Optimal range for Oysters	More is Better
> 20 psu	Increased predation/disease	Fewer is Better

The distribution of salinity at the Roosevelt Bridge differed among the three alternatives (**Table E.3-10**; X^2=486.4, df=4, p<0.001). Pairwise comparisons indicated that while the ECB and FWO had similar distributions (X^2=3.63, df=1, p=0.163), the ALTS differed from both the ECB and FWO (X^2>300.0, df=1, p<0.001 in both cases). The ALTS had fewer days at less than 12 psu and a higher number of days both within and above the 12–20 psu envelope. This pattern of generally higher salinity may reflect the fact that the ALTS had the fewest number of high discharge periods for the hydrologic performance measure and a higher number of low flow violations.

Table E.3-10. Distribution of daily average salinity at the Roosevelt (US-1) Bridge.

CEPP Scenario	Distribution of Daily Average Salinity		
	ECB	FWO	ALTS
< 12 psu	7,638	7,463	6,032
12–20 psu	4,824	4,832	5,404
> 20psu	2,513	2,608	3,539

Ecological Performance

A series of ecological simulations were conducted to evaluate the relative differences among the three inflow scenarios—ECB, FWO, and ALTS—on oyster and seagrass densities in the CRE and SLE. Two separate base simulation models were used to assess the potential effects of salinities derived from the three inflow scenarios on oysters located at Cape Coral and Shell Point in the CRE (**Table E.3-11**) (**Figure E.3-1**). Additionally, a model of shoal grass was implemented to compare predicted salinities at Shell Point. For the SLE, the effects of predicted salinities among the three inflow scenarios were evaluated using oyster density at the Roosevelt US-1 Bridge and the density of manatee grass (*Syringodium filiforme*) at Boy Scout Island in the southern Indian River Lagoon located a few miles north of St. Lucie Inlet (**Table E.3-12**)(**Figure E.3-2**).

Table E.3-11. Summary of locations and simulation models for evaluation of Northern Estuaries potential responses to CEPP inflow scenarios.

Estuary	Location	Model
CRE	Cape Coral	Oyster
	Shell Point	Oyster
	Shell Point	Shoal grass
SLE	Roosevelt (US-1) Bridge	Oyster
	Boy Scout Island	Manatee grass

The oyster simulation models for both estuaries were simplified versions of a framework derived to evaluate potential effects of increased area of oyster habitat on SLE water quality (Buzzelli et al. 2012a). This model uses an idealized oyster-salinity relationship, variable temperature, and a constant suspended solid concentration to predict oyster density. Similarly, the shoal and manatee grass simulations for both estuaries were simplified models derived to quantify effects of variable freshwater discharge and salinity on seagrass shoot density at Boy Scout Island (Buzzelli et al. 2012b). Water column chlorophyll *a* and turbidity were assumed constant although depth and the amount of colored dissolved organic matter (CDOM) and, therefore, submarine light varied dynamically throughout the 41-year simulations.

A total of 15 simulation models representing three salinity scenarios—ECB, FWO, and ALTS—and five location-biotic combinations (three oyster and two seagrass) were derived to evaluate CEPP Northern Everglades inflow alternatives. Each simulation covered 14,965 predictions of daily salinity at each location (41 year). Results were expressed as the predicted number of oysters or seagrass shoots in an acre of homogeneous habitat. The relative differences among the three salinity scenarios were visualized by comparing monthly averages with 41 individual values combined for each month of the calendar year. Additionally, the difference between the ECB and both the FWO and ALTS s were expressed as a percent difference over all 14,965 days.

Greatest oyster density (approximately 526,000 oysters per acre) was predicted in May at both the Cape Coral and Shell Point locations in the CRE. While more oysters were estimated under the ALTS relative to the FWO and ECB at Cape Coral, values were similar for the ALTS and FWO at the more downstream and saline Shell Point location (**Figures E.3-3A** and **E.3-3B**). Compared to ECB, the ALTS scenario could account for a 7.1 percent increase in oyster density at Cape Coral compared to only 4.4 percent more at Shell Point (**Table E.3-12**). The predicted seasonal pattern for oysters was similar at Roosevelt (US-1)

Bridge in the SLE although densities were much lower than in the CRE (approximately 121,400 oysters per acre). There were more oysters predicted under the ALTS relative to the FWO and ECB in the SLE (**Figure E.3-3C**) with 14.4 percent more oysters (**Table E.3-12**).

The maximum number of seagrass shoots occurred in August and September in both estuaries with approximately 202,300 shoots per acre of shoal grass at Shell Point in the CRE and approximately 242,800 shoots per acre of manatee grass at Boy Scout Island near the Saint Lucie Inlet (**Figures E.3-3D** and **E.3-3E**). Overall shoot densities predicted under the ALTS were greater than for either the FWO or ECB. Compared to ECB, increases of 15.3 and 20.1 percent more seagrass shoots were predicted with salinities representative of the ALTS in the CRE and SLE, respectively (**Table E.3-12**).

Table E.3-12. Results from estuarine ecological model scenarios related to the CEPP.

Oysters per Acre	**ECB**	**FWO**	**ALTS**
Shell Point (CRE)	3,893,214	4,047,000 (+4.0%)	4,063,188 (+4.4%)
Cape Coral	2,671,020	2,715,537 (+1.7%)	2,861,229 (+7.1%)
US 1	574,674	594,909 (+3.5%)	655,614 (+14.4%)
Shoots per Acre	**ECB**	**FWO**	**ALTS**
Shell Point (shoal grass)	1,084,596	1,165,536 (+7.5%)	1,250,523 (+15.3%)
Boy Scout Island (manatee grass)	1,873,761	2,128,722 (+13.6%)	2,250,132 (+20.1%)

Note: Values are the total number of oysters (top half) or seagrass shoots (bottom half) in an acre of estuary habitat over all 14,975 days. Numbers in (parentheses) represent percent difference from the ECB.

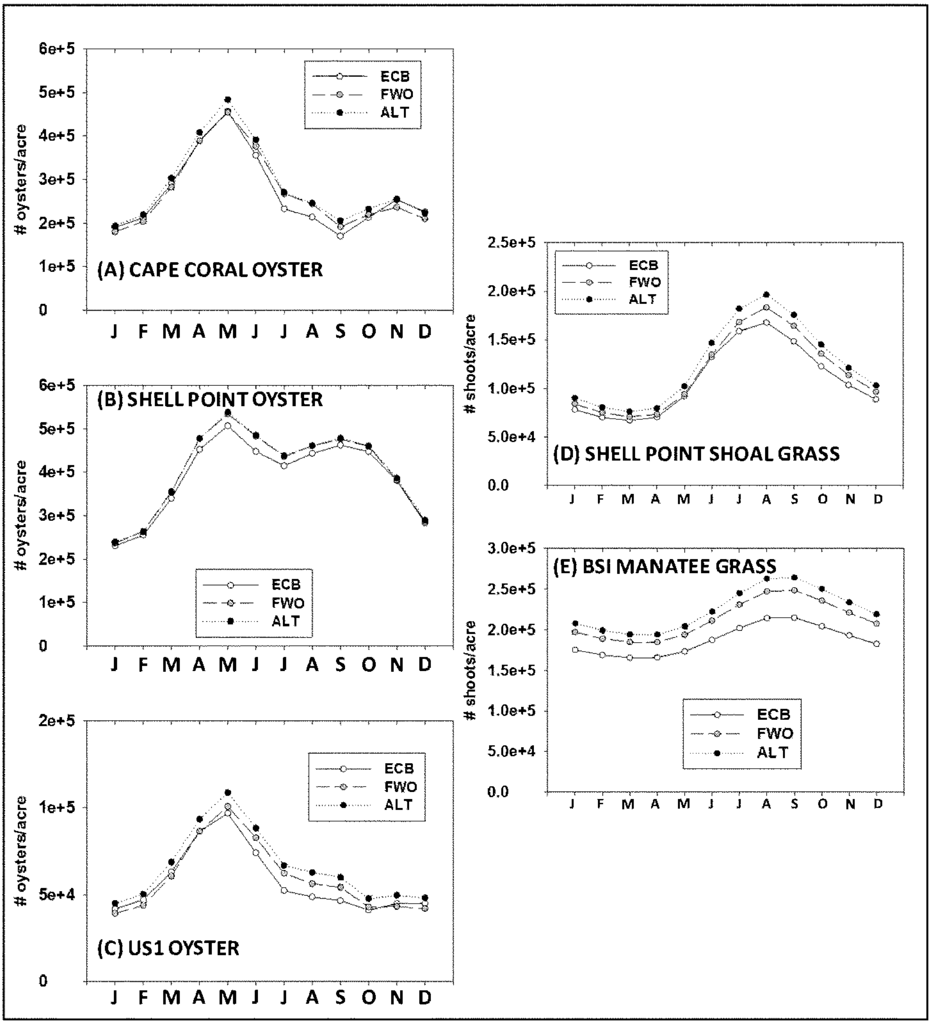

Figure E.3-3. Predicted average monthly numbers of oysters (A-C) and seagrass shoots (D-E) per acre of habitat.

E.3.5 Summary

Modeling of the hydrology, salinity, and associated ecology of the SLE and CRE showed a small reduction in freshwater discharges from Lake Okeechobee to the estuaries. Although the difference was not statistically significant, the change is "in the right direction" for reducing peak flow events. Ecological projections for oysters and seagrasses, key species in the estuaries, indicated improvements with CEPP projected implementation. Modeling indicated less fresh water entering the SLE during low flow times, when small amounts of fresh water are needed. CEPP operations and future increments of the CEPP should remain aware of the need for small amounts of base flow into the estuaries during dryer times. Future operations of the Indian River Lagoon – South project can be optimized to help provide these base flows.

E.3.6 References

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E.4 Greater Everglades Regional Report

RECOVER System-wide Regional Evaluation

Central Everglades Planning Project

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E.4.1 Introduction

An independent, ecological evaluation of the final array of Central Everglades Planning Project (CEPP) alternative plans was held January 18, 2013. The workshop was conducted by RECOVER Greater Everglades (GE) regional coordinators and included principal investigators (PIs) and staff. The purpose was to provide feedback to the CEPP project delivery team on the ecological performance both positive and negative of each of the final four CEPP alternative plans compared to the Future Without Project Condition (FWO) and to document the workshop findings.

Generally, RECOVER provides this independent scientific review by doing the following:

- Documenting the performance of the project alternatives using:
  - RECOVER approved system-wide performance measures,
  - Project hydrologic model output
  - Ecological planning tools, and
  - Best professional judgment
- Describing the ability of each alternative to meet the performance measure targets
- Describing the expected effects on the natural system

The predicted hydrologic performance of each of the RECOVER performance measures was used by the CEPP PDT to calculate habitat units, then were used in the cost-effectiveness / incremental cost analysis (See Appendix E and H). Therefore, the GE RECOVER evaluation workshop documented in **Section E.4.3** focused on maps depicting hydrologic model output (e.g., flow vector maps, hydroperiod class maps, ponding depths, and stage), results of ecological planning tools and best professional judgment. Due to the nature of the hydrologic model output (RSMGL, Appendix A), most individuals analyzed four of the "years" out of the period of record (1965-2005), which have been characterized as being climatically wet (1995), dry (1989) and normal (1978). The fourth "year" was a composite of the results from the entire 41-year period of record.

E.4.2 Performance Measures for Greater Everglades

While not used comprehensively during the ecological workshop, performance measure results were available to workshop participants and so are listed here. The five RECOVER performance measures for the greater Everglades region used in the CEPP plan formulation and evaluation process are:

1. Inundation Duration in the Ridge and Slough Landscape – the percent period of record of inundation
2. Sheetflow in the Ridge and Slough Landscape – includes the timing, continuity and distribution of sheetflow
3. Hydrologic Surrogate for Soil Oxidation – a drought intensity index
4. Dry Events in Shark River Slough – measures the number and duration of dry events in Shark Slough
5. Slough Vegetation Suitability – measures hydroperiod, dry downs and both wet and dry season depths
6. Prey Base Fish Performance Measure – DeAngelis, Donalson, and Trexler (DDT) model measures prey-fish density using logistic growth equations based on days since last drydown.

Detailed documentation of results for performance measures 1-5 can be found in Appendix H of the CEPP Project Implementation Report (PIR). Performance measure 6 documentation and results are presented below.

Prey Base Fish Performance Measure Results

The DDT model uses days since last dry down (DSDD) to approximate densities of small (up to ~8cm) prey base fish. The equation used is fitted to data taken from 1996-2006 (RECOVER, 2011). The sampling points are shown in **Figure E.4-1**. Equation 1 shows the basic equation with three parameters, r, K, and Y0. These parameters vary between different areas of the Greater Everglades. **Table E.4-1** shows the parameter estimates for each of the three regions, WCA 3, Shark River Slough, and Taylor slough. **Figure E.4-2, Figure E.4-3,** and **Figure E.4-4** show the recovery curves for each of the regions. It is important to note the difference in return times for each region. In WCA 3, the time to full recovery is ~ three months, for Shark River Slough it is closer to 2.25 years, and even longer for Taylor Slough. It is hypothesized that the differences are related to relative isolation of the different areas and therefore the relative contribution of immigration/emigration vs. local growth to the recovery. This mechanism will be explicitly included in the next version of this model. It is important to remember the differences in these response curves because, for example, a 20% increase in fish density between two alternatives in WCA 3, is much easier to achieve than say a 10% increase in Shark River Slough. Full documentation of this Performance Measure can be found in Donalson et. al. 2010.

Equation 1:

$$\mathrm{LOG(TOTFISH+1)} = \frac{K}{\left(1+\left(\frac{K-Y0}{Y0}\right)e^{\left(-r * DSLDD\right)}\right)}$$

DSLDD = days since last dry down
r = growth constant
TOTFISH = total small-sized fish density (number of individuals) per m^2
K=asymptotic density
Y0=Y intercept

Table E.4-1. Trexler small-sized fish density logistic regression equation parameters per monitoring region

Monitoring region	**WCA-3A/B**	**Shark Slough**	**Taylor Slough**
K	2.901	2.757	2.625
r	0.097	0.006	0.003
Y0	0.300	1.486	1.08

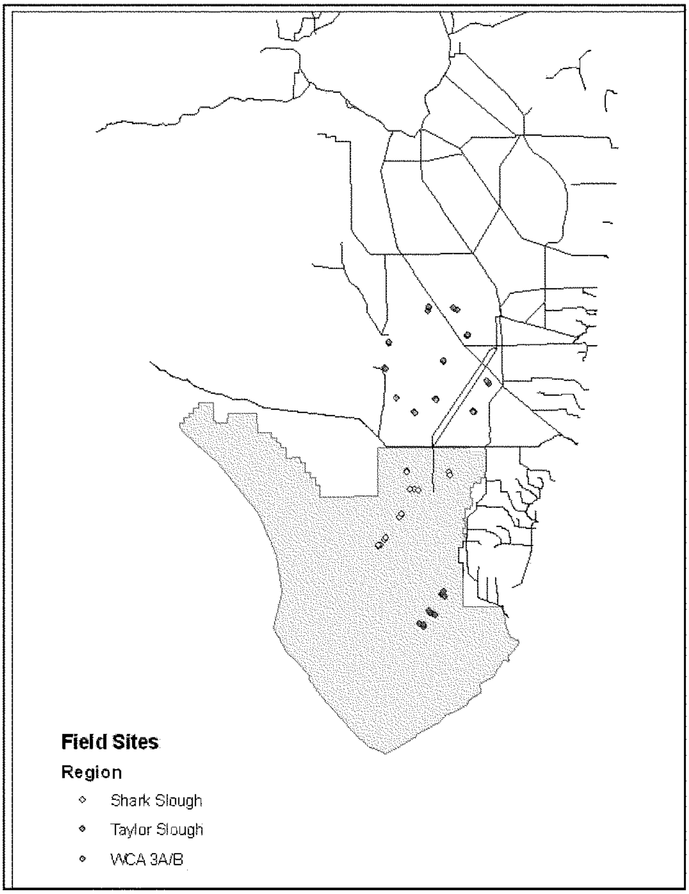

Figure E.4-1. Trexler's sampling sites within the Greater Everglades region. Canals and highlighted Everglades Nation Park boundary are included for reference purposes.

Figure E.4-2, Figure E.4-3, and **Figure E.4-4** show the best logistic model fits for predicting small-sized fish density/m^2 recovery of fish density since the last dry down event based on Equation 1.

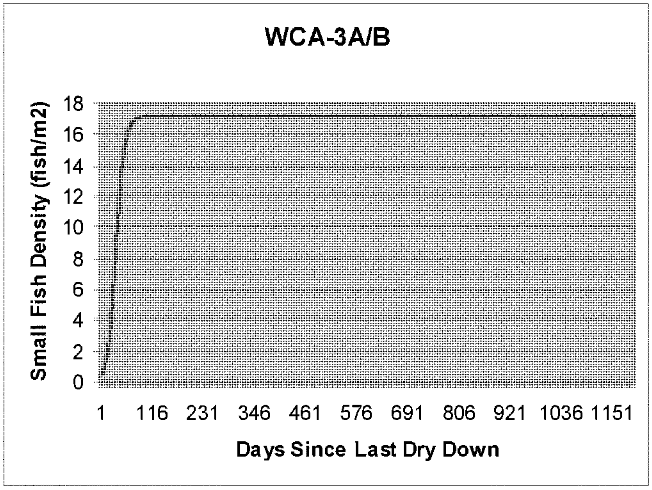

Figure E.4-2. Model fit for total small-sized fish density since last dry down event collected in WCA 3A/3B based on the Trexler (1996-2006) data

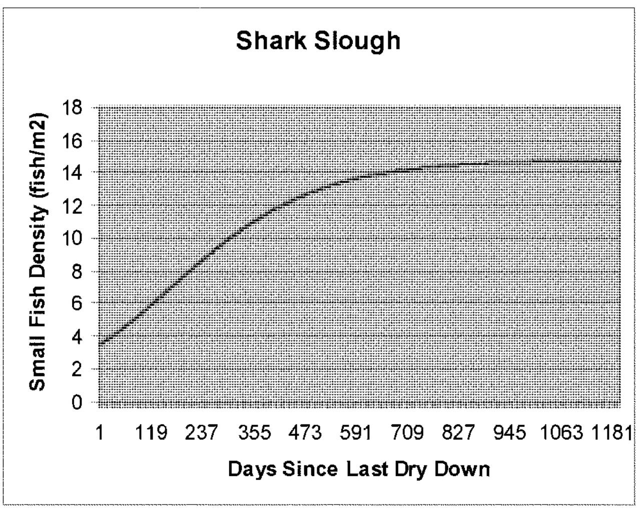

Figure E.4-3. Model fit for total small-sized fish density since last dry down event collected in Shark Slough based on the Trexler (1996-2006) data

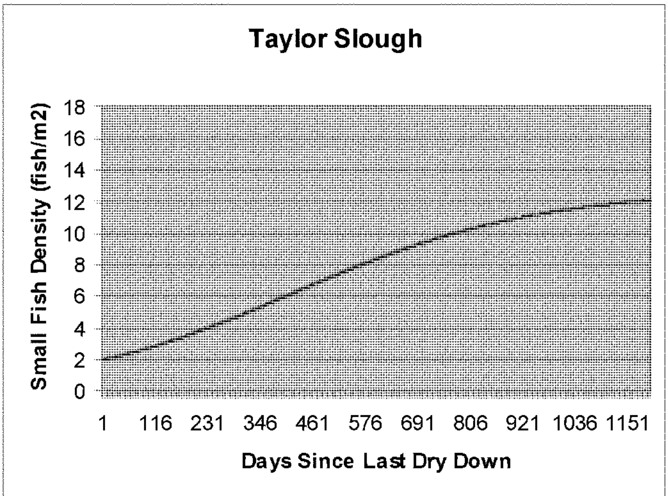

Figure E.4-4. Model fit for total small-sized fish density since last dry down event collected in Taylor Slough based on the Trexler (1996-2006) data.

WCA 3

In WCA 3A, the three northern most sites show the greatest lift with respect to FWO (see **Figure E.4-5**). The greatest increase is seen in site 10 which is to the east of Miami Canal. The increase of ~30% occurs in all four alternatives. In site 9, west of the Miami Canal the lift is closer to 17%, which although less, is still a significant increase from FWO. Site 11 shows a 7%-10% increase. Given that it is south of sites 9 and 10, and the fact that all the other sites, including site 6 which is at about the same latitude, have very little change with respect to FWO; it is not unreasonable to suppose that north of site 11 would see even a greater lift. Catano and Trexler, 2013, *Figures 6-9* indicate that this supposition is reasonable. The southern sites, 1-6, show little change between the alternatives and FWO and sites 1 and 2 show even some very small loss indicating drying. For WCA 3A, the two best performing alternatives would probably be Alts 1 and 4, but all four alternatives improve prey density over FWO. WCA 3B (sites 7 and 8) show some improvement, with Alts 2 and 3 having a lift of slightly over 10%. Here the most lift comes from Alts 2 and 3. Again however, the differences between the alternatives overall is such that any of the four could be chosen.

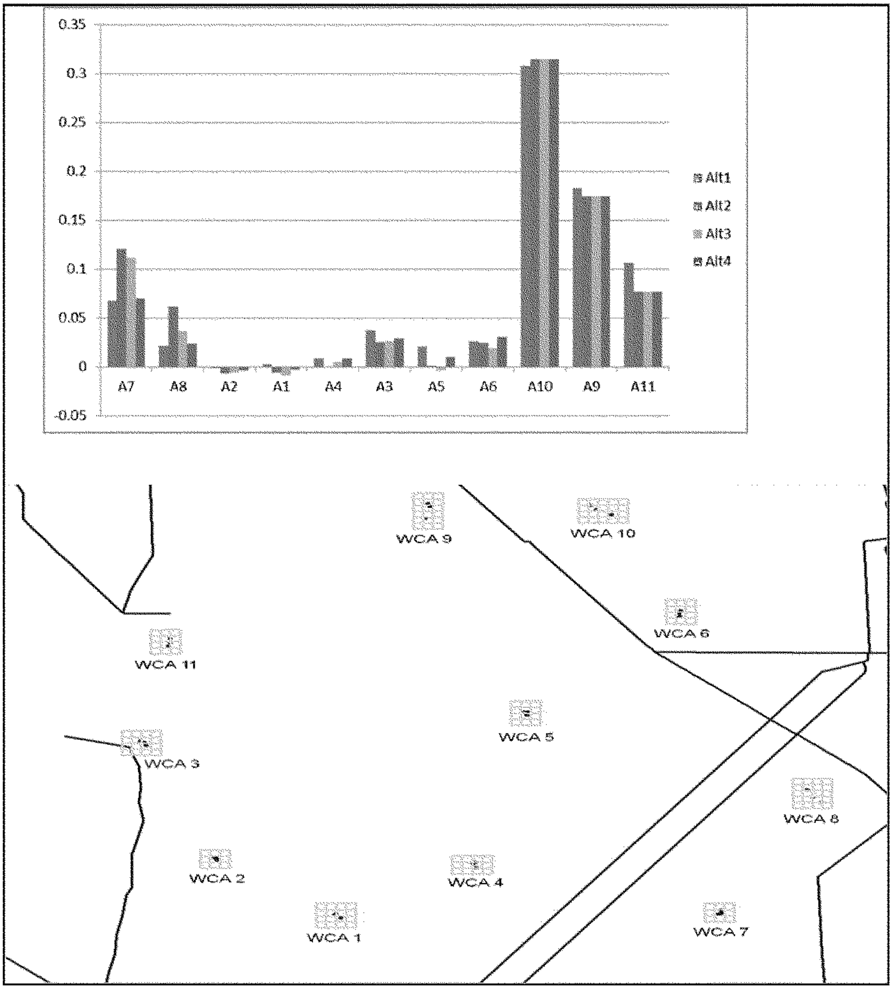

Figure E.4-5. Prey-base Fish Results for WCA 3 with sampling sites. Units of results are differences scaled 0-1. Canals are included in the map for reference purposes.

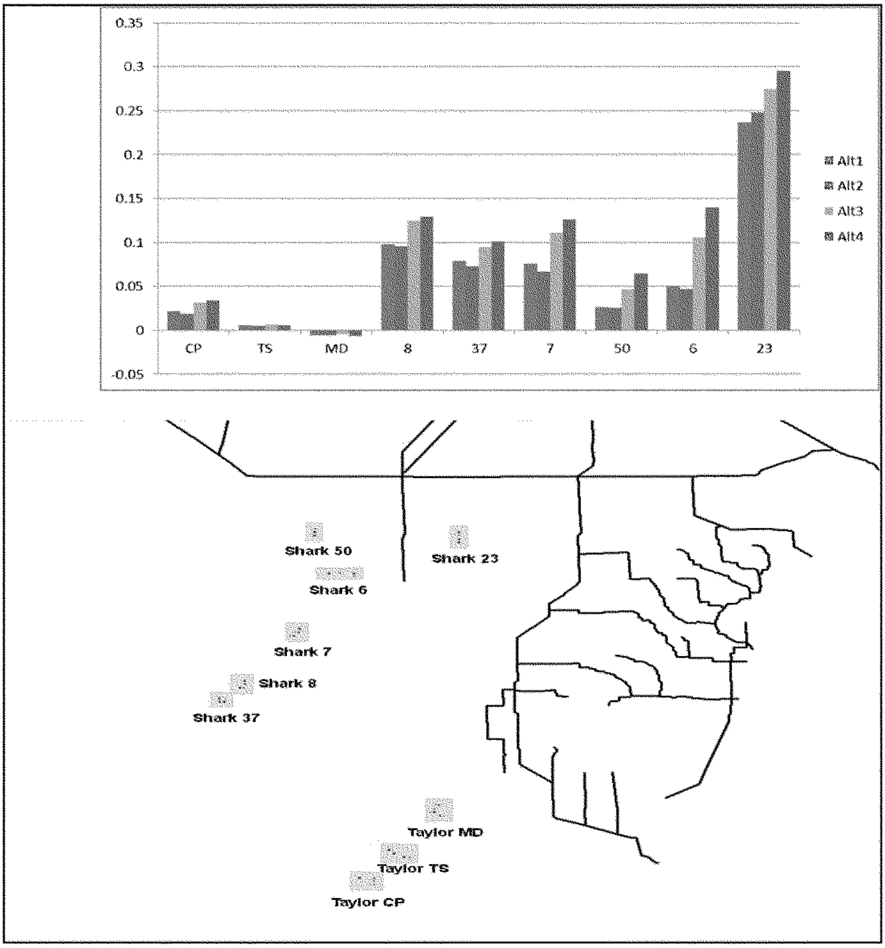

Figure E.4-6. Prey-Base Fish Results for Shark River Slough and Taylor Slough with sampling sites. Units of results are differences scaled 0-1. Canals are included in the map for reference purposes.

Shark River Slough

The Shark River Slough (SRS) results (**Figure E.4-6**) show both interesting and encouraging dynamics. The two sites directly below the Tamiami trail, site 50 on the west side of the L-67 extension, and site 23 on the east, show very different dynamics, as the greater part of the water entering SRS is entering from the east. Site 23 shows a lift of ~24%-29%. As was mentioned in the introduction, because of the much longer recovery curve between WCA 3 and SRS (**Figure E.4-2 and Figure E.4-3**), this is a much more significant change than was seen in, for example WCA 3A site 10. It is interesting to note that site 6 actually has more lift than site 50, even though it is on the same side of the L-67 extension as site 50 and south of it. This would indicate the possibility that the water coming in from the east has enough volume to actually "backflow" up the west side of the L-67 extension. There is little to distinguish between Sites 7, 8, and 37. This in itself is interesting when comparing to WCA 3A, as the benefits don't decrease as the water moves south. This is also support for the Southern Costal Systems benefits in Florida Bay. Overall, Alt 4 provides the greatest benefits for SRS, but all alternatives would provide excellent benefits over FWO.

Taylor Slough

There are only three sites in Taylor Slough, from north to south, MD, TS, and CP. There are no significant changes with respect to FWO for MD and TS. However, the southernmost site, CP, does show some change that is important given the very long recovery curve from dry down (**Figure E.4-4**). One hypothesis, as with SRS site 6, the water is coming as a back flow up Taylor Slough from the increased flow through SRS. There is not discernment between the best alternative based on benefits for Taylor Slough.

E.4.3 Other Information Sources and Evaluation Process

The evaluation process involved three steps:

1. Individual Evaluations – a "wall walk" was undertaken by workshop participants to review hydrologic model output and results of ecological planning tools, which were posted on the walls of the meeting room. Each participant was given a worksheet upon which to annotate their thoughts on the ecological performance of the alternative plans.
2. Group Evaluations – workshop participants then broke into small groups to discuss their views of the alternative plans.
3. Workshop discussion – all participants came back together to hear report outs from the small groups and to collectively discuss the findings.

Consolidated conclusions from the workshop are listed below:

All CEPP alternatives are a significant improvement towards restoring the Everglades system compared to the FWO project condition. Hydrologic output indicated there would be better hydroperiods and more sheetflow in Water Conservation Area (WCA) 3A, WCA 3B, and Everglades National Park with all alternatives. **Figure E.4-7** displays hydroperiod maps during a dry year (1989) for the four project alternatives compared to the FWO. Hydroperiods are much longer in Northern WCA 3, WCA 3B, and ENP for the four alternatives (blue circle), while the FWO is slightly longer in WCA 2 (red circle).

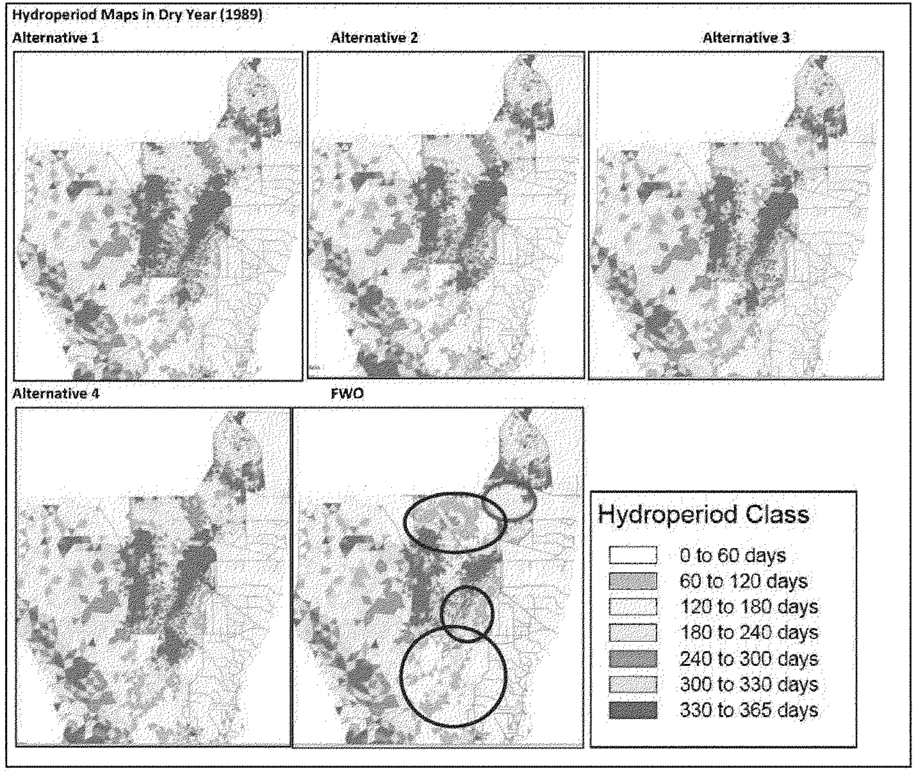

Figure E.4-7. Hydroperiod during a dry year (1989) for the four project alternatives compared to the FWO

Figure E.4-8 displays average annual surface water flow vectors from the 41 yr period of record for each alternative compared to the FWO. The darker the color (dark blue) the stronger the flow (volume and likely velocity) of surface water. Project alternatives show more sheet flow in northern and central WCA 3A and from WCA 3B to ENP, and slightly more flow to the southwest coast (dark blue circles). FWO has more flow through WCA 2 (dark red circle).

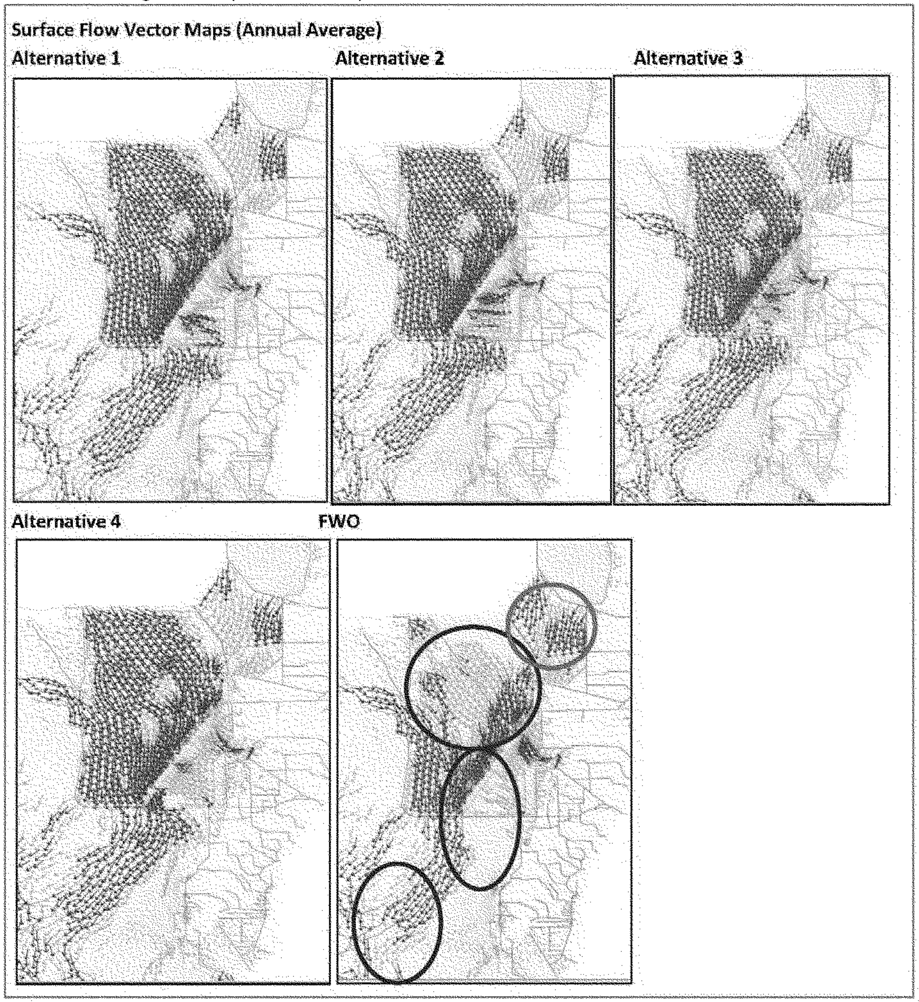

Figure E.4-8. Average Annual Surface Water Flow Vector Maps for each alternative compared to FWO.

Transect Flow Location Diagram and Flow Amount Charts

The RSM model provides model output data over a given transect line. **Figure E.4-9** below displays the placement of each transect line in the RSM grid and the associated transect number. Transect 5 (T5) (**Figure E.4-10**), 6 (T6) (**Figure E.4-11**), and 18(T18) (**Figure E.4-12**), display average flows in thousand acre-feet per year and indicate significant more flow with each alternative compared to the FWO (left). Alternative 1 (second column from left) provides more flow to T5, while alternatives 2-4 provide slightly more water to T6.

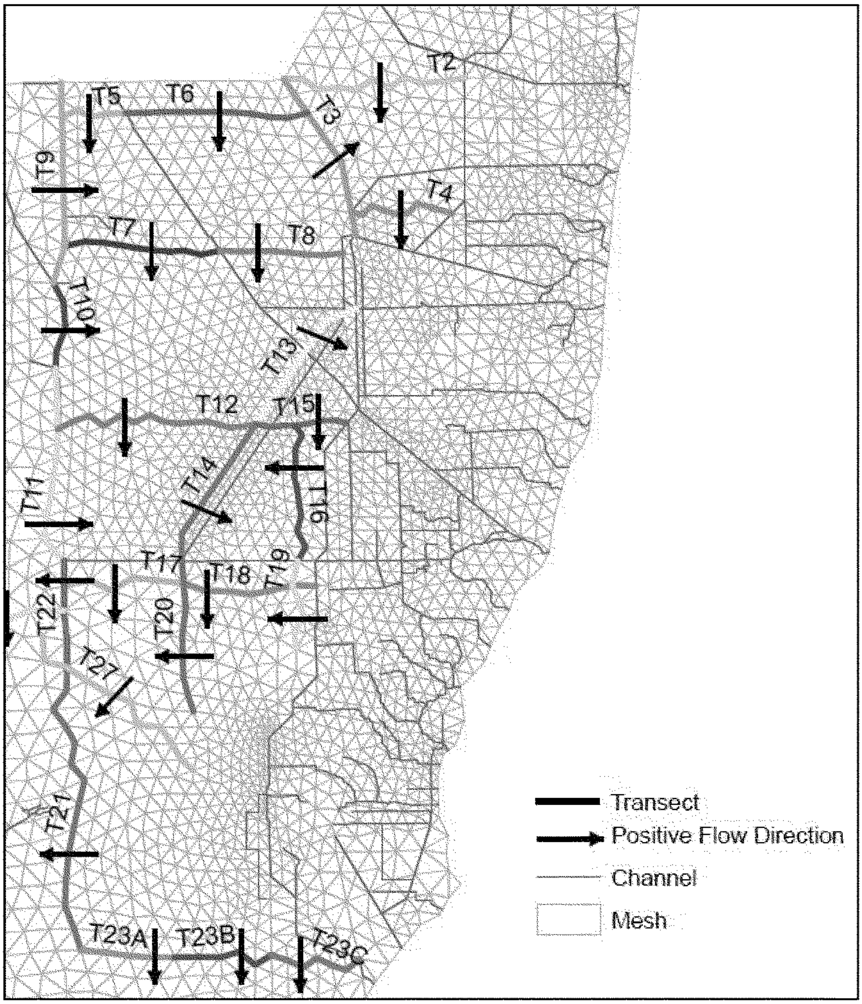

Figure E.4-9. Transect number and location to interpret flows from the RSM model data.

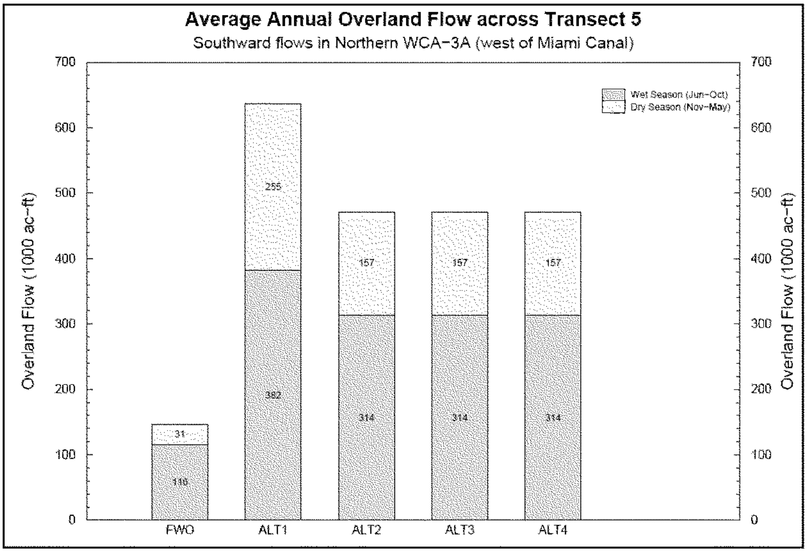

Figure E.4-10. Transect 5 (T5) average annual overland flow.

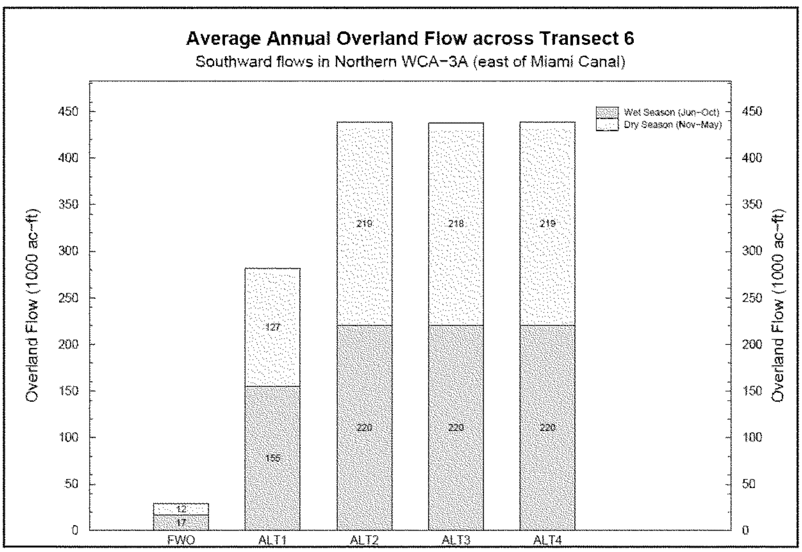

Figure E.4-11. Transect 6 (T6) average annual overland flow.

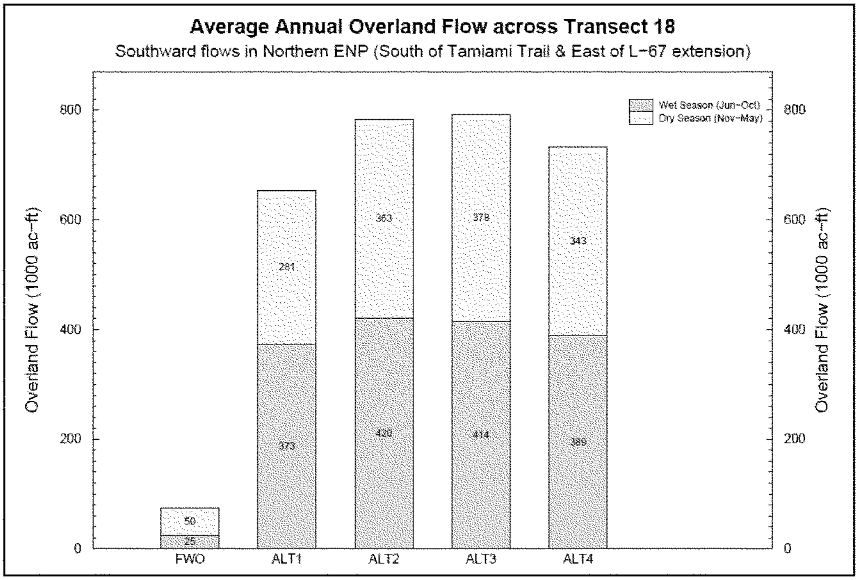

Figure E.4-12. Transect 18 (T18) average annual overland flow.

Northern WCA 3A and Shark River Slough would experience less soil oxidation, promoting peat accretion necessary to rebuild the complex mosaic of habitats across the landscape. While alternative 1 supplies more water to northwest WCA 3A, alternatives 2, 3, 4 provide more water to northwest WCA 3A as well as more water to northeastern WCA 3A, promoting sheetflow to a greater area.

All alternatives showed improved ecological performance for fish, wading birds, and apple snails in the northern and some central areas of WCA 3A, as well as in Shark River Slough, as described in the ecological planning tool summaries below. Alternatives 3 and 4 provide more water to Shark River Slough and the southern Marl Prairies compared to alternatives 1 and 2. It is thought this would improve conditions for fish, wading birds, alligators, tree islands and ridge and slough habitat. Alternative 4 appears to make the most efficient use of the roughly additional 200,000 acre-feet of water added to the system by funneling the "new" water as well as improving the distribution of the existing water through the Blue Shanty flow way. The Blue Shanty levee in alternative 4 could be moved to the east to avoid impacting large tree islands in WCA 3B and better align with the Tamiami Trail Bridge. This could allow for adaptive management opportunities for rehydrating these over-drained tree islands, as inflows into WCA 3B are controllable. While alternative 4 doesn't meet slough vegetation performance in WCA 3B as well as alternative 3, overall it may pose less risk to tree islands east of the levee and lessen the need for seepage management features. Alternative 4 appears to result in widening Shark River Slough and improving wading bird habitat on the flanks of the Eastern Marl Prairies. It also provides more flow to the southern coastal systems (i.e., Florida Bay) during wet years.

Generally, passive structures are favored; concerns were expressed regarding the use of pumps in alternative 3 that would allow the "pull" of water out of the southern end of WCA 3B. While it was acknowledged that alternative 4 removed parts of the L-67C, L-67 extension and L-29 levees, concerns were also expressed regarding adding additional compartmentalization in WCA 3B (i.e., the Blue Shanty levee).

Areas that would need adaptive management of operations to increase the likelihood of achieving more restoration benefits, while avoiding impact to sensitive resources, are:

- Southern WCA 3A along L-29 and L-67A,
- WCA 3B, and
- Marl prairies in Everglades National Park

It is important to focus operations to manage for flow and stage variance, as opposed to focusing on average hydrologic regimes. In other words, every so often the system does need to dry down to promote healthy ridge and slough/tree island formation, and should not always be kept wet in the areas of the system that are more likely to be wetter (southern WCA 3A along L-29 and L-67s). CEPP components chosen for the tentatively selected plan should not preclude the ability to add additional features to the project in the future, as more clean water becomes available.

Ecological planning tools

Documentation of the ecological planning tools presented by individual modelers and principal investigators can be reviewed in Appendix H. Brief summaries of the information provided by these tools are provided below:

<u>ELVeS</u>
The Everglades Landscape Vegetation Succession model (ELVeS) is a spatially explicit simulation of vegetation community dynamics over time in response to changes in environmental conditions (Pearlstine, et al., 2011). In examining the dominant vegetation communities selected by ELVeS at the end of the 41-year hydrologic period of record, little difference is discernible among the alternatives and FWO or Existing Condition Baseline (ECB). Open water is eliminated in all of the alternatives in southern WCA 2B and increased wetting in alternative 1 is being expressed along the western edge of northern WCA 3A with pockets of spikerush (*Eleocharis* spp.). Northern WCA 3A in the ECB and FWO is drier than it is expected to be in the alternatives and is characterized by willow and shrubs. In the alternatives, water deliveries to northern WCA 3A result in ELVeS probabilities for sawgrass becoming quite high and following the pathways of water flow. Increased wetting of northern WCA 3B can also be observed in alternative 2 and a further increase in sawgrass probabilities within the alternative 4 flow way. These changes are also apparent in the open marsh (deeper water, sparser emergent marsh vegetation) community probabilities for these alternatives.

<u>Marl Prairie Indicator</u>
The Marl Prairie Indicator model looks at discontinuous hydroperiods between May and April, Cape Sable Seaside Sparrow (CSSS) Nesting Season water depth (March 1-July 15), and Average Wet and Dry season water depths to calculate whether the habitat is suitable for CSSS (Pearlstine, et al., 2013). Overall, there appears to be little impact of the alternatives on lift of marl prairie habitat for Cape Sable seaside sparrow subpopulations A, B, C, or D. The alternatives - and alternative 2 in particular- increase habitat suitability for a series of model cells just northwest of the subpopulation A boundary. The lowered suitability scores in subpopulation E are occurring mostly in the northern area of the

subpopulation; however, there are no areas of notable gains. Subpopulation F scores mostly decline along its western boundary with lesser, but still substantial gains to the east that are masked by averaging with the losses on the western boundary.

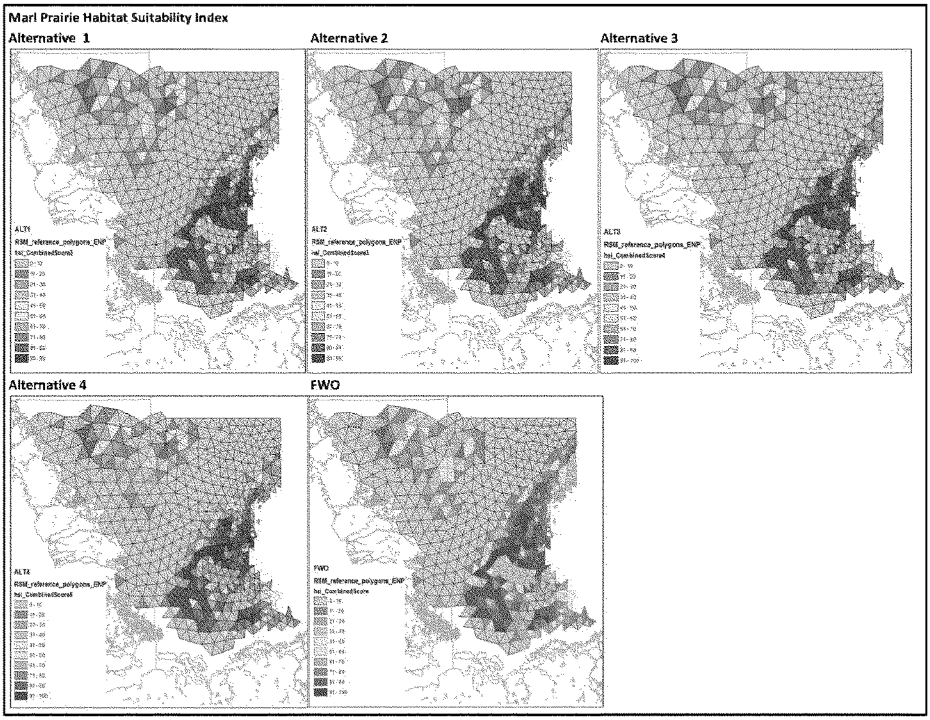

Figure E.4-13. Displays Marl Prairie Habitat Suitability Index Maps for all alternatives and the FWO. Shading from pink to green represents less to more suitable marl prairie habitat.

<u>American Alligator Production Probability Index</u>

The Alligator Production Probability Index model incorporates concepts from existing alligator habitat suitability models and the literature to estimate alligator production probability for breeding and nesting success (Shinde, et al., Draft). **Table E.4-2** and **Figure E.4-14** display cumulative alligator habitat suitability index score lift for each alternative and the existing conditions base compared to the FWO. All alternatives provide more alligator habitat suitability compared to the FWO, with alternative 1 providing the most in WCA 3A, alt.3 the most in WCA 3B, and alt.4 the most in ENP. All of the alternative plans improve alligator habitat in northern WCA 3A and the Miami Canal zone by as much as 20% because of new water delivery to northern WCA 3A. Gains are smaller in central WCA 3A, WCA 3B and ENP north and south zones with modest variation regarding which alternative best improves scores. Changes to WCA 3A south and ENP southeast are negligible. When scores are aggregated by water conservation area, the trends are similar, but lifts are compressed by aggregation over a larger area. In addition, WCA 2 has a 5% loss of habitat suitability resulting from water being redirected from WCA 2 to WCA 3A for all alternatives.

Table E.4-2. Cumulative Alligator Habitat Suitability Index

Zone	ECB Lift	ALT1 Lift	ALT2 Lift	ALT3 Lift	ALT4 Lift
3A-C	0.523023	2.667964	1.906198	1.744549	1.924805
3A-MC	0.961123	8.801647	8.403512	8.369291	8.429125
3A-NE	0.634494	6.976743	8.001702	7.972184	8.022031
3A-NW	0.159704	6.258332	5.46354	5.459678	5.467471
3A-S	0.230372	0.755098	0.065521	-0.46596	0.254751
3B	1.286395	2.147014	2.744168	4.231454	1.608658
ENP-N	0.267711	0.550803	1.152958	1.77616	2.394573
ENP-S	-0.16428	1.750491	1.578731	2.387581	2.464859
ENP-SE	0.020763	0.161189	0.137693	0.22291	0.190128

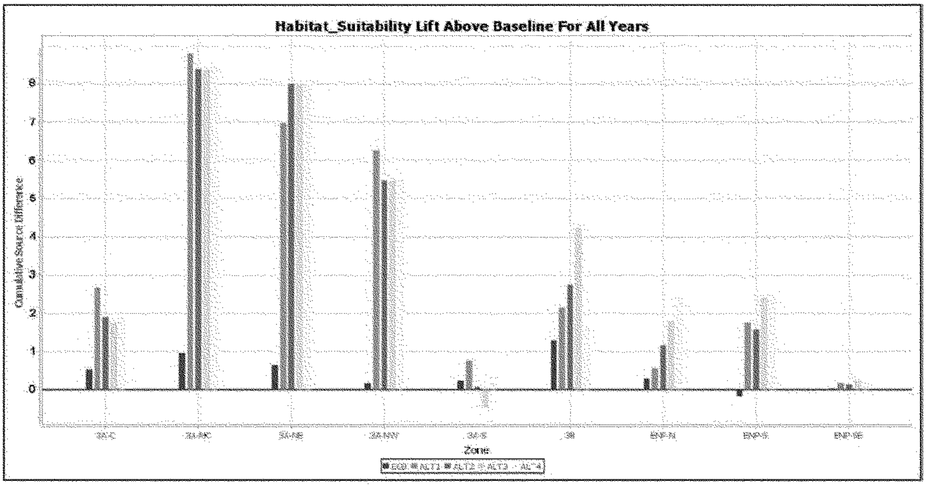

Figure E.4-14. Cumulative Alligator Habitat Suitability Index Scores by Region

Freshwater Fish Densities

J. Trexler and C. Catano (2013) used a parameterized logistic model to predict small fish densities based on the time between drying events. In all regions directly south of the L-5 canal (WCA 3A, WCA 3B, Shark River Slough, Southern Marl Prairies, and Taylor Slough) the CEPP models predicted fewer drying events than either the ECB or FWO, leading to greater days since last dry down and higher daily fish density throughout the 41-year period of record. The percent difference in average fish density between the CEPP models and baseline models was always higher when compared to 2050[1] than when compared to ECB. **Figure E.4-15, Figure E.4-16, Figure E.4-17, and Figure E.4-18** maps compare the average smallfish (< 8 cm, e.g., mosquitofish) density the alternatives to the FWO across the Greater Everglades Landscape. The map on the left is the FWO, right is the CEPP alternative being compared, and the middle map is the difference between them, where green is positive increase, yellow is little to no chance, and red is decreased density. The size of the circle represents a greater % change. In general, all alternatives increased fish density in Northern WCA 3A, slightly in 3B, and also in ENP. **Table**

[1] At the time that this RECOVER evaluation was completed the CERP period of analysis was used, which ends in 2050. See PIR Section 2.2 (Planning Horizon) for discussion.

E.4-3 provides the percent change in fish density on average in each GE area between the CEPP alternatives and ECB, FWO baselines. The largest percent gains in daily average fish density were generally predicted for northern WCA 3A and northeast Shark River Slough. In these areas, fish densities often increased in excess of 30%, with extremes of over 80%. Scaled up in space and time, this translates to a very large increase in biomass. A key point is that large areas of fish biomass are concentrated in the dry season, so modest per-meter-square increases in wet-season biomass have the potential to increase bird food availability in a geometric fashion. The regional percent changes in fish densities were highest in Shark River Slough (16% - 23%) and Southern Marl Prairies (17% - 31%) compared to the FWO. Alternatives 3 and 4 generally had the largest percent increases and were comparable in magnitudes. In addition, **Table E.4-4** provides the percent change in large fish density (largemouth bass (Micropterus salmoides)) on average in each Greater Everglades (GE) area between CEPP alternatives 1-4 and the ECB, FWO baselines. All alternatives increase large fish density in the landscape, but alternatives 1 and 2 show the most increase in the southern marl prairie (SMP), whereas alternative 2 does the best in 3B, alternative 4 is best in Shark River Slough (SRS). Taylor Slough (TS) and WCA 2A show decreases in largemouth bass density compared to the FWO. However, those decreases are far less than the percent increases seen in other areas due to the CEPP alternatives

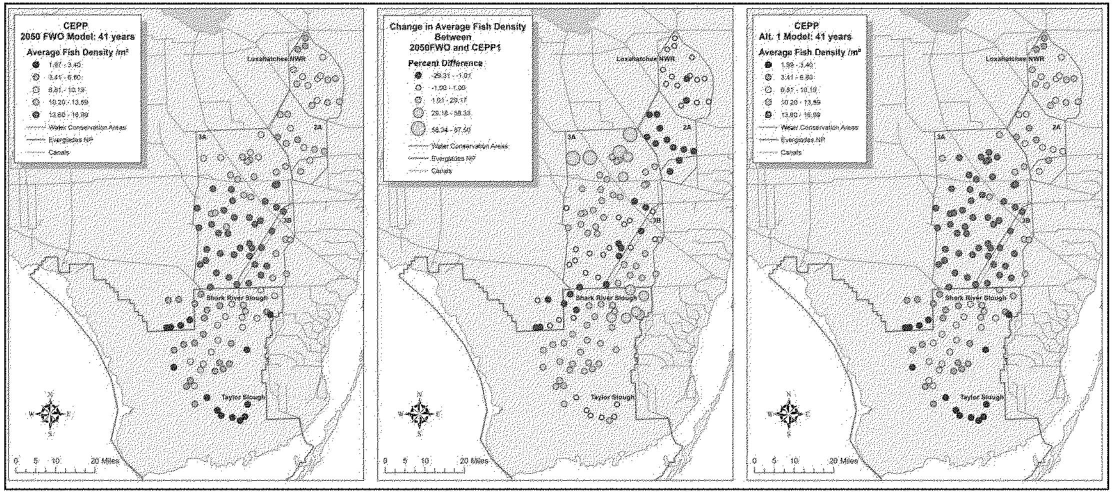

Figure E.4-15. Alternative 1 Small Fish Performance

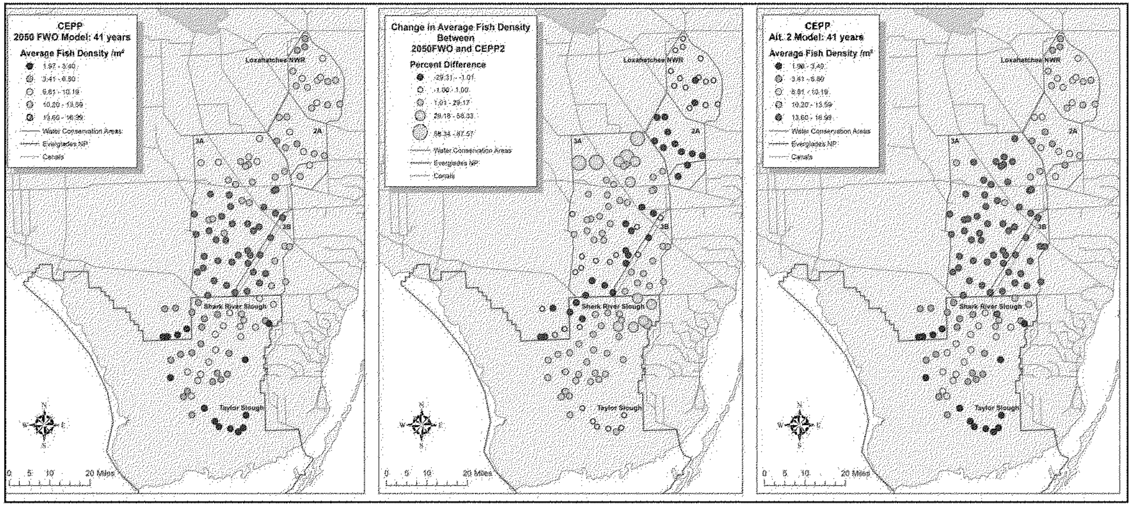

Figure E.4-16. Alternative 2 Small Fish Performance

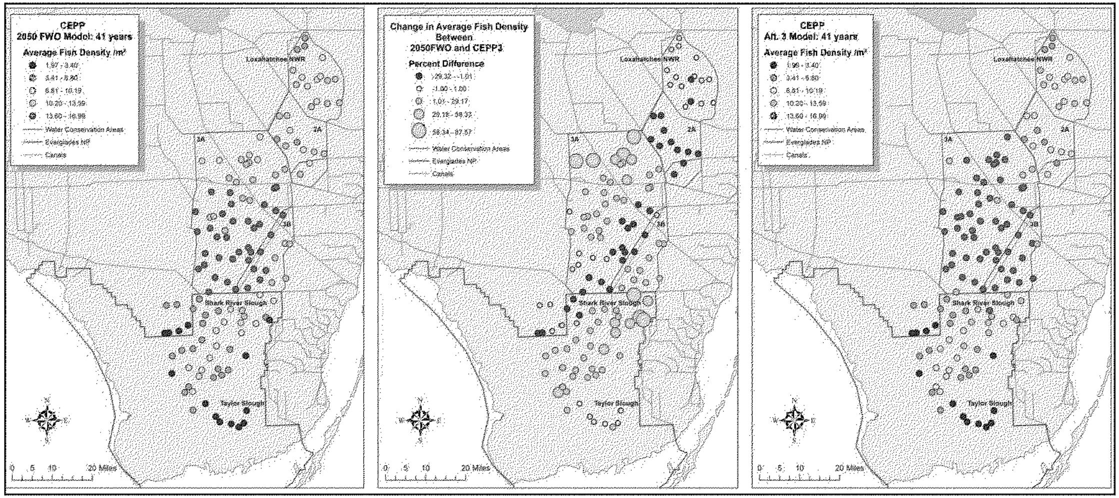

Figure E.4-17. Alternative 3 Small Fish Performance

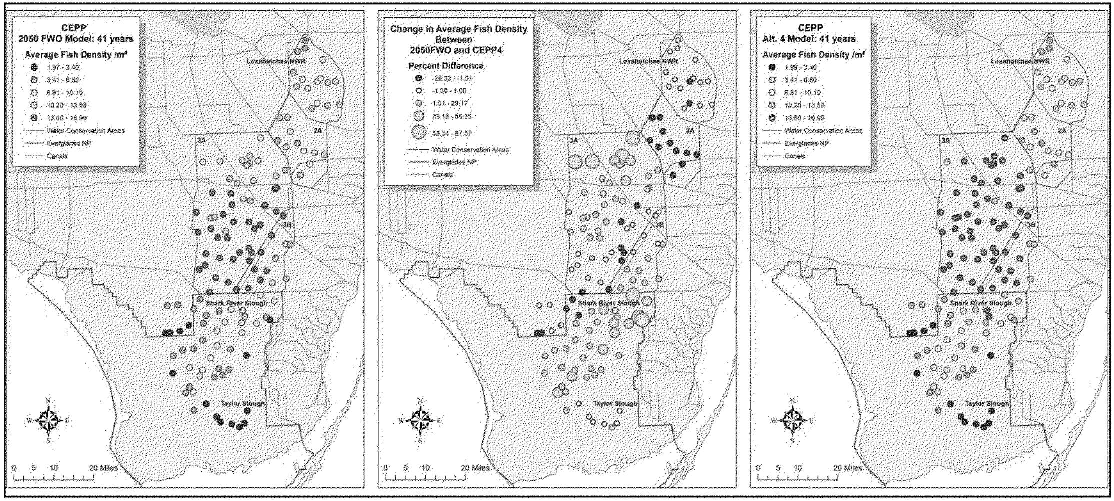

Figure E.4-18. Alternative 4 Small Fish Performance

Table E.4-3. CEPP Alternative Small Fish Density per Meter Squared

Region	CEPP1		CEPP2		CEPP3		CEPP4	
	ECB	2050FWO	ECB	2050FWO	ECB	2050FWO	ECB	2050FWO
2A	**0.70**	-12.96	**0.70**	-12.96	**0.70**	-12.96	**0.71**	-12.95
3A	**5.46**	**9.36**	**4.75**	**8.62**	**4.46**	**8.31**	**5.20**	**9.08**
3B	-0.43	**4.87**	**2.59**	**8.04**	**1.25**	**6.64**	-1.30	**3.96**
LOX	-2.71	-0.46	-2.71	-0.46	-2.71	-0.46	-2.71	-0.46
SMP	**16.05**	**18.42**	**14.85**	**17.20**	**28.65**	**31.28**	**27.45**	**30.05**
SRS	**13.39**	**16.04**	**13.64**	**16.30**	**18.66**	**21.44**	**20.48**	**23.30**
TS	**0.04**	**0.55**	-0.11	**0.39**	**0.05**	**0.56**	-0.01	**0.49**

Alternatives 3 and 4 provided a greater percent increase in fish density in ENP than alternatives 1 and 2, and all alternatives produce less fish in WCA 2 compared to the FWO.

Table E.4-4. CEPP Alternatives Large Fish Density per Meter Squared

Region	CEPP1		CEPP2		CEPP3		CEPP4	
	ECB	2050FWO	ECB	2050FWO	ECB	2050FWO	ECB	2050FWO
2A	-51.57	-53.07	-52.94	-54.40	-51.91	-53.40	-51.39	-52.90
3A	**24.50**	**54.14**	**6.77**	**32.18**	**21.22**	**50.08**	**11.66**	**38.23**
3B	**28.96**	**146.04**	**61.28**	**207.70**	**25.06**	**138.60**	**6.79**	**103.74**
LOX	-26.63	-14.94	-27.00	-15.36	-26.94	-15.29	-26.52	-14.81
SMP	**805.52**	**785.30**	**886.49**	**864.47**	**470.28**	**457.55**	**386.24**	**375.38**
SRS	**15.04**	**13.33**	**15.47**	**13.76**	**68.91**	**66.41**	**94.15**	**91.27**
TS	-64.10	-35.25	-53.63	-16.36	-69.97	-45.84	-47.08	-4.56

Apple Snail Population

The apple snail population model looks at water depths and temperatures to estimate adult apple snail numbers for each alternative plan (Romanach, S., et al., 2013). All four alternative plans provide better conditions for apple snail populations compared to the FWO. All four alternative plans lead to increased apple snail populations in northern WCA 3A. Alternatives 3 and 4 suggest that they could provide appropriate conditions for getting more apple snails into Everglades National Park compared to alternatives 1 and 2.

Figure E.4-19 provides map comparisons of apple snail habitat suitability index values between each CEPP alternative and the FWO. All four alternatives should provide better conditions for apple snail populations compared to Future Without restoration (FWO) in Northern and Central WCA 3A, 3B, and ENP. Slight decreases in apple snail habitat suitability were observed in WCA 2.

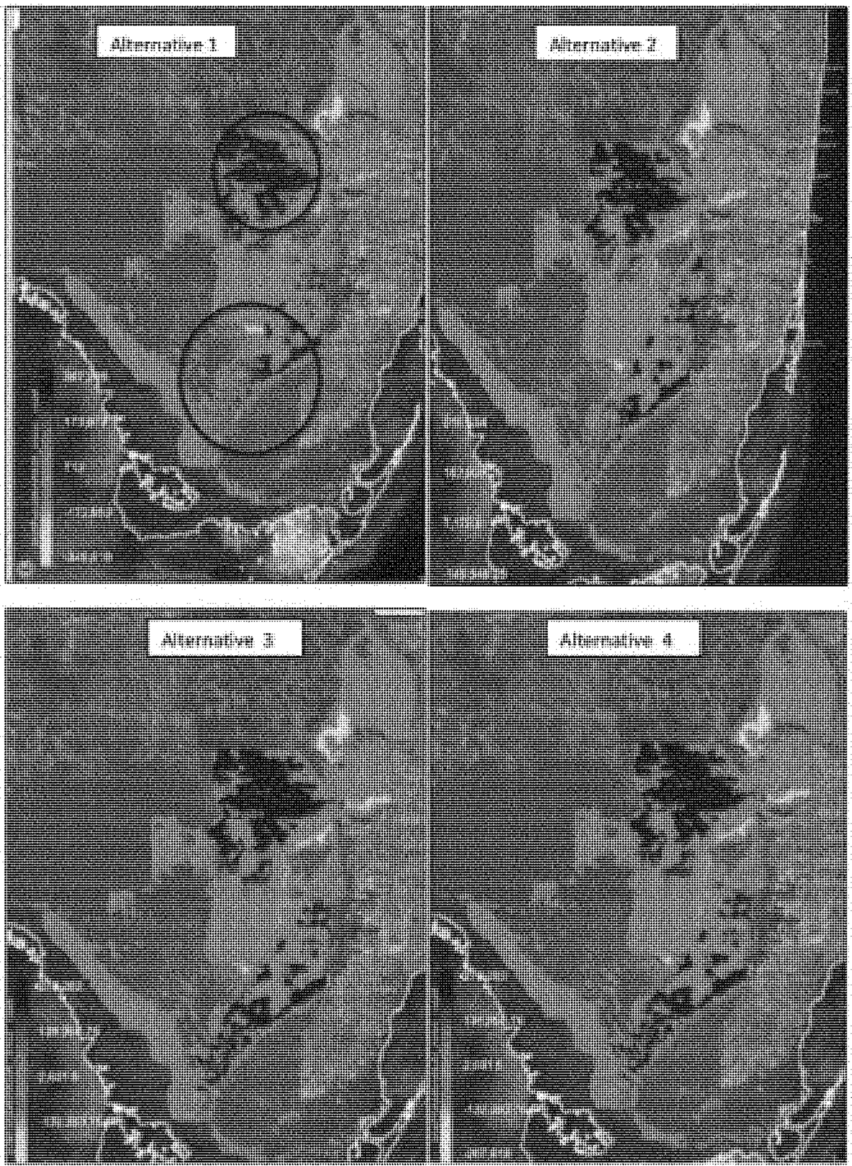

Figure E.4-19. Apple Snails ((*Pomacea paludosa*) Habitat Suitability Index

Wading Birds

Several models of wading birds were used to support the overall GE evaluation: 1) Wood Stork Foraging Probability Index model by Everglades National Park; 2) wading bird species distribution model by James Beerens; and 3) wading bird nesting success by Gawlik, et al., 2013.

The Wood Stork Foraging Probability Index (STORKI v. 1.0) was developed to provide rapid simulations of wood stork foraging conditions in response to modeled CERP scenarios (LoGalbo, et al., 2012). **Figure E.4-20** below displays woodstork foraging habitat suitability cumulatively over the 41 year period of record for each alternative compare to the FWO for wood storks. Woodstork foraging habitat suitability indicates that all alternatives performed between 70% to 130% better than the FWO foraging habitat in northeast WCA 3A and around the Miami Canal. Alternative 3 and 4 provided 50% to 68% more foraging habitat in WCA 3B and southern ENP. However, all alternatives performed worse in northern ENP (-85%) and WCA 3A South (up to -20%).

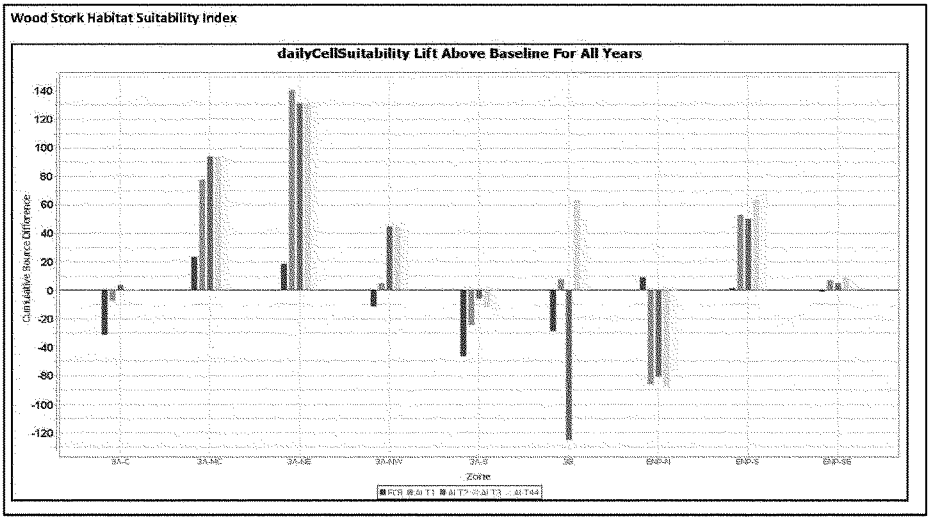

Figure E.4-20. Wading Bird Nesting Models (Great Egret, White Ibis, and Wood Stork)

Wood stork, white ibis and great egret species distribution were modeled by James Beerens, et al., 2013 in support of the Greater Everglades ecological evaluation (see **Figure E.4-21, Figure E.4-22,** and **Figure E.4-23** below). Wood storks generally showed increased numbers in northern WCA 3A and southern ENP for the four alternatives compared to the FWO. White ibis numbers were also greater in northern WCA 3A and southern ENP, but also in part of central WCA 3A for all alternatives. The great egret model showed improvements in northern WCA 3A, southern ENP, Central WCA 3A, and WCA 3B, but also indicated reductions in presence in northern ENP.

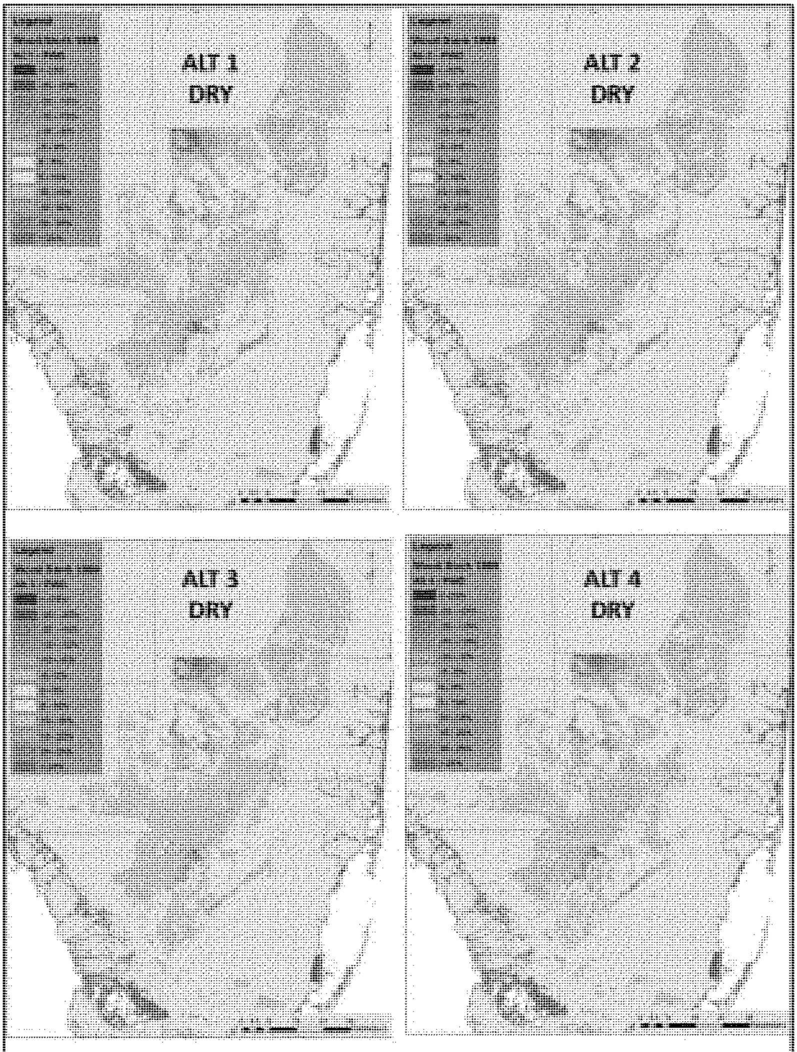

Figure E.4-21. Wood Stork Distribution Dry Year (1989)

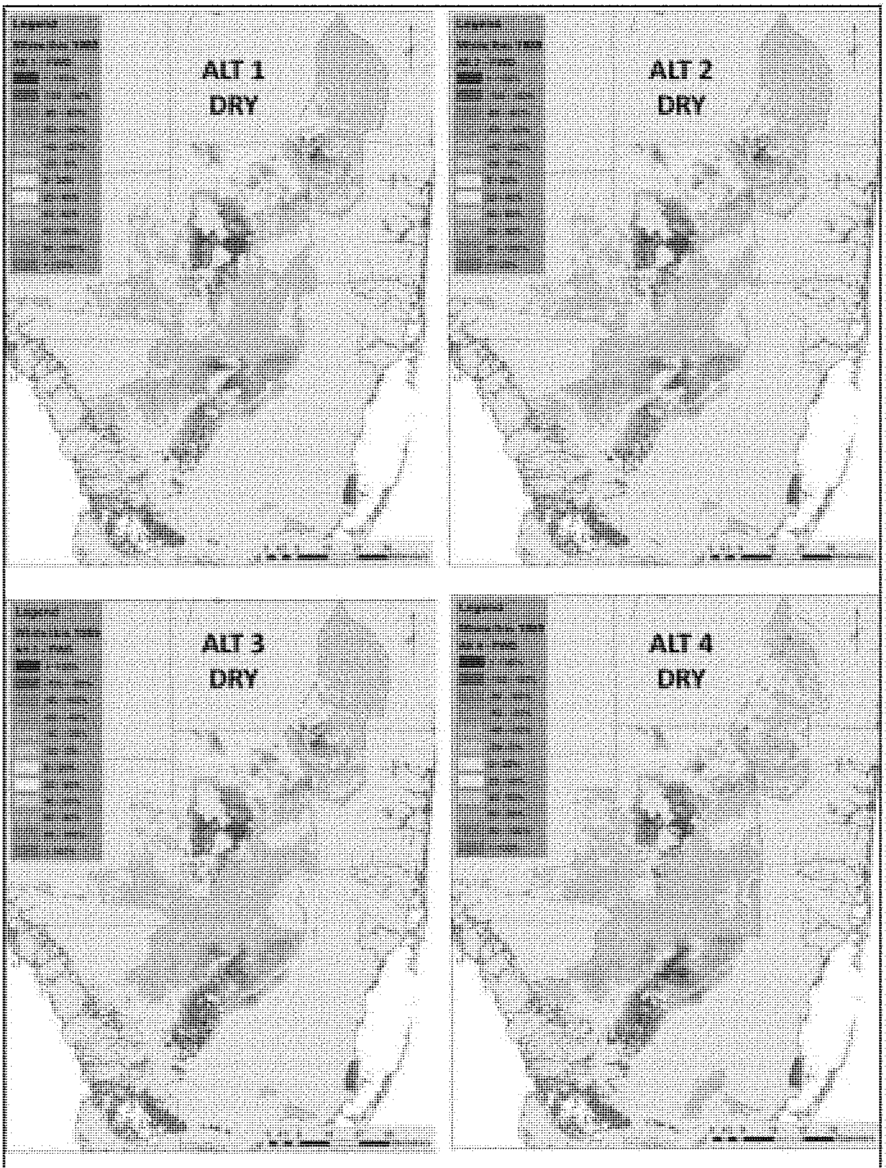

Figure E.4-22. White Ibis Distribution Dry Year (1989)

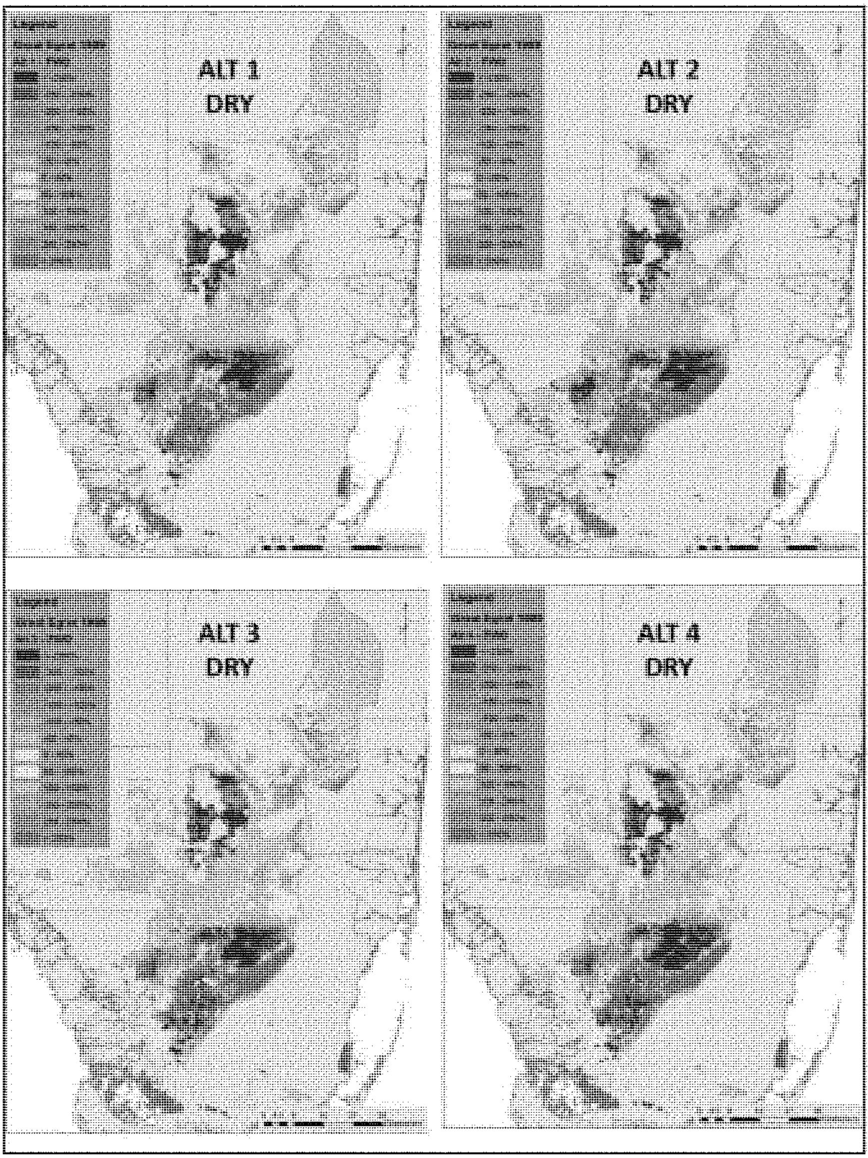

Figure E.4-23. Great Egret Distribution Dry Year (1989)

The wading bird nesting models predict the number of nests for the wood stork, white ibis, and great egret species for each alternative (Gawlik, et al., 2013). All four alternatives generally performed better for great egret, white ibis, and wood stork nesting than the FWO. In the northern Everglades each alternative showed less nests than FWO for ibis and storks, but more nests than FWO for egrets. However, in the southern Everglades, the alternatives performed better than FWO. The Great Egret nesting model showed the biggest benefit in raw numbers of nests but the Wood Stork model showed a more significant benefit relative to its population size (Gawlik, et al., 2013). This pattern of better wading bird nesting in the Southern Everglades than Northern Everglades is not unexpected and is consistent with the prediction that nesting trends in a restored Everglades would increase in the coastal zone, rather than system wide (RECOVER, 2009). **Figure E.4-24** on the next page displays wading bird nesting results cumulatively over the 41 year period of record for each alternative compare to the FWO for wood storks. In the Southern Everglades alternative 3 performed best for white ibis and great egret, whereas alternatives 1 and 2 performed best for storks. In the wood stork model case, alternative 4 produced about half as many nests above FWO, as did any other alternative.

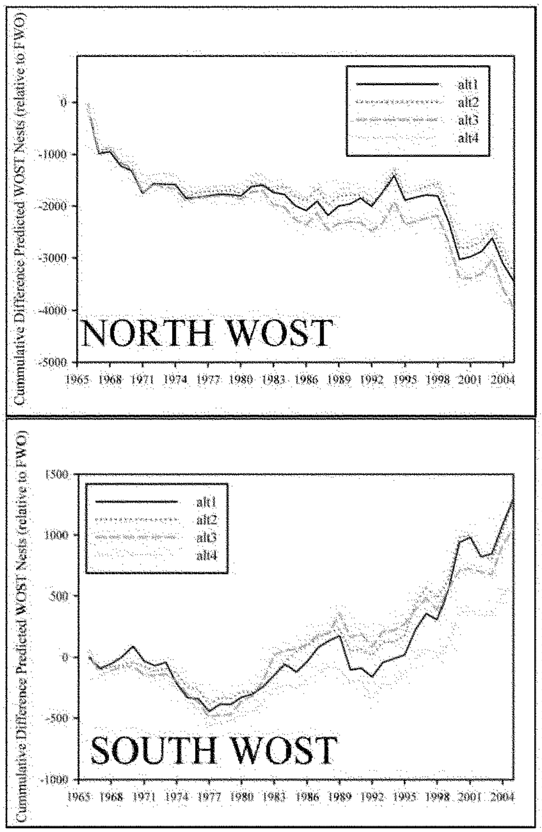

Figure E.4-24. Wading Bird Nesting Models (Great Egret, White Ibis, and Wood Stork)

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E.5 Southern Coastal Systems Regional Report

RECOVER System-wide Regional Evaluation

Central Everglades Planning Project

Southern Coastal System Regional Coordinators: Susan Kemp – USACE, Dave Rudnick – ENP, Patrick Pitts – USFWS

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E.5.1 Executive Summary of Southern Coastal Systems System-wide Evaluation

The Southern Coastal Systems region covers a network of estuaries on the southern end of Florida including Biscayne Bay, Florida Bay, and the lower southwest Florida coastal systems. The summary for the RECOVER system-wide evaluation of Central Everglades Planning Project (CEPP) is provided in the following list of key findings:

1. Flow increases in major sloughs providing freshwater to Florida Bay are predicted for all CEPP alternatives compared to the Future Without Project (FWO) condition. Flows at Transect 27 in Shark River Slough indicate significant increases (192K to 262K ac-ft/yr) for all alternatives compared to FWO, with alternative 4 providing the largest increase. However, flow analyses at Transect 23A in Taylor Slough indicate only a slight increase (2-3K acre-feet/year) in flows above FWO for all alternatives, but almost no difference between alternatives.
2. The Florida Bay salinity performance measure shows lift from all alternatives over FWO, with generally modest differences between alternatives compared to FWO or Existing Condition Baseline (ECB). The overall ranking of alternatives based on the performance measure is: alternative 4>alternative 3>alternative 1>alternative 2.
3. Spotted seatrout, pink shrimp, and crocodile habitat suitability indices and submerged aquatic vegetation (SAV) simulation model results show noticeable lift from all alternatives relative to FWO. However, differences between alternatives are modest and not statistically significant for seatrout, and may not be statistically significant for pink shrimp, crocodiles and SAV. The trend in the habitat suitability index (HSI) and SAV model data indicate that alternative 4 provides the most lift compared to the other alternatives.
4. Given the linkages between Shark River Slough flow and salinity in Florida Bay, it is likely that benefits to the lower southwest Florida coastal estuaries (e.g. Whitewater Bay) may show greater lift than the models predict for Florida Bay.
5. There are general reductions in flow at most coastal structures in central and southern Biscayne Bay from FWO and CEPP alternatives compared to ECB, and there are flow reductions from most CEPP alternatives compared to FWO in these regions.
6. There is no change or increase in flows through the northern Biscayne Bay coastal structures from FWO and CEPP alternatives compared to ECB.
7. At the coastal structures that show reductions in flow compared to FWO, reductions are generally greater during the dry season.
8. Overall ranking of alternatives based on flows and the salinity performance measure at the Biscayne Bay coastal structures is the opposite of the Florida Bay salinity ranking: alternative 2>alternative 1>alternative 3>alternative 4.
9. Flow at the three divide structures (S-338, S-194, S-196) that provide freshwater flow from the Everglades to south Biscayne Bay shows substantial reductions for all alternatives compared to FWO. Compared to FWO, reductions at S-338 are generally greater during the dry season; whereas, the opposite seasonal pattern is exhibited for the S-194 and S-196.
10. We have concerns that the model-predicted reductions in flows at the divide structures and the central and southern Biscayne Bay coastal structures may negatively impact the ecological status of Biscayne National Park and restoration progress of CERP's Biscayne Bay Coastal Wetland Project.

E.5.2 Introduction

The CERP Southern Coastal Systems (SCS) region encompasses a network of estuaries on the southern end of Florida which require fresh water inputs from upstream to maintain ecologically favorable brackish salinity conditions. Over the last century, water management and land development activities have resulted in inadequate volume, timing, and distribution of freshwater flows to these estuaries, changing the salinity regime in the estuaries and resulting in ecological degradation compared to conditions prior to water management. Preliminary analyses of modeling output from sensitivity runs indicated that the Central Everglades Planning Project (CEPP) project alternatives may increase flows to and improve salinity conditions in the SCS. This report evaluates effects of the CEPP final array of alternatives on flow, salinity, and ecological conditions in the SCS. The evaluation compares alternatives primarily against the "future without project" (FWO) condition and, where relevant, to the "existing condition baseline" (ECB) or the "target" condition for Florida and Biscayne Bays.

E.5.3 Evaluation Methods

The evaluation relies on Regional System Model (RSM) output of stage and flow in the southern part of the model domain. Analyses are performed on RSM model output for flow at select transects in the Everglades National Park that provide freshwater to Florida Bay and at select water management structures that feed freshwater to Biscayne Bay. Additionally, RSM model output for stage at select gage locations in the southern part of the model domain is converted to salinity using multi-linear regressions (paleo-adjusted MLRs) at salinity monitoring locations in Florida Bay for evaluation in the bay as described below. Salinity is evaluated directly and also used as input to habitat suitability indices, also described below.

Florida Bay

For the Florida Bay evaluation, flows across Transect 23A in Taylor Slough and Transect 27 in Shark River Slough were examined to provide information on freshwater flows to Florida Bay. The RECOVER Florida Bay salinity performance measure was used and habitat suitability indices (HSIs) for juvenile spotted seatrout, pink shrimp, juvenile crocodiles and an SAV simulation model applicable to Florida Bay were quantified.

<u>Salinity Performance Measure</u>

The Florida Bay salinity performance measure ($RECOVER_a$, 2012) used in the evaluation was approved for use by RECOVER in June 2012. Daily salinity values for the 1965-2005 period for 17 bay stations (via RSM and MLR models) were provided as input to the performance measure by the IMC for all CEPP alternatives, ECB, and FWO. The IMC-provided NSM daily salinities were not used to determine the restoration target because the required paleoecological adjustment was not applied, so a previously run paleo-adjusted NSM output data set with a 1965-2000 period of record was used to set the restoration target. The IMC-provided daily salinity values for CEPP alternatives, ECB, and FWO were truncated to match the restoration target period of record (1965-2000). The performance measure consists of three metrics—regime overlap, mean offset, and high-salinity metric—and are defined as follows:

- *Regime overlap metric* – examines the central tendency of salinity distributions by comparing the overlap between the mid-ranges of the target and the observed or predicted (CERP alternative) time series. The mid-range is defined as the salinity range between the 25th and 75th percentiles.

- *Offset metric* - provides a measure of the magnitude that the CEPP alternative may deviate from the target. It is determined by calculating absolute value of the difference between the target monthly (or seasonal) salinity mean and the predicted monthly (or seasonal) salinity mean.
- *High salinity* – estimates frequency of harmful high salinity and is calculated as frequency of salinity exceeding NSM 90th percentile, relative to frequency expected with NSM (thresholds are MMN station specific).

Each metric was calculated for wet and dry seasons and output was reported as bay zone averages. See **Figure E.5-1** for locations of the 17 salinity stations and bay zones.

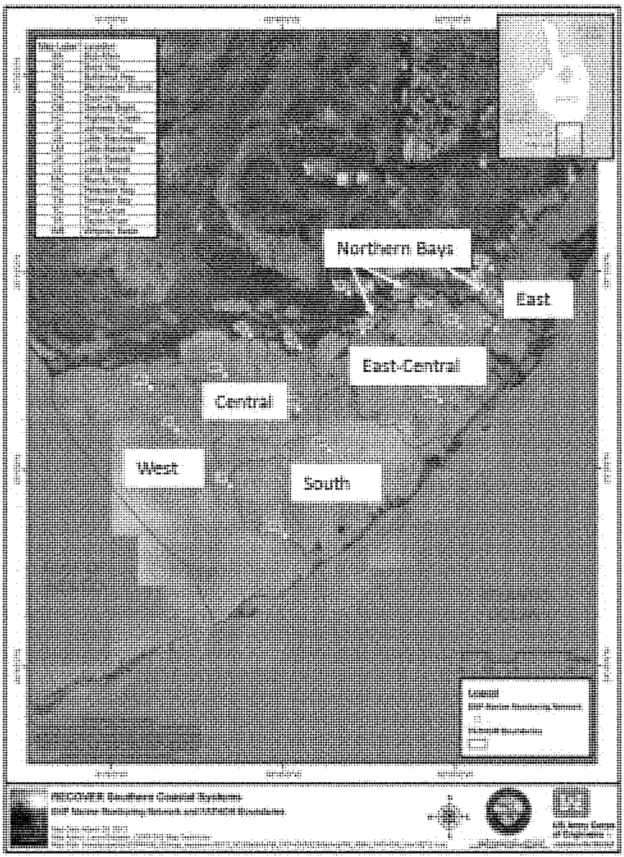

Figure E.5-1. Map showing salinity stations (yellow squares) and six bay zones used in the Florida Bay salinity performance measure analyses.

Other Information Sources - Habitat Suitability Indices and Submerged Aquatic Vegetation (SAV) Simulation Model

Juvenile Crocodiles – The crocodile (*Crocodylus acutus*) growth and survival index used in this analysis is one of the components of a crocodile HSI that characterizes suitable habitat for crocodiles based on habitat, location of known nest sites, salinity, and prey biomass. The growth and survival index is calculated for August through December, the period following hatching when hatchlings are most vulnerable to high salinities (Moler 1992; Mazzotti 1999; Mazzotti et al. 2007). For this analysis, data from the salinity monitoring stations at Joe Bay, Trout Cove, Little Madeira Bay (the stations among the available stations closest to where the highest densities of crocodile nests are) and Long Sound, Little Blackwater Sound, Terrapin Bay and Garfield Bight (generally closer to shoreline stations in areas where crocodiles could occur) are used as input to the HSI. Each day from August 1-December 31 is assigned a score based on the following salinity ranges: salinity <20 psu was assigned the highest score of 1 because salinity in this range is considered most favorable for juvenile crocodile growth and survival (Moler 1992; Mazzotti 1999; Mazzotti et al. 2007); salinity between 20 psu to <30 psu was assigned a score of 0.6; 30 psu to <40 psu a score of 0.3, and >40 psu a score of 0. Average yearly and an average overall score were calculated.

Juvenile Spotted Seatrout – The spotted seatrout (*Cynoscion nebulosus*) HSI is a qualitative model that uses a logistic regression to assess how the frequency of occurrence of juvenile spotted seatrout varies in response to environmental parameters (turbidity, temperature, salinity, and spatial coverage and density of three species of seagrass) ($RECOVER_b$, 2012). The model calculates the area of habitat suitable for juvenile spotted seatrout based on the above parameters. For this exercise, all parameters were held constant except for salinity. For juvenile spotted seatrout, there are five biologically relevant ranges for salinity as determined by the linear response in cumulative frequency of seatrout to salinity. HSI index scores were then calculated by taking the frequency of occurrence for each of these five ranges and dividing by the highest frequency of occurrence for any of the ranges. For example, the range from a salinity of 32 to 39 had the highest frequency of occurrence at 0.255 and received an suitability index (SI) =1 (0.255/0.255); however, the range from a salinity of 40 to 52 had a frequency of occurrence of 0.145 and an SI=0.57 (0.145/0.255).

Pink Shrimp – The pink shrimp (*Farfantepenaeus duorarum*) model simulates growth, survival, and potential harvest of a cohort of shrimp as a function of salinity and temperature (Browder et al. 1999, 2002). Coefficients for functions relating growth and survival to salinity and temperature were based on laboratory experiments on young shrimp collected from Florida Bay and reared under salinities ranging from 2 to 55 and temperatures ranging from 15° C to 33° C. Potential harvest, an indicator of performance, is simulated by starting with a set number of postlarval shrimp (1×10^7) from a hypothetical July cohort and tracking the potential harvest from that cohort for a given year based on the salinity for that year using the CEPP model output for each alternative. The simulation is repeated each year of the model period of record (1965-2005) to produce a time series of growth and survival for a cohort of shrimp entering the bay in a given month. Temperature for each simulation year is daily data from 2007, so temperature is, in effect, held constant.

Submerged Aquatic Vegetation – The SEACOM model (Madden and McDonald 2010), a seagrass community ecological simulation model, determines outcomes of biomass and species composition for three Florida Bay seagrass species—turtle grass (*Thalassia testudinum*), shoal grass (*Halodule wrightii*), and widgeon grass (*Ruppia maritima*). The SEACOM model was initialized as follows: average year conditions (the standard model conditions) for each Florida Bay location were calculated from real salinity, temperature data (Everglades National Park continuous monitoring platforms, computed daily), and water column nitrogen and phosphorus data (SERC FIU marine monitoring network, computed monthly) from 1996 to 2005. The standard salinity and temperature model was calculated as the average value for each Julian day across all years in the period of record (e.g. the Jan 1 value equals the average of values on January 1 from 1996-2005) and the standard nutrient model was calculated as the monthly average for total N and P across 1996-2005. The monthly average value was applied to each day of the month, yielding a step function. SEACOM was equilibrated at each location by initializing with these standard parameter conditions and run with a timestep (dt) of 0.1 day for a 50 year simulation period, by which time SAV values were fully stabilized. The final seagrass values provided by the equilibrated model were applied as initial conditions for each of the scenario runs. For each 40-year scenario run, the salinity simulations were provided from the RSM-MLR output and run with the standard model temperature and nutrients.

Biscayne Bay

Flow at Coastal Structures

For the Biscayne Bay evaluation, flows at the coastal structures were analyzed for all alternatives and compared to FWO and ECB. Structure flows are generally reported as mean annual flows and percent changes of those flows for alternatives relative to ECB and FWO. Also, the RECOVER salinity performance measures developed for select coastal structures (RECOVER, 2008) and currently approved for use by RECOVER were used. These performance measures utilize daily, monthly, or seasonal flow envelope targets at the coastal structures as a proxy for desired salinity conditions in the bay. For example, the performance measure for the S-22 control structure on the Snapper Creek Canal (C-2), which provides freshwater to central Biscayne Bay, has a restoration target flow envelope as follows: the average monthly flow should be maintained between 22,392 acre-feet/month and 50,360 acre-feet/month.

As requested by the CEPP project managers, the Biscayne Bay coastal structure evaluation was performed for four separate bay regions—north, central, south, and Manatee Bay/Barnes Sound (**Figure E.5-2**).

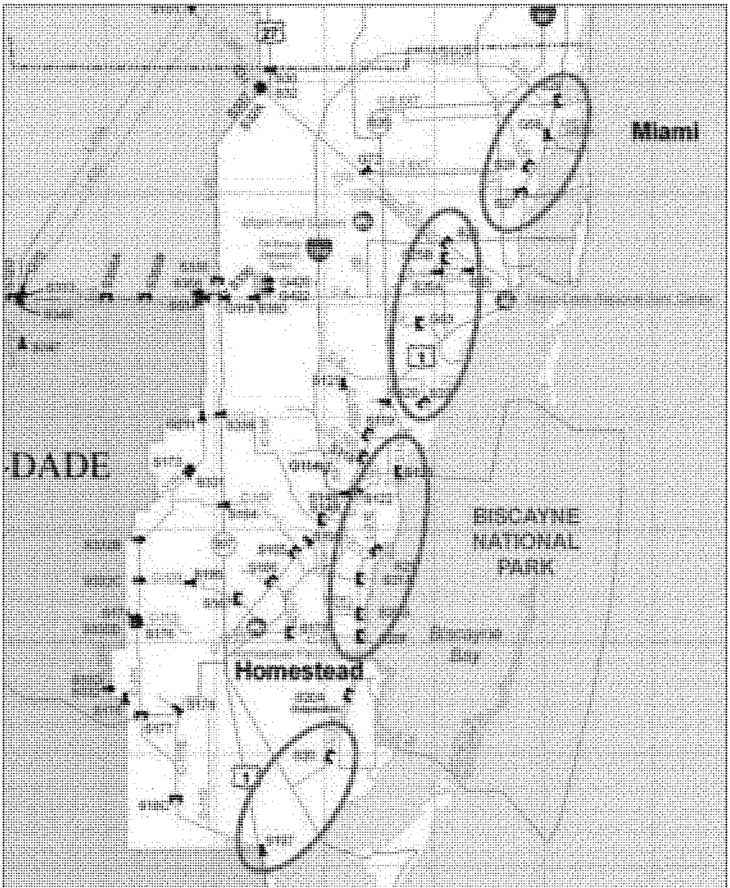

Figure E.5-2. Map showing the four regions (red ovals) evaluated for Biscayne Bay.

Flow at Divide Structures

The accuracy of hydrologic model domains along the boundaries is known to be poorer than in the interior of the domain. The RSM model is no exception. The Biscayne Bay coastal structures are along the boundary of the RSM model, so there is a greater uncertainty in the accuracy of flow output at those structures. Because of this uncertainty, the flows at the divide structures that provide freshwater to the Biscayne Bay coastal basins from the west were also analyzed. The divide structures are located in the interior of the model domain and thus, output from these structures should be more accurate relative to the coastal structure flow output. There are no RECOVER performance measures that apply to divide water control structures.

E.5.4 Results

Florida Bay

Flow Transects

Figure E.5-3 shows flows across Transect 27 in Shark River Slough. All 4 alternatives have greater flows down Shark River Slough toward the coast than the FWO. This flow can directly benefit the southwest coastal wetlands and estuaries (e.g. Whitewater Bay and riverine estuaries). It can less directly benefit Florida Bay via surface water and shallow groundwater flow and by plumes of low salinity water across the bay's western boundary (around Cape Sable). Mean annual flow, mean dry season flow, and wet season flow all have the same ranking among alternatives, as follows: Alt4>Alt3>Alt1>Alt2. Annual flow increases above FWO range from 262,000 acre-ft/y for Alt 4 to 192,000 acre-ft/y for Alt 2. Note that Florida Bay salinity for CEPP is estimated from wetland stage and not flow.

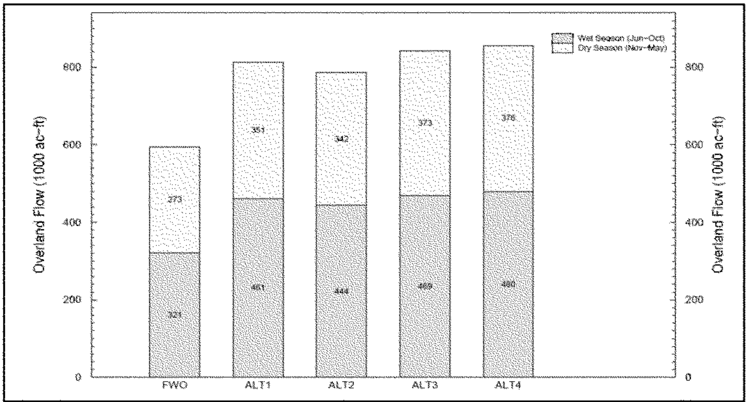

Figure E.5-3. Average annual overland flow across Transect 27 (southwestward flow in central Shark River Slough).

Figure E.5-4 shows average annual overland flow across Transect 23A (one of the 3 flow transects across western Taylor Slough). The plot shows very little difference across alternatives compared to FWO. Alternative 4 has only slightly more dry season flow than other alternatives. The two more easterly transects show similar results.

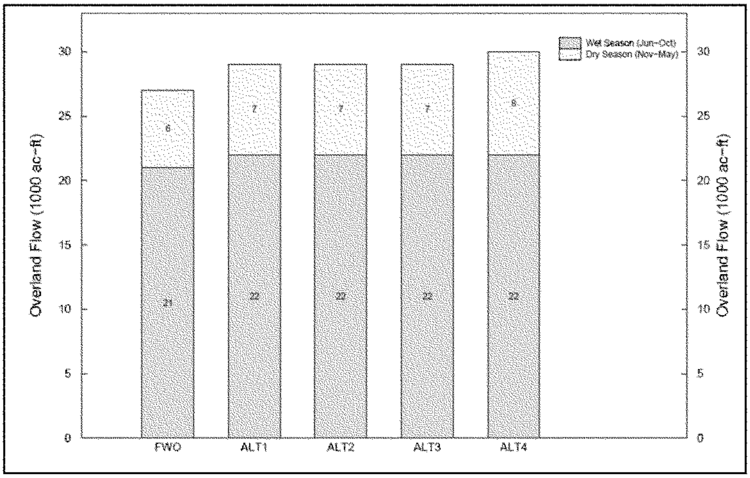

Figure E.5-4. Average annual overland flow across Transect 23A (southward flow in southern ENP; Craighead Basin).

Salinity Performance Measure

The first of the Florida Bay salinity performance measure results (regime metric) are shown in **Figure E.5-5**. This reflects the similarity of an alternative's middle two quartile ("mid-quartile" or "interquartile") salinity values with those of the NSM-based targets. Complete overlap with NSM would yield a value of 1.0 (complete restoration) and no overlap yields a value of 0. Wet season and dry season results are shown. The plots show lift in both seasons for all regions (except the east region during the dry season) for all alternatives compared to FWO. Lift during the wet season is higher than during the dry season for all regions. Generally, for all regions and seasons, the alternatives' sequence of best index scores is: Alt 4>Alt3>Alt1>Alt2. Not shown in this report are the total or absolute index scores, which indicate that conditions in Florida Bay are always better (relatively closer to the NSM target) in the wet season than dry season – dry season conditions are typically very poor.

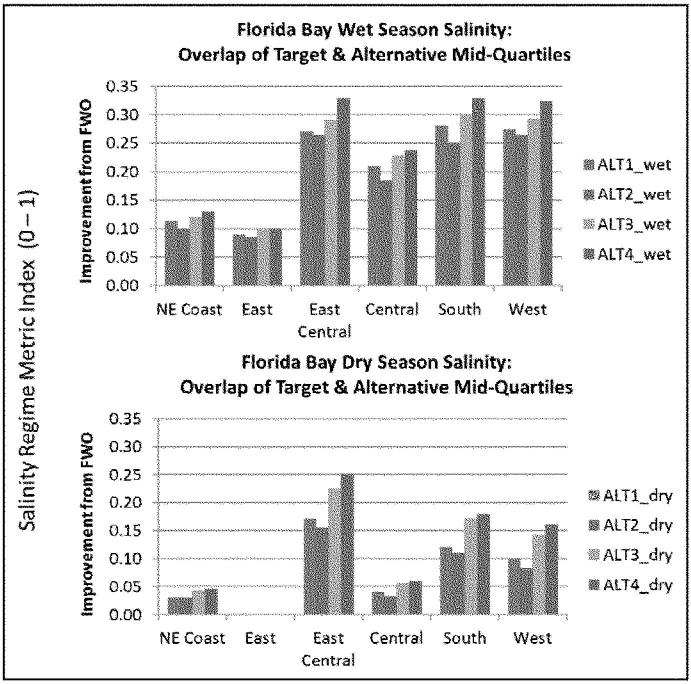

Figure E.5-5. Histogram plot of salinity regime metric comparing CEPP alternatives to FWO (wet season shown in top plot and dry season in bottom plot). Dry season values from alternative in the East zone are zero.

The high-salinity metric scores for the four alternatives compared to FWO are shown in **Figure E.5-6**. This metric indicates the frequency of unnatural and harmful high salinity conditions. It shows a similar lift pattern to that of the regime metric, with generally more lift occurring in the wet season except for the East-central Region. For this metric, the rank of alternatives is Alt4>Alt3>Alt 1and Alt2 for almost all regions and seasons. In several cases, Alt 1 and Alt 2 appear to be equal. Also, the East Region shows no lift in the dry season over FWO, as was the case for the regime metric.

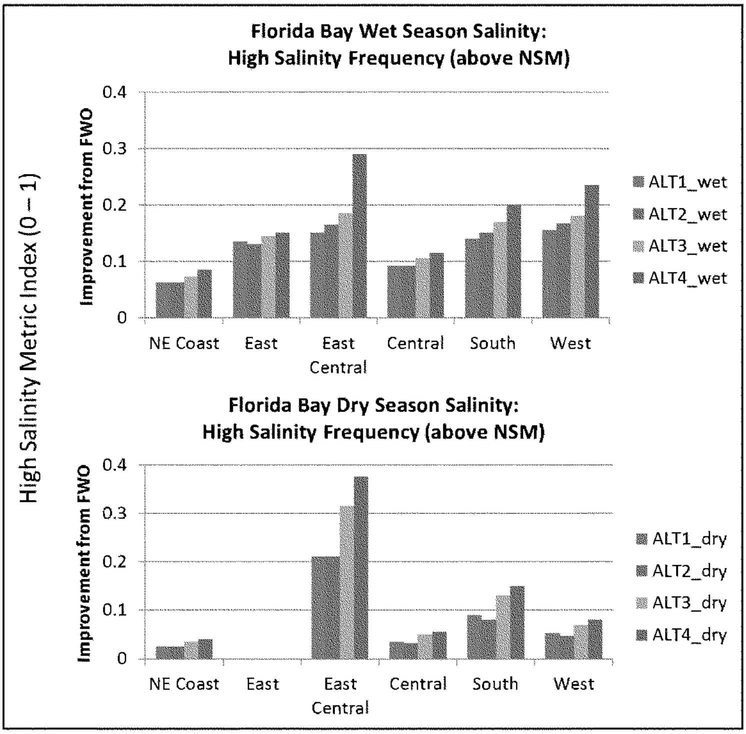

Figure E.5-6. Histogram plot of high-salinity metric index comparing CEPP alternatives to FWO (wet season shown in top plot and dry season in bottom plot). Dry season values from alternatives in the East zone are zero.

The third of the three Florida Bay salinity performance measure metrics—the salinity offset—is shown in **Figure E.5-7**. This metric is the difference between an alternative's mean salinity and the NSM target's mean salinity. The values are absolute salinity units ("psu" is practical salinity units, which are nearly equivalent to parts per thousand). Lower values mean the alternative is closer to the NSM target. The results show that all four alternatives generally decrease mean salinities about 2 psu closer to the NSM target, except in the East zone, which is more hydrologically isolated from the Everglades than other zones. Decreases in salinity for all zones and both seasons were greatest for alternative 4, with the same overall ranking as for the other two metrics: Alt4>Alt3>Alt1>Alt2. Note that this salinity offset metric was not included in habitat unit calculations of the CEPP Benefits analysis.

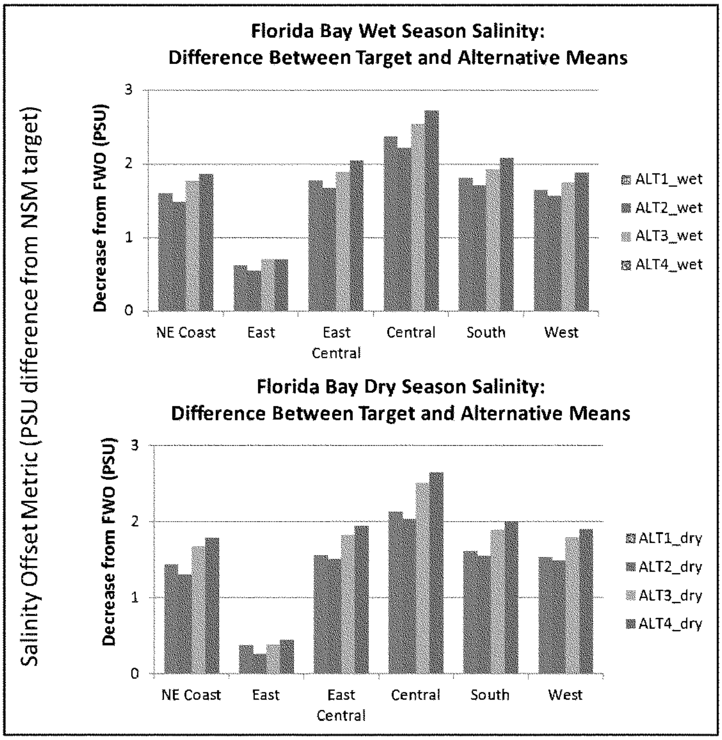

Figure E.5-7. Histogram plot of mean offset metric index comparing CEPP alternatives to FWO (wet season shown in top plot and dry season in bottom plot). Each value is a salinity decrease from the FWO, with this increment being closer to the NSM target.

An example of the ribbon plots used to graphically display the regime metric for individual salinity stations is provided in **Figure E.5-8**. The plots show the middle two quartiles of all daily data for the model runs period of record (36 years) for all alternatives, FWO and ECB for Terrapin Bay, which is located along the northern edge of the Central Region ("TB" in Fig.1). In FWO and EC there is very little overlap with the target, and when overlap occurs it does so in the wet season. All alternatives show significantly more overlap compared to FWO and ECB, but again it occurs mostly during the wet season. There is minimal overlap during the dry season. The blue lines correspond to the maximum and minimum of alternative 2's 75th percentile values. Alternative 4 had a 3.1 psu lower corresponding maximum and slightly lower minimum. Alternative 3's corresponding values fell in between the alternative 2 and alternative 4 values, and alternative 1 was very similar to alternative 2.

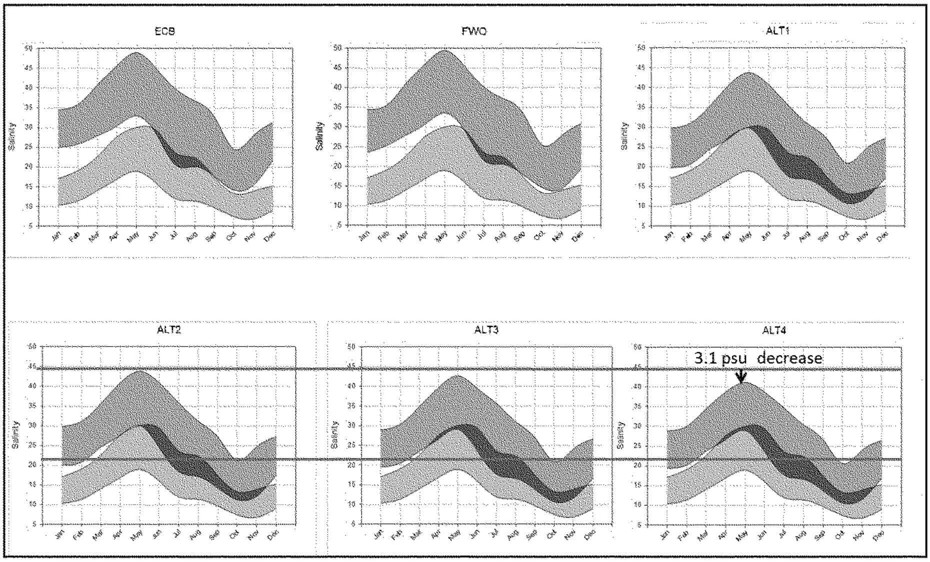

Figure E.5-8. Ribbon plots showing salinity mid-range regime overlap in Terrapin Bay for the four alternatives, FWO and ECB.

Habitat Suitability Indices and Submerged Aquatic Vegetation (SAV) Simulation Model

Juvenile Crocodiles:

Results from applying the salinity data into the juvenile crocodile HSI is shown in **Figure E.5-9**. The plot shows the lift (alternative minus FWO) of an index of juvenile crocodile growth and survival at sites along the northern Florida Bay shoreline for all years of the model runs. Sites in the orange box historically have had the most crocodile nesting. For the four sites with the highest predicted growth and survival, alternative 4 appears to perform better than the other alternatives. However, the difference in performance between alternatives is very subtle. For example, the maximum difference between alternative 4 and alternative 2 occurred in Terrapin Bay and is only about 0.02 units of the 0-1 scale index. Also, determination of any statistical significance between alternatives is not possible. Not surprisingly, the ranking of alternatives follows the salinity performance measure ranking (4>Alt3>Alt1>Alt2) because salinity is the only driver for the HSI, as it is for the other two HSIs reported below. Note that for the three locations that have the lowest crocodile HSI performance, there is almost no difference between alternatives, with alternatives 3 and 4 performing nearly identically.

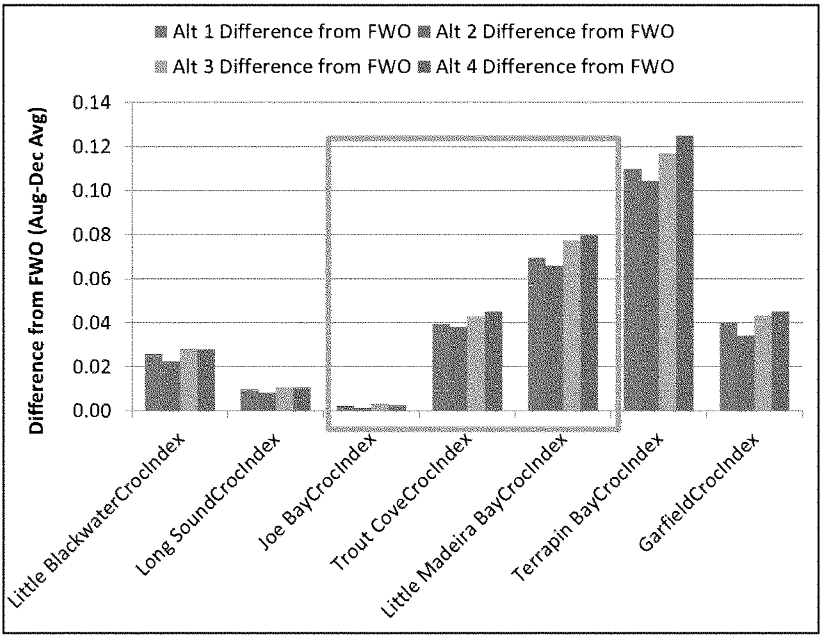

Figure E.5-9. Histogram showing the results of the juvenile crocodile HSI for 7 locations of know crocodile nesting areas. Index values show lift provided by alternatives compared to FWO.

Results of the juvenile crocodile HSI performance for an extremely dry (1989) year are shown in **Figure E.5-10**. For the three highest performing locations (Trout Cove, Little Madiera Bay, and Terrapin Bay), alternative 4 performed noticeably better than the other three alternatives. However, determination of any statistical significance between alternatives is not possible. At sites with very low lift values (<0.02), differences between alternatives was minimal.

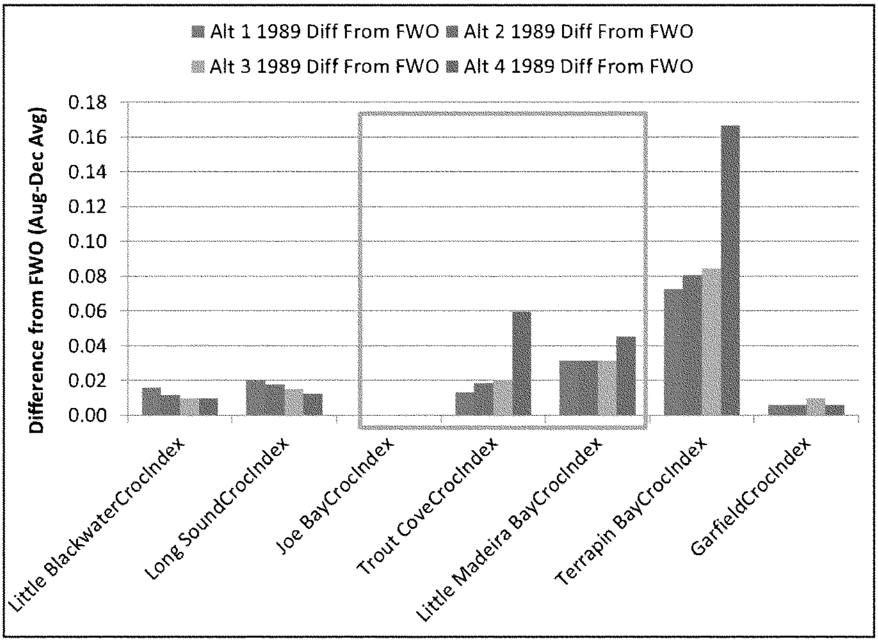

Figure E.5-10. Histogram showing the results of the juvenile crocodile HSI for 7 locations of known crocodile nesting areas during 1989 (very dry year). Index values show lift provided by alternatives compared to FWO.

Juvenile Spotted Seatrout:

The juvenile spotted seatrout HSI model was run on the monthly average salinities from May through November to coincide with spotted seatrout juvenile recruitment for all CEPP scenarios. The HSI model output from the salinity monitoring stations in Florida Bay was gridded to produce spatial distributions of HSI scores for each month. This allowed for the calculation of area of optimal juvenile spotted seatrout habitat in square kilometers. The mean area of optimal juvenile spotted seatrout for each scenario for the entire period of record is shown in **Figure E.5-11**. The error bars reflect the standard error for the data set. The natural system model serves as the target for this analysis. It had the largest mean area of optimal juvenile spotted seatrout habitat at 368 km^2. The future without project was the lowest followed by existing conditions baseline. All four CEPP alternatives showed improvements over FWO and ECB. A Mann-Whitney U-test was applied to conduct pair-wise comparisons among all of the scenarios. All four CEPP alternatives had significantly higher areal extent of optimal habitat for juvenile spotted seatrout (α=0.1) compared to FWO. However, there were no significant differences among any of the alternatives (α=0.1).

To ease in the interpretation of the spotted seatrout data, the percent increase in area of optimal juvenile spotted seatrout relative to the future without project is depicted in **Figure E.5-12**. The four CEPP alternatives showed increases from 44% for alternative 1 up to 65% for alternative 4. Alternatives 2 and 3 were in the middle showing 49% and 52% increase, respectively. The juvenile spotted seatrout analysis shows that all four CEPP alternatives showed statistically significant improvement over FWO.

The differences among the alternatives were not statistically significant, but suggest alternative 4 has the highest potential to show the greatest gains for spotted seatrout in Florida Bay.

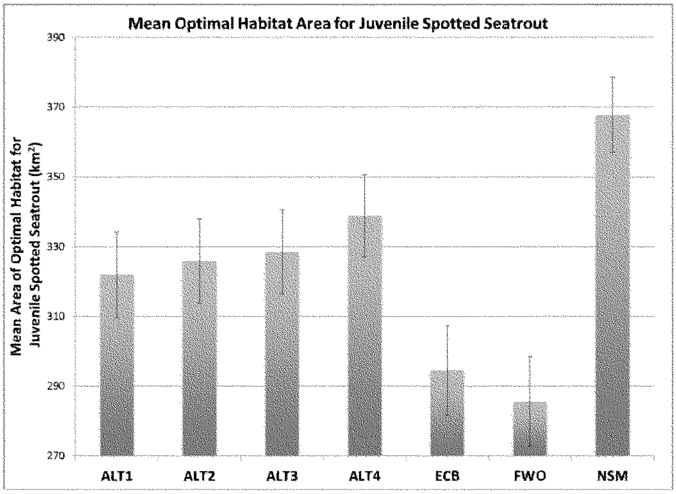

Figure E.5-11. Histogram showing the mean optimal habitat area of the juvenile spotted seatrout HSI for NSM (target), ECB, FWO and the four CEPP alternatives.

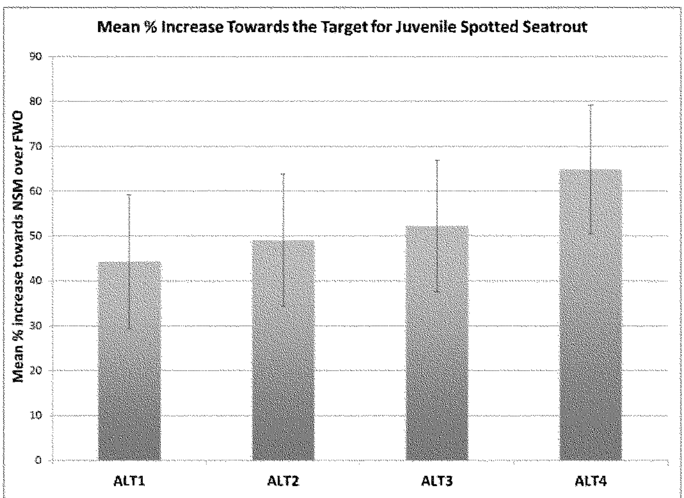

Figure E.5-12. Histogram showing the mean increase towards the target for the juvenile spotted seatrout HSI for the four CEPP alternatives relative to FWO.

Pink Shrimp:

Results of the 41-year simulations of potential harvests from two representative Florida Bay basins, Whipray Basin in north central Florida Bay and Johnson Key Basin in western Florida Bay, are shown in **Figure E.5-13** and **Figure E.5-14.** Results show the lift above FWO (as percent of FWO) in potential harvests from each of the four alternatives. The equation for calculating lift as percent of FWO was as follows: 100 x (ALT_x – FWO) / FWO, where ALT_x is simulated potential harvest from a given alternative and FWO is simulated potential harvest from future without salinity conditions. Each alternative provides lift in potential harvest over FWO. The lift in each case is a small percentage of FWO (i.e., 1.05%, at most). In both areas, the lift provided by Alt 4 is greater than that of the other three alternatives. Alternative 1 provides the least lift. Variation across alternatives in most years is less than inter-annual variation.

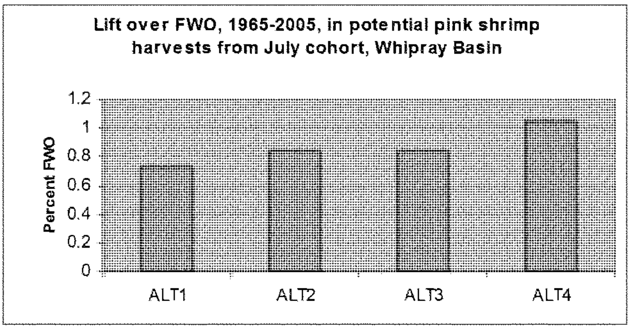

Figure E.5-13. Histogram showing the results of the potential pink shrimp harvest in Whipray Basin for the 1965-2005 period of record for model output.

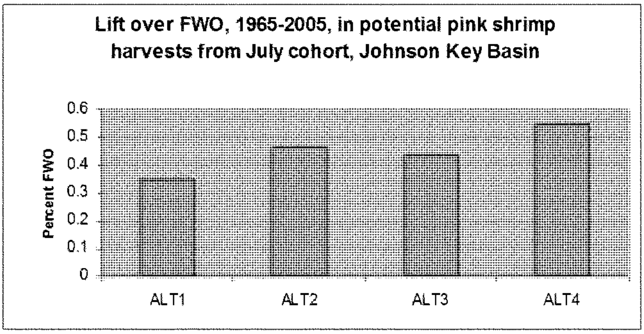

Figure E.5-14. Histogram showing the results of the potential pink shrimp harvest in Johnson Key Basin for the 1965-2005 period of record for model output.

Submerged Aquatic Vegetation

The desired outcome of restoration of freshwater flows is a more diverse, mixed SAV community, characterized by enhanced *Ruppia* habitat in the northern sites and mixed *Thalassia-Halodule* in sites farther from freshwater sources. Downstream sites modeled included TR (Little Madeira Bay downstream of Taylor River mouth), WB (Whipray Basin in the central bay) and TC (Trout Cove in the eastern bay). The TC model is not yet fully calibrated and provisional results are provided here for illustration purposes only.

The SEACOM output for TR under NSM hydrology (**Figure E.5-15**) shows a fully diverse mix of SAV species under the wetter conditions resulting from greater freshwater flows from the pre-drainage Everglades relative to the ECB (**Figure E.5-16**). *Thalassia* is more constrained by lower salinities under NSM, while *Halodule* and *Ruppia* thrive. The FWO scenario for Taylor (not shown) reflects little change from the ECB, with no *Ruppia* present and stable *Thalassia* and *Halodule*. CEPP alternatives 3 and 4 produce the most favorable outcomes for restoring Florida Bay SAV at Taylor River (Alt 4 shown in **Figure E.5-17**). Both result in mixed stable communities of three SAV species. Alternatives 1 and 2 both produce similar results, though with less *Ruppia*. NSM conditions for Whipray (not shown) reflect a stable mix of *Thalassia* and *Halodule*, with *Thalassia* dominating and no presence of *Ruppia*. These results are similar to the ECB (**Figure E.5-18**) and FWO scenarios for Whipray, indicating little difference between historic pre-drainage conditions and current conditions at that site, which is distal from freshwater sources in the central bay. All four CEPP alternatives for WB show slight increases in *Halodule*, slightly improving the balance of SAV, with no occurrence of *Ruppia*.

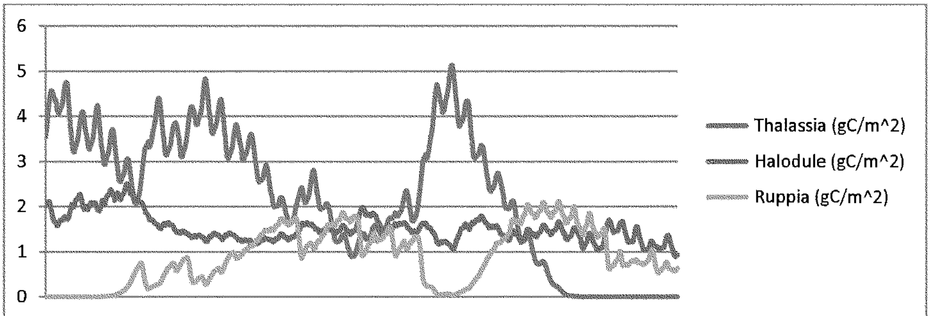

Figure E.5-15. Seagrass community at Little Madeira Bay/Taylor River (TR) under NSM hydrology; 40-yr simulation.

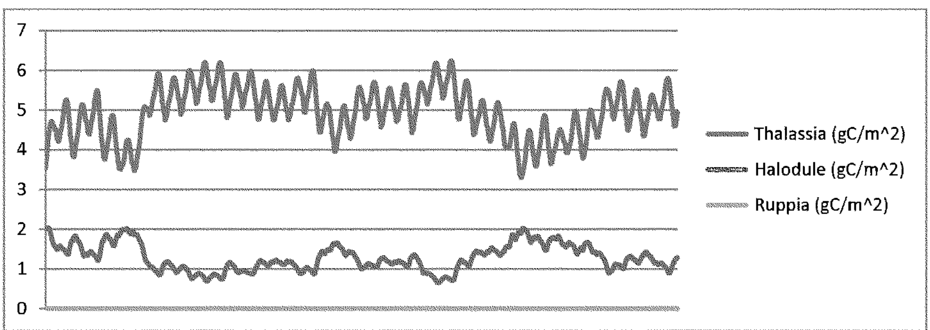

Figure E.5-16. Seagrass community at Little Madeira Bay/Taylor River (TR) under ECB hydrology (similar to FWO).

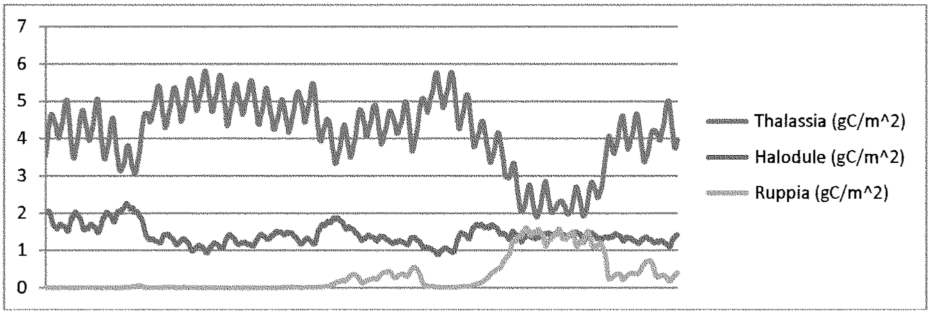

Figure E.5-17. Seagrass community at Little Madeira Bay/Taylor River (TR) under Alt4 hydrology (similar to Alt3).

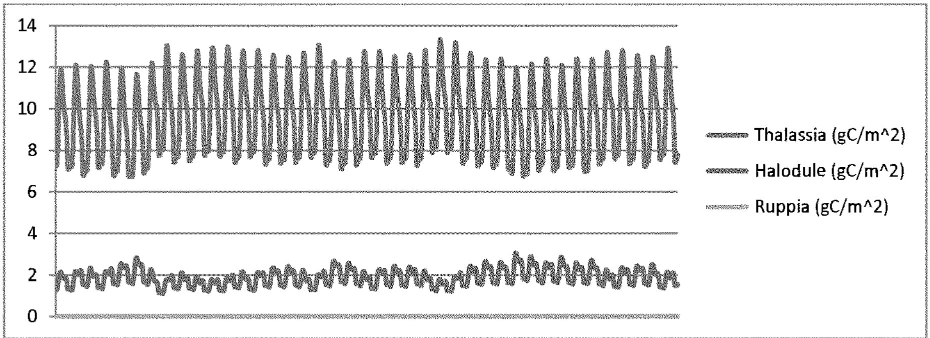

Figure E.5-18. Seagrass community at Whipray Basin (WB) under ECB hydrology; 40-yr simulation.

For Trout Cove, downstream of Joe Bay and the C111 Basin, both the ECB (**Figure E.5-19**) and FWO (not shown) runs exhibit a healthy mixed community of *Thalassia-Halodule* with no presence of *Ruppia*. For each of the CEPP alternative runs, the Trout Cove SAV community was greatly improved with a strong presence of the low-salinity *Ruppia* species and a better balance of *Thalassia* and *Halodule*. Alternative 4 (**Figure E.5-20**) produced the best results, followed in order by alternatives 3, 1 and 2. Results for Trout Cove are provisional. SEACOM model results indicate that in areas influenced by Everglades discharge, the SAV community stands to be significantly improved by CEPP, with alternative 4 producing the most favorable results, followed closely by alternative 3.

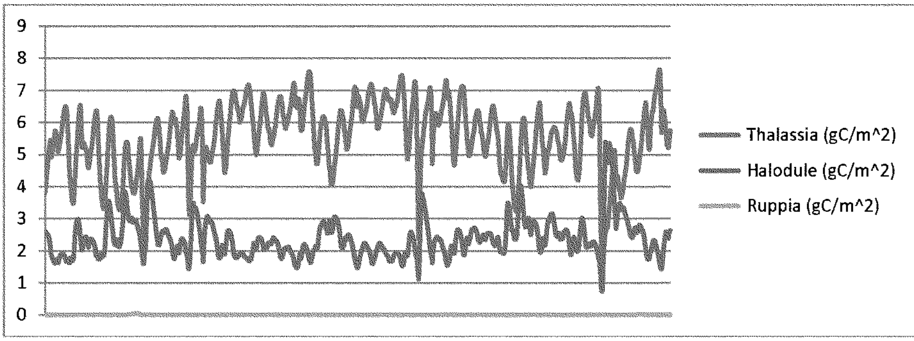

Figure E.5-19. Seagrass community at Trout Cove (TC) under ECB hydrology (similar to FWO); 40-yr simulation.

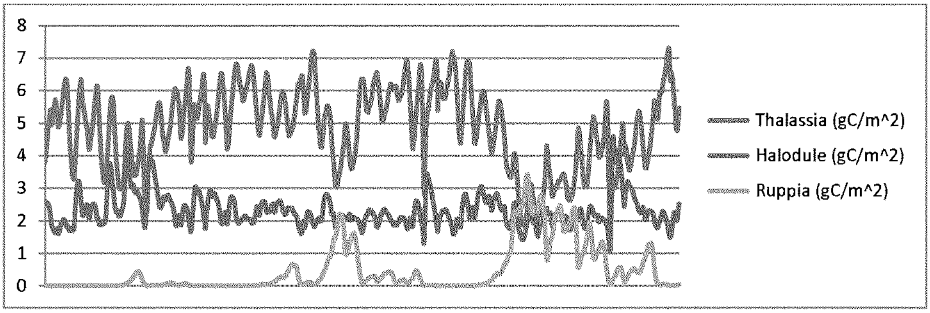

Figure E.5-20. Seagrass community at Trout Cove (TC) under Alt 4 hydrology (similar to Alt 3).

Biscayne Bay

Flow at Coastal Structures

Evaluation of the coastal structure flow begins by comparing total flows at all coastal structures for ECB, FWO, and the four CEPP alternatives (**Table E.5-1**). Results indicate that flows under FWO and all alternatives are greater than ECB, but not by much. Alternative 2 provides the most additional flows at 7% more than ECB; whereas, alternative 4 provides only 0.3% more water than ECB. Just as importantly, all alternatives except alternative 2, provide less flow to the bay than FWO. Alternative 4 coastal structure flows are 4% less than FWO (about 62 cfs/year), which is the alternative that has the greatest reduction in flows compared to FWO. Alternative 2 provides 3% more flows to the bay compared to FWO.

Table E.5-1. Mean annual flows for all Biscayne Bay coastal structures. Differences between annual means off all alternatives compared to ECB and FWO (expressed in percent).

Total Flows at Biscayne Bay Coastal Structures	ECB	FWO		Alt1			Alt2			Alt3			Alt4		
	Mean	Mean	% diff ECB mean	Mean	% diff ECB mean	% diff FWO mean	Mean	% diff ECB mean	% diff FWO mean	Mean	% diff ECB mean	% diff FWO mean	Mean	% diff ECB mean	% diff FWO mean
	1234.2	1299.3	+5	1285.4	+4	-1	1333.9	+7	+3	1252.7	+1	-4	1237.1	+0.3	-5
Means are in cubic feet per second.															

The following results break down the Biscayne Bay coastal structure flow by region (North Bay, Central Bay, South Bay, Manatee Bay/Barnes Sound). Results from the flow analyses and salinity performance measure evaluation are presented together for each of the four regions. Flow evaluations are presented as stoplight indicator tables to better illustrate flow conditions relative to FWO. Alternatives are first compared against FWO, then alternatives and FWO are compared against ECB. Because CEPP is to not affect Biscayne Bay in any manner that would worsen it from existing conditions, the comparison of FWO and the alternatives against ECB is necessary to understand the effects of the different model assumptions made in the ECB and future conditions (FWO and alternatives).

North Bay:
The mean annual flow stoplight indicator results for the three coastal structures in the North Bay region are shown in **Table E.5-2**. Alternative 2 shows increased flows relative to FWO of up to 4.4% (S-29). Alternative 4 shows a decrease in flows of between 1% and 2% compared to FWO. Alternatives 1 and 3 show no appreciable change in flow relative to FWO.

Table E.5-2. Stoplight table showing flow analysis results for three coastal structures in North Biscayne Bay.

Structure	Basin	ALT1	ALT2	ALT3	ALT4
S29	C-9	0.00%	4.43%	-0.73%	-2.12%
S28	C-8	-0.21%	1.07%	-0.54%	-0.97%
S27	C-7	0.17%	1.92%	-0.26%	-1.14%
Green=greater than 1% mean increased flows					
White=0% to +- less than 1% mean change					
Yellow=1% to less than 5% mean decrease					

Mean annual flows of each alternative and FWO compared to ECB for the three coastal structures in North Bay are shown in **Table E.5-3**, together with the salinity performance measure evaluation results for S-29. Compared to FWO, flows reflect the stoplight table above. Compared to ECB, mean annual flows for all alternatives and FWO are significantly higher at S-29 and slightly higher at S-28. There appears to be little change in flow at S-27. The values for the performance measure are interpreted as the percent of time the daily flows are within the flow target envelope. When compared to FWO, results indicate daily flows fall within the target envelop a slightly higher percentage of time (2% higher for alternatives 1, 3, and 4, and 4% higher for alternative 2).

Table E.5-3. Mean annual flows at the three coastal structures in North Bay for all alternatives, FWO and ECB, plus results from the salinity performance measure for S-29 (C-9 canal).

Structure	ECB		FWO			Alt1			Alt2			Alt3			Alt4		
	Mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM
S29	282.8	68	372.3	32	79	372.3	32	81	388.8	38	83	369.6	31	81	364.4	29	81
S28	90.9	-	93.2	3	-	93.0	2	-	94.2	4	-	92.7	2	-	92.3	2	-
S27	115.2	-	114.5	-1	-	114.7	0	-	116.7	1	-	114.2	-1	-	113.2	-2	-

Means are in cubic feet per second.
†PM includes flow from S26+S25B+S25

Central Bay:
The mean annual flow stoplight indicator results for the five coastal structures in the Central Bay region are shown in **Table E.5-4**. Alternative 2 again shows increased flows relative to FWO at all structures of up to 4.5% (G-93). Alternative 4 shows a marked decrease in flows at all structures of between 4.5% and 8.9% compared to FWO. Alternatives 1 and 3 show no appreciable change in flow relative to FWO.

Mean annual flows of each alternative and FWO compared to ECB for the five coastal structures in Central Biscayne Bay are shown in **Table E.5-5**, together with the salinity performance measure evaluation results for S-26 and S-22. Compared to FWO, mean annual flows reflect the percentage increases or decreases in stoplight table above. Mean annual flows for all alternatives and FWO are lower than ECB at all structures. Compared to ECB, the largest decreases in flow occur under alternative 4 and the least reductions in flow occur under alternative 2. Performance measure results indicate that at the S-26 structure compared to FWO, daily average flows fall within the target envelop 1% of the time more under alternative 1, 1% and 2% of the time less under alternatives 3 and 4, respectfully. There is no change in performance for alternative 2 compared to FWO for the S-26 performance measure. For the S-22 performance measure, alternatives 1 and 2 indicate no change compared to FWO; whereas, alternatives 3 and 4 show a reduction in time within the target envelope of 1%.

Table E.5-4. Stoplight table showing flow analysis results for five coastal structures in Central Biscayne Bay.

Structure	Basin	ALT1	ALT2	ALT3	ALT4
S26	C-6	-1.98%	17.27 %	-5.50%	-8.93%
S25B	C-4	0.88%	2.64%	-2.64%	-5.27%
S25	C-5	0.00%	1.04%	-4.17%	-6.25%
G93	C-3 West	1.12%	4.49%	-1.87%	-4.49%
S22	C-2	0.88%	3.25%	-2.63%	-5.27%
Green=greater than 1% mean increased flows					
White=0% to +- less than 1% mean change					
Yellow=1% to less than 5% mean decrease					
Red=5% to less than 10% mean decrease					

Table E.5-5. Mean annual flows at the five coastal structures in Central Biscayne Bay for all alternatives, FWO and ECB, plus results from the salinity performance measure for S-26 (C-6 canal) and S-22 (C-2 canal).

Structure	ECB		FWO			Alt1			Alt2			Alt3			Alt4		
	Mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM
S26†	124.6	35	116.4	-6	32	114.1	-8	33	136.5	10	32	110.0	-12	31	106.0	-15	30
S25B	109.3	-	102.4	-6	-	103.3	-5	-	105.1	-4	-	99.7	-9	-	97.0	-11	-
S25	9.7	-	9.6	-2	-	9.6	-2	-	9.7	-1	-	9.2	-5	-	9.0	-7	-
G93	28.4	-	26.7	-6	-	27.0	-5	-	27.9	-2	-	26.2	-8	-	25.5	-10	-
S22	121.2	12	113.9	-6	12	114.9	-5	12	117.6	-3	12	110.9	-9	11	107.9	-11	11

Means are in cubic feet per second.
†PM includes flow from S26+S25B+S25

South Bay:

The mean annual flow stoplight indicator results for the five coastal structures in the South Bay region are shown in **Table E.5-6**. All alternatives show reductions in flow at the S-21, S-21A, and S-20F structures compared to FWO. Alternatives 3 and 4 also show reduction in flows at the S-123 structure compared to FWO, and they show similar overall reductions in flow at the aforementioned structures, which are higher reductions compared to alternatives 1 and 2. Alternatives 1 and 2 appear to show similar overall reductions in flow. Results from S-20G Military Canal) are reported as not valid. The sole function of this canal is to provide stormwater drainage from Homestead Air Reserve Base and is not affected by the overall operation of the South Dade Conveyance System and; therefore, CEPP would have no effect on this canal.

Table E.5-6. Stoplight table showing flow analysis results for 5 coastal structures in South Biscayne Bay.

Structure	Basin	ALT1	ALT2	ALT3	ALT4
S123	C-100	0.58%	0.00%	-4.05%	-5.78%
S21	C-1	-4.32%	-1.18%	-15.60%	-16.00%
S21A	C-102	-7.26%	-9.41%	-12.87%	-10.56%
S20G	HARB	*	*	*	*
S20F	C-103	-4.40%	-4.91%	-4.98%	-4.52%
S20	C-107/Model Land	0.00%	0.00%	0.00%	0.00%
Green=greater than 1% mean increased flows					
White=0% to +- less than 1% mean change					
Yellow=1% to less than 5% mean decrease					
Red=5% to less than 10% mean decrease					
Purple= 10% or greater mean decrease					
*Simulation not valid.					

Mean annual flows of each alternative and FWO compared to ECB for the five coastal structures in South Biscayne Bay are shown in **Table E.5-7**, together with the salinity performance measure evaluation results for S-123, S-21, S-21A, and S-20F. Compared to FWO, mean annual flows reflect the percentage increases or decreases in stoplight table above. Mean annual flows for all alternatives and FWO are lower than ECB at all structures. Compared to ECB, the largest decreases in flow occur under alternative 4 and the least reductions in flow occur under alternative 2. .Salinity performance measure results indicate that for the S123 coastal structure, there is no change for alternatives 1 and 2 compared to FWO, but alternatives 3 and 4 show slight reduction of 1 and 2 percent, respectively. For the S-21 structure, all alternatives show a reduction in performance compared to FWO ranging from 1 percent reduction under alternative 1 to 8 percent reduction under alternative 3. For the S21A, alternative 1 performs the same as FWO, but the other three alternatives show a reduction in the time flow falls within the target envelope (alternative 2 shows a 3 percent reduction, alternative 3 shows a 5 percent reduction and alternative 4 shows a 4 percent reduction). For the S20F coastal structure, performance measure results indicate all alternatives perform the same as FWO.

Table E.5-7. Mean annual flows at the five coastal structures in South Biscayne Bay for all alternatives, FWO and ECB, plus results from the salinity performance measure for S-123 (C-100 canal), S-21 (C-1 canal), S-21A (C-102 canal), and S-20F (C-103 canal).

Structure	ECB		FWO			Alt1			Alt2			Alt3			Alt4		
	Mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM
S123	17.5	22	17.3	-1	22	17.4	-1	22	17.3	-1	22	16.6	-5	21	16.3	-7	20
S21	101.3	67	101.9	1	66	97.5	-4	65	100.7	-1	62	86.0	-15	58	85.6	-15	61
S21A	58.2	46	60.6	4	47	56.2	-3	47	54.9	-5	44	52.8	-9	42	54.2	-7	43
S20G	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
S20F	145.7	43	154.7	6	43	147.9	2	43	147.1	1	43	147.0	1	43	147.7	1	43
S20	6.6	-	6.6	0	-	6.6	0	-	6.6	0	-	6.6	0	-	6.6	0	-
Means are in cubic feet per second.																	
*Simulation not valid.																	

To further investigate flow reductions at coastal structures in South Biscayne Bay, the data were analyzed on a seasonal basis. **Figures E.5-21** through **Figure E.5-24** show histogram plots of the results.

At the all but one of the coastal structures on the four major canals in this region, dry season flows always exhibit larger reductions in flow than the wet season compared to ECB. S-20F is the exception and shows an overall increase in flows compared to ECB with most of the increases occurring during the dry season. Also, all alternatives almost always show larger reduction in flow during the dry season compared to FWO than during the wet season.

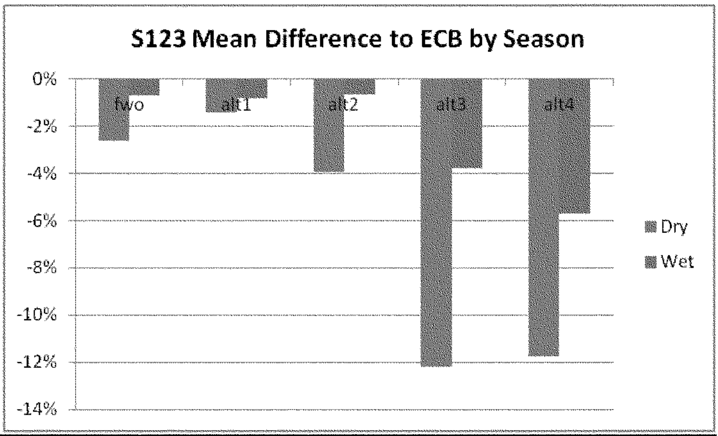

Figure E.5-21. Histogram showing the mean difference (percent) in flow at the S-123 structure (C-100 canal) compared to ECB for FWO and the four CEPP alternatives.

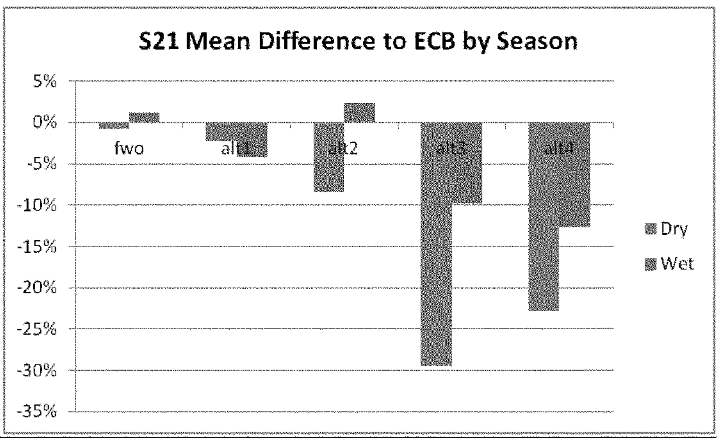

Figure E.5-22. Histogram showing the mean difference (percent) in flow at the S-21 structure (C-1 canal) compared to ECB for FWO and the four CEPP alternatives

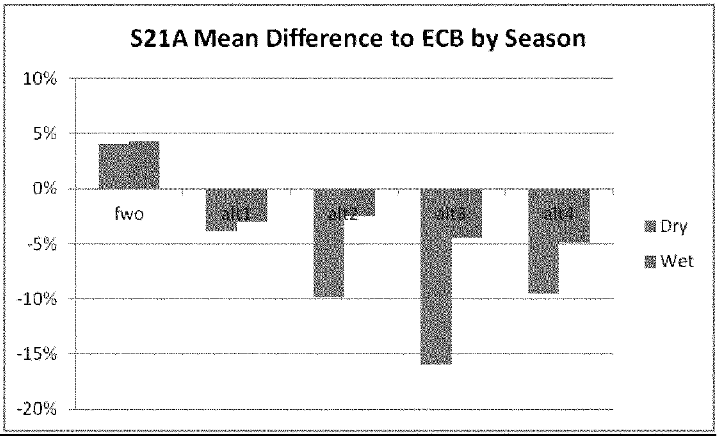

Figure E.5-23. Histogram showing the mean difference (percent) in flow at the S-21A structure (C-102 canal) compared to ECB for FWO and the four CEPP alternatives

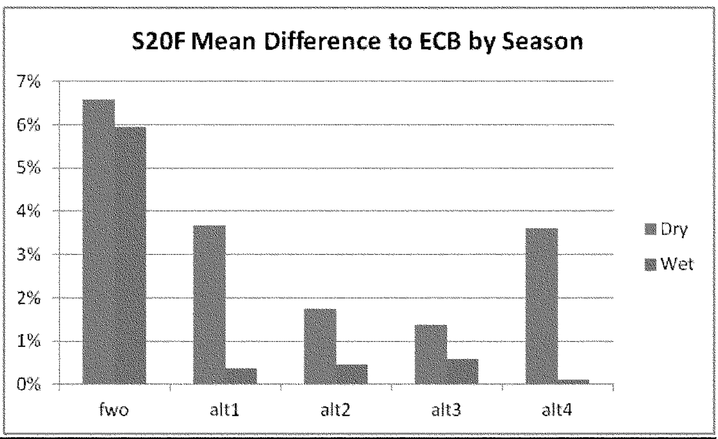

Figure E.5-24. Histogram showing the mean difference (percent) in flow at the S-20F structure (C-103 canal) compared to ECB for FWO and the four CEPP alternatives

Manatee Bay/Barnes Sound:

The mean annual flow stoplight indicator results for the two coastal structures providing freshwater flows to Manatee Bay and Barnes Sound are shown in **Table E.5-8** on next page. Results show no change in flows at S-20, but significant and similar increases in flow at S-197 for all alternatives compared to FWO. Results from the stoplight analysis for S-197 may be misleading because flows at this structure are relatively small compared to other coastal structures. **Table E.5-9** provides the mean annual flows of each alternative and FWO compared to ECB for these two water control structures, together with the salinity performance measure evaluation results for S-197. Flows at S-20 are exactly the same for ECB, FWO, and all alternatives. Note that all alternatives and FWO exhibit significant reductions in flow (from 50-60%) at S-197 compared to ECB. While the desired restoration scenario for Manatee Bay includes the reduction of flows through the S-197 structure, it is important to emphasize that the volume of water lost to the reduction in flows in FWO and the alternatives is not captured by another feature and redistributed to the region. This results in a net loss of freshwater flows to this particular region. Performance measure results indicate extremely poor performance for all scenarios, including ECB. All alternatives and FWO exhibit a decrease in percent time within the target envelop compared to ECB.

Table E.5-8. Stoplight table showing flow analysis results for two coastal structures providing flows to Manatee Bay and Barnes Sound.

Structure	Basin	ALT1	ALT2	ALT3	ALT4
S20	C-107/Model Land				
S197	C-111	18.5%	17.4%	21.7%	23.9%
Compared to the Future Without (FWO) Green=increased flows and improved PM performance. White=less than 1% mean decrease.					

Table E.5-9. Mean annual flows at the two coastal structures that provide freshwater flows to Manatee Bay and Barnes Sound for all alternatives, FWO and ECB, plus results from the salinity performance measure for S-197 (C-111 Canal).

Structure	ECB		FWO			Alt1			Alt2			Alt3			Alt4		
	Mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM	Mean	% ECB mean	% w/in PM
S20	6.6	-	6.6	0	-	6.6	0	-	6.6	0	-	6.6	0	-	6.6	0	-
S197	22.8	3.0	9.2	-60	1	10.9	-52	1	10.8	-52	1	11.2	-51	1	11.4	-50	1
Means are in cubic feet per second.																	

Flow at Divide Structures

As noted in Section 6.3 (Evaluation Methods), flows at certain divide structures were also evaluated because of model uncertainty associated with output at the coastal structures. Only flows at the S-338 (C-1 Canal), S-194 (C-102 Canal), and S-196 (C-103 Canal) were included in the analysis to further investigate the apparent severity of flow reductions in the South Bay region. Results show (**Table E.5-10** on next page) that all alternatives exhibit reductions in flow compared to ECB. Perhaps more importantly, all alternatives show substantial and alarming reductions in flow compared to FWO. The percent reductions range from 7 to 56%. Percent reductions compared to FWO are generally greatest at the S-196 structure and least at the S-338 structure. Alternatives 3 and 4 appear to have greater flow reductions compared to Alternatives 1 and 2 at S-338; whereas, flow at the other two divide structures are similar for Alternatives 1, 2 and 3. Alternative 4 exhibits less reduction than the other three alternatives at S-194 and S-196.

Table E.5-10. Mean annual flows at the three divide structures that feed major canals emptying into South Biscayne Bay for all alternatives, FWO, and ECB. The percent differences form ECB and FWO are also report.

Structure	ECB		FWO			Alt1			Alt2			Alt3			Alt4		
	Mean	% diff FWO mean	Mean	%dif ECB mean		Mean	%dif ECB mean	% diff FWO mean	Mean	%dif ECB mean	% diff FWO mean	Mean	%dif ECB mean	% diff FWO mean	Mean	%dif ECB mean	% diff FWO mean
S338	81.3	3	78.9	-3		70.6	-13	-7	73.4	-10	-7	40.1	-51	-49	45.5	-44	-42
S194	29.0	-19	35.6	23		21.9	-24	-38	21.6	-26	-39	23.3	-20	-35	25.6	-12	-28
S196	12.4	-34	18.9	53		9.1	-27	-52	8.4	-32	-56	8.4	-32	-56	9.9	-21	-48
Means are in cubic feet per second.																	

Flows at the divide structures were further analyzed for seasonal patterns. **Figures E.5-25** through **Figure E.5-27** show histogram plots of the results. At the S-338, reductions in flow are greatest under alternatives 3 and 4. At the S-338, flow reductions compared to FWO seasonal flow is greater during the dry season than the wet season for all alternatives except alternative 1, which shows the opposite pattern. For the S-194 and S-196 structures, percent reduction in flows compared to FWO are very large for all alternatives. Flow reductions compared to FWO at these two structures show seasonal flows are greater during the wet season than the dry season for all alternatives, and the wet season reductions are remarkably similar between alternatives at these two structures (approximately 60% at S-194 and approximately 70% at S-196. Flow reductions during the dry season at these two structures are least for alternative 4 and greatest for alternatives 2 at S-194 and alternative 3 at S-196.

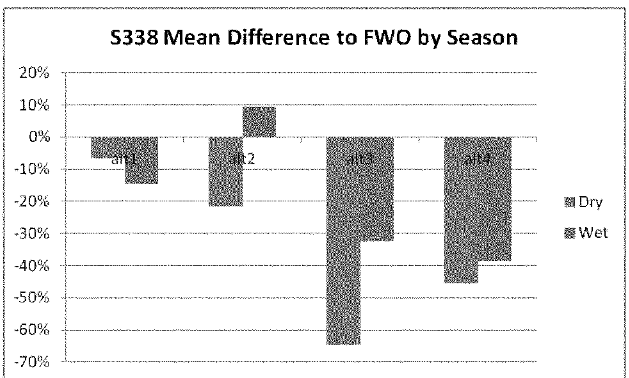

Figure E.5-25. Histogram showing the mean difference (percent) in flow by season at the S-338 for all alternatives compared to FWO.

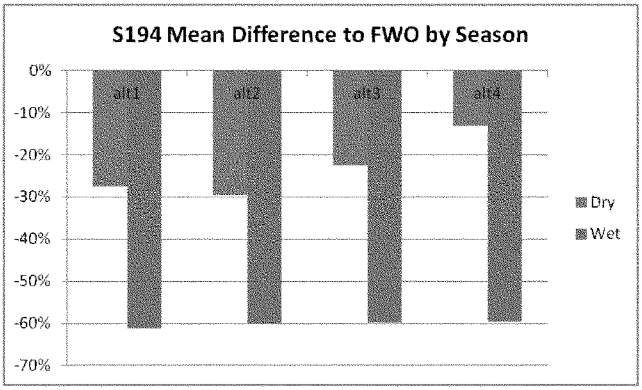

Figure E.5-26. Histogram showing the mean difference (percent) in flow by season at the S-194 for all alternatives compared to FWO.

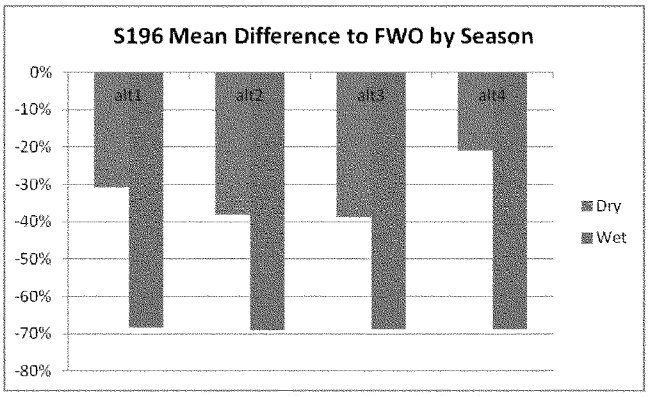

Figure E.5-27. Histogram showing the mean difference (percent) in flow by season at the S-196 for all alternatives compared to FWO.

E.5.5 Summary and Conclusions

Output from the RSM model predicts flow increases in major sloughs providing freshwater to Florida Bay for all CEPP alternatives compared to FWO, with substantial increases predicted for Shark River Slough, These predicted flow increases support the model-predicted salinity improvements in Florida Bay for CEPP alternatives compared to FWO. Flows at Transect 27 in Shark River Slough indicate significant increases (192K to 262K ac-ft/yr) for all alternatives compared to FWO, with alternative 4 providing the largest increase, including a 36% increase over alternative 2. However, flow analyses at Transect 23A in Taylor Slough indicate a slight increase (2-3K acre-feet/year) in flows above FWO for all alternatives, but almost no difference between alternatives.

All CEPP alternatives show an ecologically beneficial decrease in salinity compared to the FWO and ECB in Florida Bay. The Florida Bay salinity performance measure shows lift from all alternatives over FWO, with generally subtle differences between alternatives compared to improvements over FWO or ECB. However, predicted mean salinity for all alternatives is still higher than NSM conditions (about 2 to 9 psu greater than NSM in the dry season across different Florida Bay zones, but about 2 psu closer to NSM than salinity under FWO or ECB). Alternative 4, which yielded more flow through Shark River Slough, improves estuarine salinity conditions compared to the other alternatives The overall ranking of alternatives based on salinity is: alternative 4>alternative 3>alternative 1>alternative 2. Mean bay salinity in alternative 4 is about 0.4 psu less than in alternative 2. There appears to be a greater difference between alternatives when salinity is high. For example, in central Florida Bay, the maximum 75th percentile salinity level at the end of the dry season was 1.7 psu less for alternative 4 compared to alternative 2.

Model-predicted salinity improvements translated to a noticeable lift in juvenile spotted seatrout, pink shrimp, and juvenile crocodile habitat suitability indices and the SAV model results for all CEPP alternatives relative to FWO. However, differences between alternatives are modest and not statistically significant for seatrout, and may not be statistically significant for pink shrimp, crocodiles or SAV. The trend in the HSI data indicate that alternative 4 provides the most lift compared to the other alternatives. The alternative ranking based on the HSIs generally followed the salinity ranking pattern, but not always. In some areas, alternative 1 appears to perform poorer than alternative 2 (e.g., the pink shrimp HSI in Whipray and Johnson Key Basins).

Based on the hydrologic connections between Shark River Slough and the lower southwest coastal areas of Florida (e.g., Whitewater Bay), there is high likelihood that the lower southwest coastal areas would experience significant ecological benefits from any CEPP alternative, perhaps even more benefits than those predicted for Florida Bay. However, benefits to the lower southwest coast could not be quantified to be added to CEPP evaluations due to the lack of salinity and ecological models in that region.

In Biscayne Bay, model results indicate that for total flows at all coastal structures combined all alternatives, except alternative 2, provide less flow to the bay than FWO. Alternative 4 flows are 4% less than FWO (about 62 cfs/year), which is the alternative that has the greatest reduction in flows compared to FWO. Alternative 2 provides 3% more flows to the bay compared to FWO. The evaluation of structure flow by bay region indicates there is generally no change or an increase in flows through the northern Biscayne Bay coastal structures from CEPP alternatives compared to FWO for alternatives 1, 2, and 3. Alternative 4 shows slight decreases in flow compared to FWO at two of the three coastal structures. Modeling exhibits a general reduction in flow at most coastal structures in central and southern Biscayne Bay from CEPP alternatives compared to FWO. Reductions in flows appear to be most extreme at several of the coastal structures in the area of Biscayne National Park and CERP's Biscayne Bay Coastal Wetlands (BBCW) Project. Reductions in flows to the coast may result in increased salinity conditions in Biscayne Bay, negatively impacting the ecological status of Biscayne National Park and other areas of Biscayne Bay. A reduction in flows to the BBCW Project may not allow the project to achieve predicted restoration results as described in the final PIR. In general alternative 4 causes the most reductions in flow and alternative 2 causes the least. Overall ranking of alternatives based on flows and the salinity performance measures at the Biscayne Bay coastal structures is the opposite of that for Florida Bay: alternative 2>alternative 1>alternative 3>alternative 4. Compared to FWO, when reductions in flow are exhibited in the model output they are generally greater during the dry season.

In contrast to the comparison above to FWO flows, the alternatives provide annual average flows to coastal structures equal to or greater than flows provided under ECB. However, this similarity is a result of increased flows to northern Biscayne Bay structures along with decreased flows to central and southern structures. This indicates that Adaptive Management should consider a need to redistribute water in both space and time.

Because the level of model uncertainty of predicted flows at the coastal structures is of concern, the flows at divide structures that provide flows from the Everglades to south Biscayne Bay were included in the evaluation. The three divide structures (S-338, S-194, S-196) that feed freshwater flow from the Everglades to south Biscayne Bay shows substantial reductions in flow for all alternatives compared to FWO (7% to 56% volume reductions compared to FWO). Compared to FWO, reductions at S-338 are generally greater during the dry season; whereas, the opposite seasonal pattern is exhibited for the S-194 and S-196.

The apparent reductions in flows at the divide structures and the central and southern Biscayne Bay coastal structures are of concern because they may negatively impact the ecological status of Biscayne National Park and effectiveness of CERP's BBCW Project, including meeting the BBCW Project's canal discharge targets. Aside from some alternatives providing less flow to the bay compared to FWO in some areas, there is also concern that FWO and CEPP alternatives provide less flow compared to ECB in some areas compared, particularly in central and south Biscayne Bay. Overall, it appears that the alternatives that provide the most water to Everglades National Park provide the least water to Biscayne National Park, and vice versa, may be associated with the level of protection provided by the proposed seepage management features and operational protocols employed. These concerns are to be addressed in the CEPP Savings Clause and Assurances analyses and be incorporated into the CEPP Adaptive Management Plan to be addressed during CEPP's implementation and operation.

E.5.6 References

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E.6 RECOVER CONSISTENCY REVIEW: PROJECT-LEVEL MONITORING AND ADAPTIVE MANAGEMENT PLAN

Central Everglades Planning Project

November 13, 2013

E.6.1 Introduction and Purpose of the Evaluation

In accordance with CERP Guidance Memorandum 40.02 and other relevant guidance (e.g., CERP Guidance Letter 12/06), RECOVER must review the Central Everglades Planning Project (CEPP) project level monitoring plan in regards to consistency with the existing Monitoring and Assessment Plan (MAP 2009) to prevent duplication of monitoring activities. Additionally, in this review, RECOVER evaluates the need for project-level monitoring to fill temporal or spatial gaps for parameters monitored in the MAP 2009 in order to evaluate project-level effects. As projects are typically not at the construction stage when this Review is prepared, and that a variety of changes may occur between now and operational readiness of the Project, this Review should be considered an interim document. Future developments may require modification of monitoring plans and/or revision of this Review. This document provides RECOVER's recommendations to the Project PDT regarding incorporation of proposed monitoring into the project.

Adequate monitoring is needed to effectively implement RECOVER's adaptive management (AM) principals per Federal Principals and Requirements for Federal Investments in Water Resources (Mar 2013)] and USACE implementation guidance of Section 2039 of the Water Resources Development Act of 2007– Monitoring Ecosystem Restoration , and to be in coordination with the CERP RECOVER AM strategy (http://www.evergladesplan.org/pm/program_docs/adaptive_mgmt.aspx). MAP related monitoring generally has as its goal the generation of long-term datasets of sufficient temporal and spatial scope to permit valid interpretation(s) and consequently facilitate effective adaptive management of system-wide restoration over the long-term. Proposed monitoring, as envisioned by CERP project teams, must address the reality that finite resources and rising costs are additional considerations that must be included when prioritizing monitoring needs. The objectives of the review are to identify monitoring elements appropriate and necessary to be incorporated into the Project and coordinated with the MAP to verify restoration performance of the project and drive adaptive management for the project, as needed.

Project-level monitoring typically involves monitoring that is: 1) required by permit, 2) directly related to project operations (e.g., stage and flow), and 3) to be used for assessing overall project performance, and 4) to adaptively manage the individual project components and its interaction with the larger group of project components into the future.

E.6.2 Background

The Greater Everglades ecosystem has been significantly altered by human activities. Historically, freshwater flowed in a north-south direction from Lake Okeechobee to Florida Bay. This pattern has been altered by regional drainage of freshwater flow patterns and volumes that have resulted in the loss of ridge-slough pattern in the freshwater wetlands and an inland migration of saline conditions in both the groundwater and surface waters such that the expansion of moderate to high salinity zones have diminished the spatial extent of freshwater wetland habitats, and have allowed the landward expansion of saltwater and mangrove wetlands. Prior to the hydrologic changes described above, freshwater and mangrove marshes provide important habitat for wetland species and are indicators of healthy Everglades and coastal wetlands. Among other things, the hydrologic change to the system has caused a significant degradation of both the freshwater and the estuarine environments that has resulted in the loss of or reduction in populations of important estuarine species that once were abundant in the area, including Spoonbills, Wood Storks, and Alligators among other wildlife. Efforts of CEPP focus on re-directing flow to re-establish more natural overland flow regimes that will provide appropriate hydropatterns and salinity regimes to re-establish and maintain key habitats within the Greater Everglades, including the Everglades National Park and Florida Bay.

E.6.3 CEPP Adaptive Management and Monitoring Plans

Adaptive Management Plan

The Adaptive Management (AM) Plan provides the strategies to address prioritized project uncertainties that will be faced as CEPP progresses toward achieving project restoration goals and objectives while remaining within constraints. Each strategy follows a scientific approach that uses performance measures, monitoring, triggers and/or thresholds to inform restoration progress and support decisions regarding the need to adjust CEPP to improve restoration performance. Suggestions for informing future increments of CERP that were discussed by the AM team during the development of the CEPP AM Plan have been included, but demarcated to show that they are not expected to be authorized as part of the CEPP Plan. Rather, these are described here to ensure the best current understanding of needs that may be considered in the future to further improve restoration. Therefore, the management options included in this AM plan are specific to informing CEPP implementation and can be described as the following:

1. *Informing CEPP Implementation* - results of monitoring a project component inform next phase of project component design and construction sequencing,
2. *Inform Project Operations* - results inform project operations or system operating manuals,
3. *CEPP Adaptive Management Contingency Options* - results inform potential additional restoration actions that are part of CEPP's authorization.

Water Quality Monitoring Plan

The Water Quality Plan contains the necessary monitoring to ensure CEPP implementation complies with all applicable State water quality standards.

Hydrometeorological Monitoring Plan

The Hydrometeorological Plan identifies the necessary hydrologic and meteorologic monitoring needed to operate new CEPP project structures along with the existing Central and Southern Florida (C&SF) structures.

Ecological Monitoring Plan

The primary purpose of the CEPP Ecological Monitoring Plan is to identify the monitoring necessary to inform decision-makers, CEPP partner agencies, and the public on CEPP's achievement of its project objectives, i.e., its achievement of restoration success. Given the scope and scale of CEPP, the ecological monitoring and the monitoring identified in the AM plan are not one-and-the-same because the ecological monitoring plan focuses on CEPP's success at meeting project objectives (per WRDA 2007 guidance) even though the AM action to improve restoration success may be outside the authorized scope of CEPP and require a new CERP project or action. The monitoring specified in the AM plan focuses on addressing project uncertainties and provides a feedback mechanism to management (per WRDA 2007 and subsequent guidance) to improve CEPP project implementation in achieving restoration success. Also, the AM plan focuses on project adjustments to improve project performance, and the monitoring described in that plan will inform such adjustments. The plans have been designed to work together and inform each other as much as possible and it is encouraged that any future refinements of these plans include continual improvements of the streamlining between plans.

E.6.4 RECOVER Recommendations

General Comments

The CEPP Adaptive Management and Monitoring Plans are consistent with, and complimentary to the MAP, neither duplicating nor replacing this program per May 27, 2010 guidance from USACE South Atlantic Division on Section 2039(a) of WRDA 2007 to use existing system-monitoring to the extent possible to evaluate restoration success of the project. The plan also acknowledges the guidance present in CGM40, CGM42, and the QASR.

RECOVER recommends that the hydro-meteorological and ecological monitoring should be integrated with the AM monitoring and will be the restoration success indicators that are communicated to managers to be able to make decisions to adjust project design, construction, sequencing, operations, or implement contingency options.

RECOVER recommends that existing multiagency funding levels for the water quality, hydro-meteorological and ecological monitoring that CEPP is relying upon need to be maintained for CEPP to be able to verify restoration success and inform any needed AM changes.

If MAP funding is reduced, then CEPP will need to fund the MAP monitoring that is required for the project, or will lose the ability to verify restoration success and inform needed changes to implementation to improve restoration success in the most efficient and cost effective manner.

Many of the MAP monitoring programs are funded from multiple funding sources. CEPP needs to be cognizant of this and include potential contingencies to handle unforeseeable future reduction in support of these programs.

CEPP and RECOVER need to be cognizant that the CEPP will result in large manmade changes to the landscape (such as the FEB and major hydrologic changes to the Greater Everglades Ecosystem). There is a need to ensure that the system-wide view is maintained and coordinated between the CEPP PDT and RECOVER.

RECOVER recommends that all monitoring (water quality, hydro-meteorological and ecological) be reviewed every 3-4 years to ensure the monitoring remains relevant, provides the information required, and to implement changes that improve efficiency and effectiveness of monitoring execution and results.

The Draft PIR and EIS in Section 1.5 of Annex D states RECOVER will coordinate adaptive management monitoring, analysis, and reporting. The plan states CEPP funds will be used to fund monitoring in the absence of Adaptive Assessment and Monitoring project funds. Prior to the implementation of the PLMP, RECOVER will recommend coordination activities for incorporation into the CEPP PMP as needed by both projects to meet the requirements of the Programmatic Regulations for systemwide adaptive management and to govern the success of the project, realizing that shared resources may continue to be necessary. This proposal will clearly state the RECOVER "coordination" activities needed and will describe the data management, data analysis, and reporting tasks provided by RECOVER to support the project. RECOVER recommends that the AM and Monitoring Plan clearly identify the resources needed to provide QA/QC, analysis, reporting and data management for the additional CEPP monitoring. The plan also needs to clarify who is coordinating the data management, analysis and reporting of the CEPP specific data.

General Adaptive Management Plan Comments

RECOVER believes the development and support of tools used by CEPP during the Planning phase that provide efficient data analysis such as EDEN, the Florida Bay Salinity PM, and ecological models (oyster, fish, crocodile HSIs, SAV) are necessary to support timely feedback to AM when changes are made or to show project performance.

RECOVER recommends more detail in the Table D.1.1 and Table D.4.1 to clarify the differences between existing ecological monitoring and the CEPP AM proposed monitoring.

General Water Quality Monitoring Plan Comments

RECOVER recommends that all existing water quality stations that CEPP is going to rely upon be added to the Water Quality Monitoring Plan.

General Hydrometeorological Monitoring Plan Comments

RECOVER recommends that all existing hydrometeorological stations that CEPP is going to rely upon be added to the Hydrometeorological Monitoring Plan and that the footprint of this plan be expanded to include the coastal stations.

General Ecological Monitoring Plan Comments

RECOVER recommends that the CEPP monitoring targets in Table D.4.1 are reviewed to ensure they are consistent with RECOVER PM targets and CERP targets prior to implementation of the CEPP PLMP.

RECOVER recommends that the monitoring target column is clarified to ensure it is clear that the table reflects CEPP targets, not the "interim goals" or full restoration target.

RECOVER suggests that additional details be included in the monitoring plan text and Table D.4.1 to ensure institutional knowledge is captured.

Lake Okeechobee Comments

Will CEPP monitor the water flow from Lake Okeechobee to the Northern Estuaries, C-44 and C-23 due to CEPP operations?

If the funding for the existing SAV monitoring in Lake Okeechobee ends, CEPP may be responsible for continuing that monitoring.

Northern Estuaries Comments
RECOVER supports the focus of monitoring locations and indicator species on locations where we expect changes in flows due to CEPP.

RECOVER agrees that the monitoring data and analysis in this area will provide important information to operations managers and therefore, are best captured in the AM plan.

EDEN stations are not located in the Northern Estuaries and Lake Okeechobee regions so please remove the reference from the table.

FEB Comments
RECOVER agrees that the monitoring plan will need to be updated as the CEPP team learns from the A-1 FEB.

CEPP is not expecting full performance until the A-2 FEB comes online. Once it is online, RECOVER recommends that monitoring be established that would determine if it is operating as expected and see if it being used by migratory or wading birds in a way that was not intended. There is uncertainty of the effect of the FEB on wildlife.

RECOVER recommends that mercury and phosphorus are included in the FEB Water Quality Monitoring Plan if not already conducted by other programs (i.e. SFWMD Restoration Strategies Science Plan and/or permits for the operations of the FEB).

Greater Everglades Comments
This is a very well designed AM Plan with the focus on three distinct regions where CEPP uncertainties are greatest and there is the best opportunity to inform operation of the CEPP features.

RECOVER recommends that the AM and Monitoring Plan look beyond the footprint of the project when assessing the changes on the ecosystem. This is particularly important when looking at changes to populations of charismatic mega fauna (such as wading birds, deer, alligators) which have the ability to move freely in the landscape. In addition, multiple lines of evidence at different scales need to be considered in order to discern changes due to the project vs. climate variability.

Many items in the AM plan heavily reference operations so the AM Plan needs to have a direct link to the operating plan. In addition, RECOVER staff need to be directly involved in the design reviews and development of detailed operations plans to ensure monitoring locations are sited correctly and operations include the flexibility and information exchange protocol to properly execute tests described in the AM plan.

RECOVER recommends that the plan clarify that the monitoring needs to be done for a long enough period before a management action is taken because not all indicators respond in similar timescales.

RECOVER recommends a clearer crosswalk where there is monitoring in both the AM and Ecological Monitoring Plans
RECOVER recommends that the Adaptive Management Plan should call for CEPP to assess its effects on mercury bioaccumulation risk to upper trophic level species unless conducted through another program and/or permit reuquirement. CEPP will alter patterns of sulfate availability, which can alter mercury

methylation rates and bioaccumulation. The uncertainty of this effect is linked to other CEPP Adaptive Management uncertainties regarding biogeochemical effects (uncertainties #63, #73, #76). Monitoring should only be at select features south of the redline, such as downstream of the HRF and in the Blue Shanty flow-way. This element of the Plan minimally could entail measurements of mercury in the prey base (mosquitofish tissue) and water column sulfate. Learning from such measurements could influence short-term CEPP operations, but more likely influence future management actions in association with CEPP's next restoration phase.

Southern Coastal System Comments

CEPP will require existing and new hydro-meteorological monitoring stations to ensure constructed features are operating as expected. All hydro-meterological monitoring stations, not just new structure stations should be listed in the Hydro-meterological Monitoring Plan.

Table D.1.1 and Table D.4.1 need to clarify that the ecological monitoring is in addition to current MAP and other monitoring

For the FHAP monitoring, are the monitoring targets consistent with RECOVER PM targets and CERP targets?

RECOVER recommends that the biological indicators chosen for this area is reassessed closer to implementation to determine which indicator (s) would be the best.

RECOVER budget has been cut for biological indicators, this needs to be taken into account by CEPP in determining the indicators to use given the baseline data provided by RECOVER.

E.6.5 Summary

RECOVER supports the CEPP Adaptive Management and Monitoring Plan and believes it uses the best available science and monitoring currently available. The key assumption in the CEPP Adaptive Management and Monitoring Plan is that all existing monitoring will continue in accordance with the MAP 2009. If any of the non-CEPP monitoring outlined in this plan is eliminated, CEPP will need to incorporate that monitoring into the project in order to meet the project goals. All monitoring will need to be re-evaluated over time to determine if it is working as intended, if additional monitoring is advisable, if monitoring should be expanded or reduced in scope, or terminated or replaced by another monitoring element as the data and the changing landscape of restoration priorities so warrant.

E.6.6 RECOVER Consistency Review Team Approvals

	Concur	Do Not Concur	Comments
Gretchen Ehlinger, USACE	☒	☐	
Patti Gorman, SFWMD	☒	☐	
Fred Sklar, SFWMD	☒	☐	
Andy LoSchiavo, USACE	☒	☐	
Laura Mahoney, USACE	☒	☐	
Sue Kemp, USACE	☒	☐	
Patrick Pitts, FWS	☒	☐	
Steve Schubert, FWS	☒	☐	
Liberta Scotto, FWS	☒	☐	
Dave Rudnick, ENP	☒	☐	

E.6.7 RECOVER Executive Committee Approvals

REC	Concur	Do Not Concur	Comments
April Patterson, USACE	☒	☐	
Susan Gray, SFWMD	☒	☐	
Agnes McLean, ENP	☒	☐	
Steve Traxler, USFWS	☒	☐	

E.7 RESTORATION, COORDINATION AND VERIFICATION (RECOVER) REVIEW OF THE CENTRAL EVERGLADES PLANNING PROJECT (CEPP) DRAFT PROJECT OPERATING MANUAL (DPOM)

The following memo documents RECOVER and the CEPP Project Delivery Team's attention to the CERP Programmatic Regulations guidance that provides for, but does not require, a RECOVER review of the Project Operating Manual (DPOM). The memo also documents recognition that the CEPP operating manual will undergo updates in the future. It is recommended that a detailed review of the DPOM be performed by RECOVER near the end of the project design phase, in order to gain input from scientists with the most current system-wide scientific knowledge at that time. RECOVER will continue coordination with U.S. Army Corps of Engineers and the South Florida Water Management District during future CEPP project operations manual updates as requested.

ANNEX F

PHOSPHORUS ASSESSMENT FOR WCA-3 AND ENP

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F ASSESSMENT OF TOTAL PHOSPHORUS CHANGES IN WCA- 3 AND ENP THAT RESULT FROM IMPLEMENTATION OF THE CEPP PROJECT (SFWMD/USACE 07.18.13)

F.1 INTRODUCTION

This report presents a qualitative analysis of water quality impacts to the WCA-3 and ENP as a result of implementing the Central Everglades Planning Project (CEPP). This assessment focuses on ALT4R; however, ALT4R2 is the Tentatively Selected Plan (TSP). Given the similarities between these two alternatives the impact to water quality are expected to be very similar. Also, since this is a qualitative analysis, the findings presented here are generally applicable to the other with-project alternatives such as ALT1, ALT2, and ALT3. The CEPP will substantially alter the timing, quality, quantity, and distribution of water flows to Water Conservation Areas (WCAs) 3A and 3B and Everglades National Park (ENP or Park). ALT4R and ALT4R2 (**Figure F-1**) includes major features that improve flows through the WCA 3A and 3B such as an additional Flow-Equalization Basin (A-2 FEB) in the Everglades Agricultural Area (EAA), a partially backfilled Miami Canal in northern WCA-3A, degrade of the L-4 levee to distribute water in northwestern WCA-3A, and construction of structures to improve water deliveries into WCA-3A and WCA-3B including the construction of the Blue Shanty Flow-way in western WCA-3B. Additional ALT4R features improve inflow at the northern boundary of ENP. Such features include a partial degrade of the L-29 levee allowing the Blue Shanty Flow-way to discharge into the Park, increasing S-333 and S-356 flow capacities, seepage management features, L-67 Extension Canal Backfill, and Old Tamiami Trail removal.

As required by the Everglades Forever Act (EFA), the State of Florida developed and implemented a total phosphorus (TP) water quality criterion [Rule 62-302.540, Florida Administrative Code (F.A.C.)] for the Everglades Protection Area (EPA). The EPA includes the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge, also known as WCA-1), WCA-2, WCA-3, and ENP. The criterion, as it is applied to the WCAs, is expressed as a long-term geometric mean of 10 micrograms per liter (µg/L), or parts per billion (ppb) TP. Compliance with the criterion for ENP is determined via the methods set forth in Appendix A of the 1991 Settlement Agreement (Case No. 88-1886-Civ-Moreno). As the with-project alternatives (ALT1, ALT2, ALT3, ALT4, ALT4R, and ALT4R2 are expected to have beneficial impacts on water quality in WCA-3A, but minimal impact on water quality within WCA-1 and WCA-2, these portions of the EPA are not discussed in this paper. Additionally, no analysis of water quality impacts to Taylor Slough inflows to ENP is presented as the with-project alternatives are expected to have minimal impacts to flow and water quality conditions within the C-111 basin.

F.2 NORTH OF THE REDLINE (EVERGLADES AGRICULTURAL AREA)

Since EFA implementation, the state has established numeric criteria for TP throughout the EPA, required the implementation of agricultural Best Management Practices (BMPs) to reduce phosphorus levels in farm discharges and constructed, operated, and maintained massive manmade treatment wetlands known as the Everglades Stormwater Treatment Areas (STAs). Over the past 2 decades, the South Florida Water Management District (SFWMD or District) has operated STAs to substantially reduce TP concentrations in water being delivered to the WCAs. The effective treatment area of STAs has increased from approximately 4,000 acres in 1994 to 57,000 acres as of today. While the construction and operation of the STAs have substantially improved the quality of water discharged to the WCAs, both the federal and state parties to the Settlement Agreement acknowledge that additional reductions are necessary.

In early 2010, the SFWMD, State of Florida, and USEPA began technical discussions to establish a Water Quality Based Effluent Limit (WQBEL) for TP discharges from the Everglades STAs that would achieve compliance with the state's numeric TP criterion in the EPA and to identify a suite of additional water quality projects to work in conjunction with existing STAs to meet the WQBEL. From these discussions, in 2012, the FDEP issued a National Pollutant Discharge Elimination System (NPDES) Watershed Permit and an associated Consent Order and an EFA Watershed permit and associated Consent Order, establishing the WQBEL, the suite of water quality improvement projects to be constructed under the Restoration Strategies Program, and the compliance schedules for those projects.

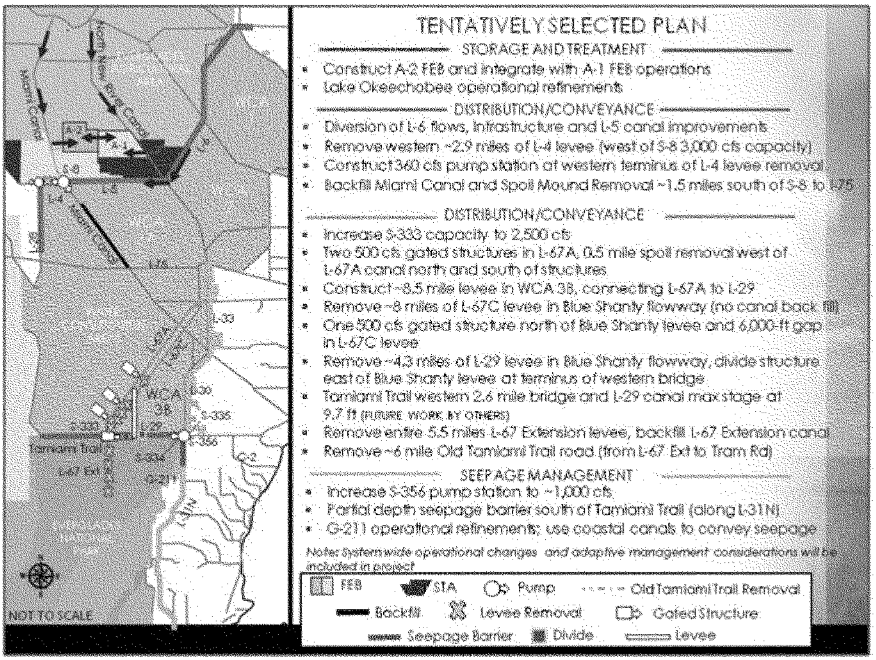


Figure F-1. Map and description of the Tentatively Selected Plan (TSP) (ALT4R).

These permits establish a WQBEL for TP in which STA Discharges shall not exceed 13 parts per billion (ppb) as an annual flow-weighted mean (FWM) in more than three out of five years on a rolling basis (Part 1), and shall not exceed 19 ppb as an annual FWM in any water year (Part 2). The State and USEPA agreed that achieving these limits would ensure that the STA discharges do not cause or contribute to exceedances to Florida's water quality standard for TP in the Everglades. The State and USEPA also agreed to a suite of additional projects which includes constructing 6,500 acres of STAs and 110,000 acre-feet of water storage, or Flow-Equalization Basins (FEBs). Additionally, the plan includes enhancements to existing conveyance features and STAs. **Figure F-2** shows the components of the Restoration Strategies Regional Water Quality Plan tagged with white labels; the existing STA facilities are shown in green. The Central Flow

Path includes A-1 FEB, STA-3/4, and STA-2. Additional detail on the Restoration Strategies Regional Water Quality Plan is available at www.sfwmd.gov/restorationstrategies.

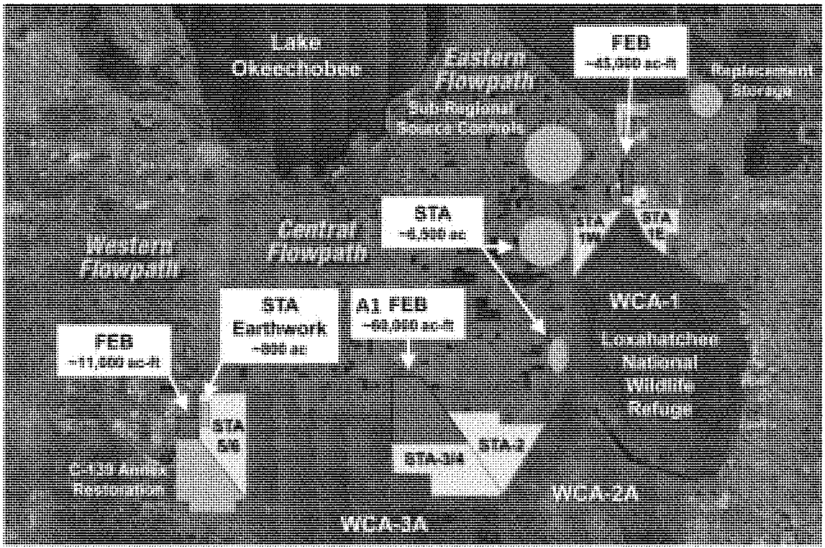


Figure F-2. Restoration Strategies (RS) key projects in Eastern, Central, and Western Flow Paths.

In order to deliver the additional flows anticipated under the CEPP, water will be delivered through the Central Flow Path down the Miami and North New River canals. These canals are the main north-south conduits connecting Lake Okeechobee and upstream basins to WCA-3A. These additional flows must be treated prior to entering WCA-3A to maintain compliance with water quality standards. ALT4R will most likely have minimal effect on the Eastern or Western Flow Paths. Since the delivery of additional flows under the CEPP is reliant upon the existing STAs and Restoration Strategies project features for water quality treatment, CEPP project features that redistribute existing flows and/or deliver additional flows cannot proceed unless/until it is determined that construction and/or operation of the feature 1) will not cause or contribute to a violation of water quality standards; 2) will not cause or contribute to a violation of the permit(s) discharge limits or specific conditions; and, 3) reasonable assurances exist that demonstrate adverse impacts on flora and fauna in the area influenced by the project element will not occur. Compliance with WQBELs for the STAs cannot be determined until all corrective actions have been completed. Compliance with the WQBEL shall be determined based on the conditions contained within the NPDES permit (FL0778451), EFA permit (0311207), NPDES Consent Order (12-1148), and EFA Consent Order (12-1149).

ALT4R2 proposes the A-2 FEB with an approximate capacity of 60,000 ac-ft to allow for additional inflows to the Central Flow Path. Alt 4R will also rely on several SFWMD-owned/operated facilities, such as the A-1 FEB for storage and STA-2 and STA-3/4 for treatment. **Figure F-3** depicts the A-2 FEB and the state's A-1 FEB, which will both be operated as an integrated facility under CEPP (A-1/A-2 FEB). The S-628 divide structure will allow water to be routed from the A-1 FEB to the A-2 FEB depending upon available capacity. Flows from the A-1/A-2 FEB can be delivered to the Miami and North New River Canals and to STA-2 and STA-3/4 when capacity or operational desires exist. During CEPP plan formulation, a dedicated storage and treatment facility for CEPP was screened out because it was not deemed cost effective. It is not anticipated that dedicated water treatment facilities for CEPP will be warranted. This estimation may be reassessed as identified in the Adaptive Management Plan once facilities are built and water quality compliance is evaluated. Additional details regarding the integrated operation of the A-1/A-2 FEB are presented in the Draft Project Operating Manual (DPOM).

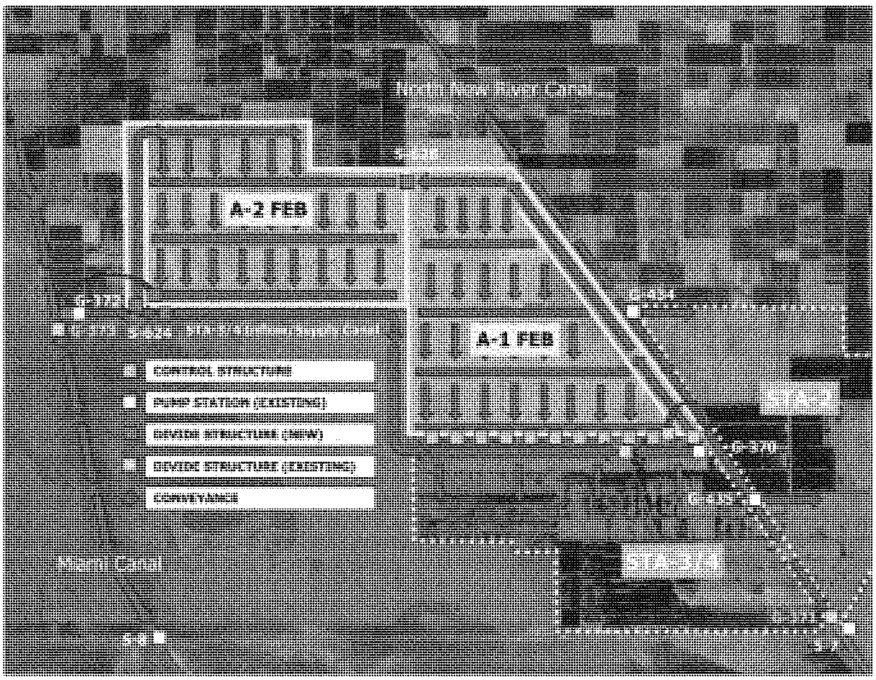


Figure F-3. Integrated A-1/A-2 FEB component of the CEPP.

DMSTA2 modeling predicted the TP removal performance of the integrated A-1/A-2 FEB, STA-2, and STA-3/4 facilities. The A-1 FEB was included in the future without (FWO) project conditions, as it will be operational before the CEPP features are constructed. The DMSTA2 model assumed the phosphorus removal performance of the A-1 FEB was that of emergent aquatic vegetation (EAV). This assumption is based on the anticipated establishment of native marsh vegetation due to the hydrologic conditions expected at the site, coupled with proposed vegetation management activities. The following assumptions were incorporated into the DMSTA2 model:

1. Lake Okeechobee TP concentrations were set to the 2000-2009 monthly average from the S-351 and S-354 structures at the Lake rather than at the lower concentrations observed at the STA-2 and STA-3/4 inflow structures.
2. The STA duty cycle factor used in DMSTA2 was set to 0.95, which effectively simulates each STA to be offline for 5 percent of the time.
3. The DMSTA2 modeling was done using the calibration dataset which does not reflect the future improvements in STA removal efficiency that are expected from Restoration Strategies operational refinements.
4. To allow for additional vegetation management flexibility within the STAs, a resting period of 45 days, scheduled every three years was incorporated into the DMSTA2 operational scheme for STA-3/4. STA resting periods are intended to simulate conditions during the dry season that allow vegetation rejuvenation and expansion, which will sustain vegetation health and maintain treatment performance.
5. Due to the uncertainty associated with DMSTA-simulated low level TP concentrations, annual values less than 12 ppb were replaced with a value of 12 ppb.

DMSTA2 modeling results are provided below in **Figure F-4** and **Table F-1**. The difference in average monthly flows between with CEPP and FWO project conditions are shown in **Figure F-4** and the seasonal distribution of those flows are shown in **Table F-1**. Note that RS_FEB34 includes the A-1 FEB only (FWO), and the CEPP_FEB34 represents ALT4R with the integrated A-1/A-2 FEB. **Figure F-4** shows that with the additional monthly CEPP flows in the Central Flow Path, most of the additional flow (WTRSHD_DIFF) occurs during the dry season, November through May. CEPP increases the percentage of annual flows occurring during the dry season through the Central Flow Path, FEB, and STAs (**Table F-1**). CEPP additional flows to the watershed are relatively small during the wet season (20 kac-ft) as compared to the dry season (234 kac-ft). CEPP (A2) also provides additional capacity for storing and treating wet season runoff from the S8/S7 basins that would occur regardless of additional Lake Okeechobee releases. CEPP also reduces the runoff volume and load by reducing the watershed area (A2). This will increase the probability of achieving the WQBEL with or without additional flow from the Lake.

Historical observations suggest that STA phosphorus removal efficiency may be lower during the dry season and this pattern is likely associated with multiple components of internal phosphorus cycling. Lower temperatures, fewer hours of daylight, STA dryout, reduced algal and plant growth, changes in microbial growth and decomposition, increased herbivory by avian species, and the overall decrease in biological activity that exist in the dry season may all impact an STA's ability to retain phosphorus. In addition to these contributing factors, stagnant or non-flowing conditions that can occur for several weeks during the dry season within the STAs and the resultant increase in upward flux of phosphorus are also hypothesized to affect STA outflow phosphorus concentrations. Accordingly, moderate STA inflows during the dry season may enhance an STA's ability to retain phosphorus from the sediment during the dry season. While uncertainty remains about the performance of STAs in the dry season, future implementation of flow equalization basins, as proposed by CEPP (and previously by Restoration Strategies), paired with appropriate STA resting periods and vegetation rejuvenation and management activities, should ultimately assist in reducing dryout and stagnant conditions and may result in improved dry season STA performance.

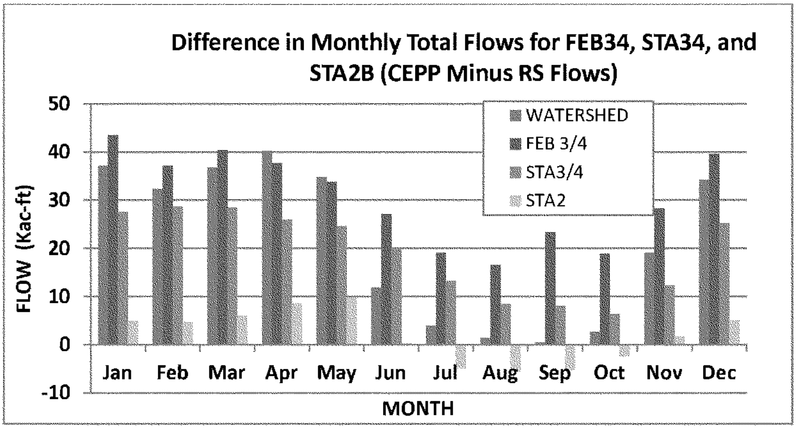


Figure F-4. Difference in average monthly flows for FEBs, STA-3/4, and STA-2 under CEPP and future without (FWO) (RS) project conditions. [Note: Period of record (POR) is 1965 to 2005.]

Table F-1. Annual and seasonal flows for CEPP and FWO (RS) project conditions in the Central Flow Path Watershed, RS_FEB34, CEPP_FEB34, STA-3/4, and STA-2.

Period of Analysis	RS_WTRSHD (kac-ft/yr)	CEPP_WTRSHD (kac-ft/yr)	WTRSHD DIFFERENCE (kac-ft/yr)	RS_FEB34 (kac-ft/yr)	CEPP_FEB34 (kac-ft/yr)	FEB34 DIFFERENCE (kac-ft/yr)
Average Annual Flow (May 1 to April 30)	803	1058	255	276	641	365
Dry Season Flow (Nov 1 through May 31)	270	505	234	95	355	260
Wet Season Flow (June 1 through October 30)	533	553	20	180	285	105
Dry Season Percent of Annual Flow	34%	48%	14%	35%	55%	20%
Wet Season Percent of Annual Flow	66%	52%	-14%	65%	45%	20%
Period of Analysis	RS_STA34 (kac-ft/yr)	CEPP_STA34 (kac-ft/yr)	STA34 DIFFERENCE (kac-ft/yr)	RS_STA2B (kac-ft/yr)	CEPP_STA2B (kac-ft/yr)	STA2B DIFFERENCE (kac-ft/yr)
Average Annual Flow	408	637	229	392	415	23
Dry Season Flow	137	310	173	122	163	41
Wet Season Flow	272	328	56	270	252	-18

Note: RS_FEB34 is the A-1 FEB, CEPP_FEB34 is the integrated A-1/A-2 FEB

Table F-2 shows the estimated performance of the A-1/A-2 FEB, STA-2 and STA-3/4 for the with CEPP and FWO condition based upon DMSTA modeling. The implementation of CEPP will reduce the predicted period of record FWM TP concentrations from STA-2 and STA-3/4 when compared to the FWO condition. **Table F-2** also shows that the ALT4R will increase the A-1/A-2 FEB annual inflow volumes and TP loads as compared to FWO in part by reducing the flows that are sent directly to STA 3/4 and STA 2. There are increases in load removal in STA 2 and STA-3/4. The CEPP project will also reduce the annual diversion volumes and TP loads around STA-2 and STA-3/4. The CEPP will increase the unit area TP loading to the A-1/A-2 FEB by 55 percent, STA-2 by 3 percent, and STA-3/4 by 12 percent over the FWO condition. Increased TP loading under the with CEPP condition to the A-1/A-2 FEB, STA-2, and STA-3/4 is expected to increase the frequency in which these facilities will require maintenance to structures and the removal of accumulated sediments to maintain hydraulic capacity.

There are potential risks associated with treatment of CEPP flows using the existing conveyance features, STA facilities, and portions of the A-1 FEB capacity. For instance, it is possible that the STA/FEB system may be less efficient at removing TP than predicted by the DMSTA2 modeling presented here. There is also uncertainty about whether the A1/A2 FEB can effectively operate with single pumps used for inflows and outflows. If this operation scheme proves unworkable, structural or operational changes may be required. As the A-1 FEB, and other Restoration Strategies projects, will be constructed and operational for several years before the design of the A-2 portion of the integrated A-1/A-2 FEB, there should be sufficient time for the SFWMD to evaluate system performance and initiate structural or operational changes prior to finalizing design of the A-2 FEB features. An adaptive management plan has been developed for the CEPP to address some of the uncertainties associated with operating the A-1/A-2 FEB as an integrated system.

Table F-2. DMSTA2 predicted hydrologic and water quality performance under FWO and Alt 4R2 conditions in the Central Flow Path.

Performance Measures	Facilities	FWO (RS*)	ALT4R	Difference (CEPP - RS)	Percent Change
		A-1 FEB	A-1/A-2 FEB		
FWM Outflow TP Concentration (ppb) - Facility Outflow Only (No Diversions)	FEB 34	23.6	32.1	8.5	36%
	STA-2**	12.4	11.5	-0.9	-7%
	STA-3/4**	11.6	10.9	-0.7	-6%
Average Annual Inflow Volumes (kac-ft/yr)	FEB 34	276	641	365	132%
	STA-2	392	414	22	6%
	STA-3/4	408	637	229	56%
	STA-2 + STA-3/4	800	1051	251	31%
Average Annual TP Load Reduction (mt/yr)	FEB 34	24.1	66.7	43	176%
	STA-2	47.2	48.7	1.5	3%
	STA-3/4	23.8	24.4	0.6	3%
	FEB + STAs	95.2	139.8	44.6	47%
Average Annual Volumes Directly to STAs(kac-ft/yr)	STA-2 + STA3/4	167	76	-91	-54%
Average Annual Untreated Diversion Volumes (kac-ft/yr)	STA-2	5.4	4.9	-0.5	-10%
	STA-3/4	5.9	0.8	-5.1	-86%
Average Annual Load Directly to STAs TP Load (mt/yr)	STA-2 + STA3/4	23	11	-12	-53%
Average Annual Untreated Diversion TP Load (mt/yr)	STA-2	0.8	0.7	-0.1	-10%
	STA-3/4	0.7	0.1	-0.6	-89%
Unit Area TP Removal ($mg/m^2/yr$)	FEB 34	428	613	185	43%
	STA-2	849	871	22	3%
	STA-3/4	386	393	7	2%
Unit Area TP Loading ($mg/m^2/yr$)	FEB 34	528	819	291	55%
	STA-2	849	871	22	3%
	STA-3/4	445	497	52	12%

* RS = Restoration Strategies Plan for Central Flow Path
** FWM TP concentrations for STA2 and STA3/4 are adjusted using minimum outfall concentration of 12 ppb.

Note: RS_FEB34 is the A-1 FEB, CEPP_FEB34 is the integrated A-1/A-2 FEB. ac-ft – acre-feet; FEB –Flow Equalization Basin; FWM – flow-weighted mean; mg/m^2 – milligrams per cubic meter; mt – metric tons; ppb – parts per billion; STA – Stormwater Treatment Area; TP – total phosphorus.

** Annual FWM TP concentrations for STA-2 and STA-3/4 are adjusted using minimum annual concentration of 12 ppb due to uncertainty associated with DMSTA2 simulation of low level phosphorus concentrations.

F.3 WATER CONSERVATION AREA 3A (WCA-3A)

WCA-3A receives the majority of its surface water inflow from STA-3/4 and WCA-2. Under Alt 4R, a portion of flows historically routed to WCA-2 will be diverted into WCA-3A. ALT4R2 includes the removal of 2.9 miles of the L-4 levee to create an east-west distribution spreader for inflows along the northwestern boundary of WCA-3. This modification, together with the partial backfill of the Miami Canal from 1.5 miles south of the northern border of WCA-3A to Interstate 75 (I-75), will help introduce sheet flow into the northern WCA 3A marsh. At the southern end of WCA-3A/3B, the Blue Shanty Flow-way will be constructed to divert flows from the L-67A canal into the marsh before it flows across Tamiami Trail into ENP.

F.3.1 Flows and Loads into WCA-3A

The impact of the CEPP on WCA-3A is described below in terms of additional flows and associated concentrations, changes to hydropattern, and TP concentrations within the marsh. **Table F-3** compares the flows and TP loads expected in the Existing Conditions Baseline (ECB), FWO, and ALT4R scenarios at the northern boundary of WCA 3A. These load estimates were developed using historic TP concentrations for ECB and DMSTA2 predicted TP concentrations for FWO and Alt4R at WCA-3A inflow locations and hydrologic flow predictions from the RSMBN and RSMGL regional simulation models. The hydrologic predictions show that FWO flows will be slightly reduced relative to ECB while the ALT4R2 flows will be greater than both the ECB and FWO condition. Relative to FWO, the CEPP (ALT4R) will increase TP loads by approximately 12 percent. Relative to ECB, the CEPP (ALT4R2) will decrease TP loads by approximately 26 percent as well this load will be dispersed across the northern marsh instead of routed down the Miami Canal. The FWM TP concentrations shown in **Table F-1** for the FWO and ALT4R are higher than the WQBEL of 13 ppb because; 1) they were computed using flows and loads from all of the WCA-3A inflows, not just the northern WCA-3A inflows, 2) the lack of historic data prior to 1990 required the use of an average FWM TP concentration applied to the 41 year long simulated flows at several of the structures (S9x, S190, S140 and S11x), and 3) future conditions will likely have lower concentrations at S9x, S190, and S140 than the historic data used here. Even with the likely over-estimated loads, the inflow concentrations into WCA-3A are expected to decrease by one third relative to existing conditions for both the FWO and ALT4R condition. Flows and TP loads for ALT4R2 into WCA-3A are similar to those shown for ALT4R.

Table F-3. Net WCA-3A inflows and loads for ECB, FWO, and ALT4R.

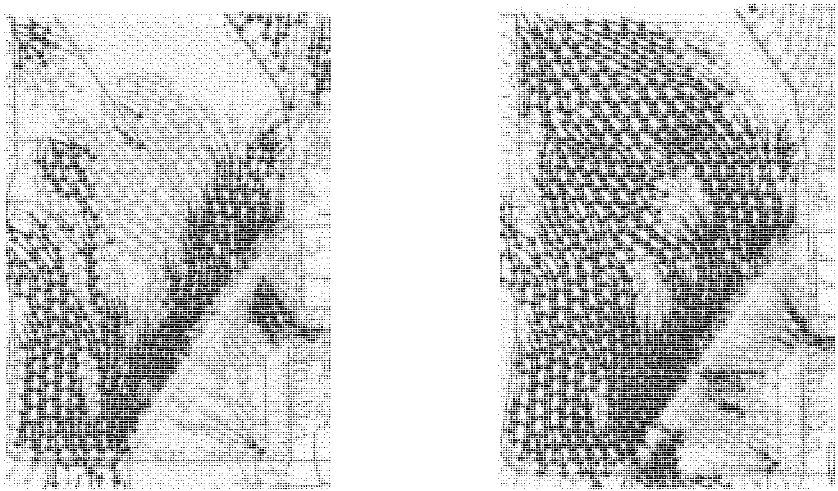
WCA-3A Average Annual Flow (kac-ft/yr)			
	ECB	**FWO**	**ALT4R**
WCA-3A Inflows	1,470	1,400	1,637
Change from FWO	5%	n/a	17%
Change from ECB		**-5%**	**11%**
TP Load Discharged into Northern WCA-3A			
Total Load (mt/yr)	51	34	38
Change from FWO	50%	n/a	12%
Change from ECB	n/a	**-34%**	**-26%**
TP Concentrations Discharged into Northern WCA-3A			
FWM TP Concentration (ppb)	28	20	19
Change from FWO	+43%	n/a	- 4 %
Change from ECB	n/a	**-30%**	**-33%**

Notes:

1. Flow volumes are from Regional Simulation Model - Glades *LECSA* (*RSMGL*) model for 41 year simulation period..
2. ECB Average flow-weighted mean TP concentrations applied using available period of record grab sample data ((Northern 3A 2006-2011), S11x (2006-2012), S9x (2003-2012), S140 (2008-2012), S190 (2008-2012) multiplied by daily simulated flows.
3. FWO, ALT4R TP loads for Northern WCA-3A inflows calculated using DMSTA2 predictions adjusted to 12 ppb minimum annual outflow concentration. Estimated loads for the remaining structures were computed using historic period of record FWM TP concentrations applied to the 41 year simulated hydrology.
4. Loads based on flow-weighted mean calculations.

F.3.2 Hydrologic Flow Patterns in WCA-3A

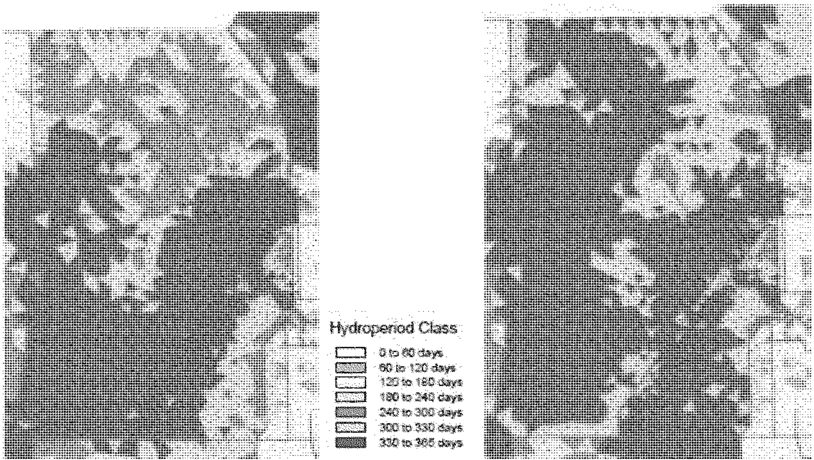
ALT4R will improve the sheetflow distribution and hydroperiod as compared to the FWO conditions as shown in **Figure F-5** and **Figure F-6**, respectively. The flow and hydroperiod patterns for ALT4R2 are similar to ALT4R. Increased sheetflow coupled with longer hydroperiod will likely increase the TP assimilative capacity over time within the northern WCA-3A marsh and decrease TP transport to the southern WCA-3A and ENP. Once the marsh and impacted areas have had time to stabilize from both past hydroperiod alterations and project construction, the risk of downstream TP spikes caused by dry out and rewetting, should be reduced.



Average FWO Flow Patterns in WCA- 3 Average ALT4R Flow Patterns in WCA-3

Figure F-5. Average flow pattern conditions for FWO (left) and ALT4R (right) in WCA-3.

(Source *Regional Simulation Model Glades-LECSA* (*RSMGL*) CEPP Model Output, Dec. 2012, SFWMD).



Average FWO Hydroperiod in WCA-3 Average ALT4R Hydroperiod in WCA-3

Figure F-6. Average Hydroperiod Conditions for FWO (left) and ALT4R (right) in WCA-3 (Source: RSMGL CEPP Model Output, Dec. 2012, SFMWD).

The ALT4R2 flows that pass through the S-631 structure in the L-67A canal (**Figure F-7**) and into WCA-3B will reduce some of the channelized discharge of S-9 flows to S-333 and S-12D. The S-632 and S-633 structures in the L-67A canal will divert L-67A canal flow into the Blue Shanty flow-way which will be constructed in the southwestern corner of WCA-3B. Discharges will continue through the S-12's and the S-333, but the distribution will change such that S-333 flows will increase. By introducing flows into the WCA-3B marsh and optimizing operations, an increase in TP uptake is expected.

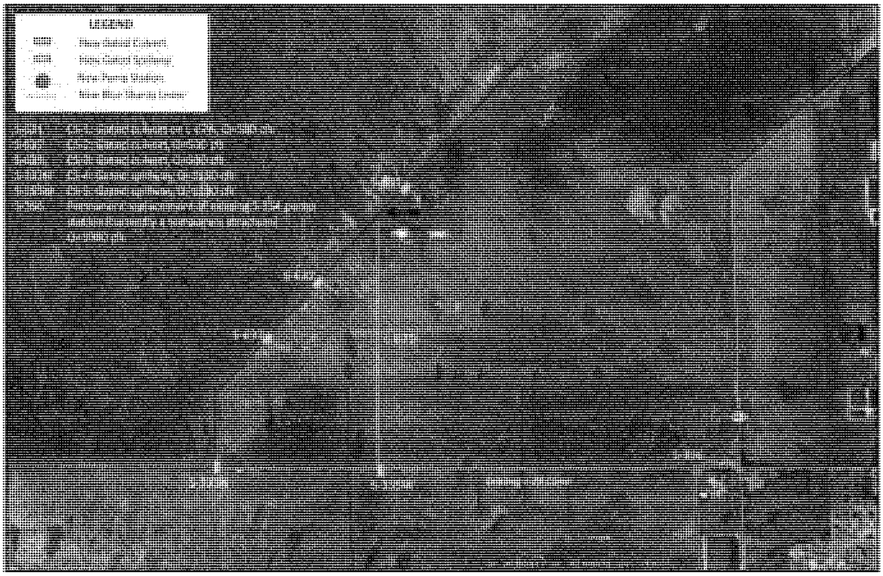


Figure F-7. Proposed WCA-3B infrastructure.

F.3.3 Marsh TP Concentrations in WCA-3A

The state's Phosphorus Rule (Rule 62-302.540, F.A.C) requires the SFWMD to maintain a network of marsh monitoring stations to track changes in soil and water column TP concentrations within the EPA (WCAs and ENP). **Figure F-8** shows the network of monitoring stations within the WCAs. In WCA-3A, four of the marsh stations (CA33, CA35, CA36, and CA314) have been identified as impacted based upon elevated soil phosphorus and water column TP concentrations at these locations.

Achievement of the criterion for the ambient monitoring network is evaluated and determined annually for each WCA based on data collected monthly from a network of ambient monitoring stations in both impacted and unimpacted areas. To achieve the criterion, the following four provisions must be met:

1. The five year geometric mean averaged across all stations is less than or equal to 10 µg/L.

2. The annual geometric mean averaged across all stations is less than or equal to 10 µg/L for three of five water years.

3. The annual geometric mean averaged across all stations is less than or equal to 11 µg/L; and

4. The annual geometric mean at all individual stations is less than or equal to 15 µg/L.

Assessment of TP compliance is usually conducted for each section of the EPA (i.e., Refuge, WCA-1, WCA-2, and WCA-3) annually. However, this section presents the compliance calculation period from Water Years 2008–2012 (WY2008–WY2012) (May 1, 2007–April 30, 2012) for WCA-3 only. Both unimpacted and impacted networks had a slight increase in the average geometric mean TP concentrations in WY2012 (**Figure F-9**). Despite this slight increase, the unimpacted portion of the marsh did not exceed the limits of 10 µg/L (long-term, five-year limit) and 11 µg/L (network limit). Furthermore, all stations within each unimpacted network did not exceed the 15 µg/L annual limit, and only one station (CA36) within the impacted network exceeded the 15 µg/L annual limit (**Figure F-10** and **Table F-4**).

The highest TP concentration was observed at an impacted network station, CA36, which is located in northern WCA-3A near the Miami Canal and the S-339 divide structure. The S-339 structure is usually closed, forcing S-8 discharge water into the marsh at this location. The highest geometric mean TP concentration within the unimpacted network was experienced at station CA3B2 (7.7 µg/L). During WY2012, one of the five impacted stations was below the 15 µg/L annual limit. However during WY2012, due to low water levels, data from three stations had less than six data points (CA324, CA33, and CA35) and, therefore, these stations were excluded in the overall compliance determination. Slightly higher TP concentrations in both impacted and unimpacted portions of the marsh can potentially be explained by the irregular rainfall and dryer than normal start to the water year and wet season.

The results of the WY2008–WY2012 TP criterion assessment (**Table F-4**) indicate that, even with the data limitations, the unimpacted portions of the WCAs passed all four parts of the compliance test (as expected) and are therefore in compliance with the 10 µg/L TP criterion. Occasionally, individual sites within the unimpacted portions of the WCAs exhibited an annual site geometric mean TP concentration above 10 µg/L, as expected, but in no case did the values for the individual unimpacted sites result in an exceedance of the annual or long-term network limits. None of the annual geometric mean TP concentrations for the individual unimpacted sites during the WY2008–WY2012 period exceeded the 15 µg/L annual site limit.

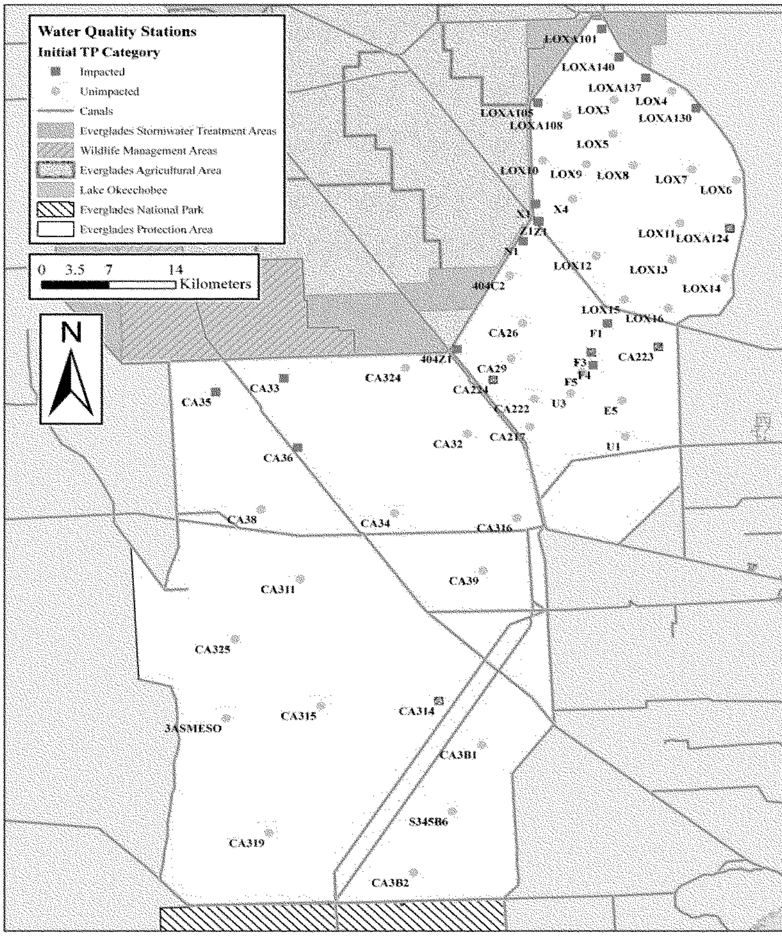


Figure F-8. Total phosphorus (TP) criterion assessment network stations within the Everglades Protection Area (EPA).

Note: All sites were used in the Water Years 2008–2012 (WY2008–WY2012; May 1, 2007–April 30, 2012) evaluation.

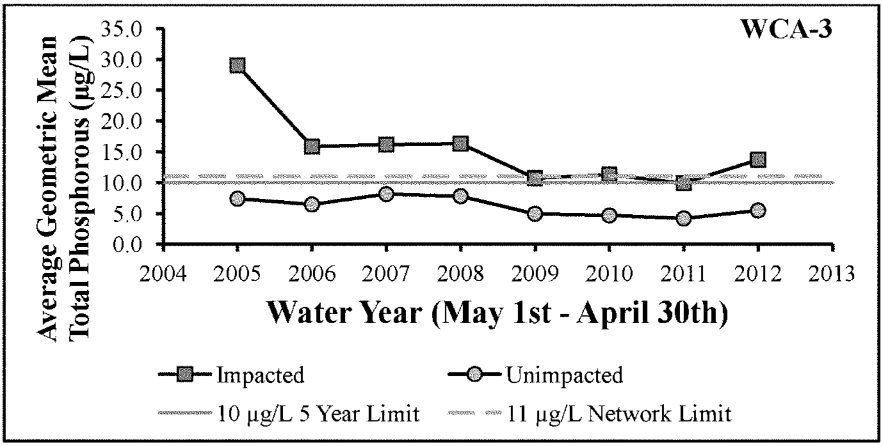


Figure F-9. Network (impacted and unimpacted) trends for WCA-3 from WY2005–WY2012 relative to the TP 10 µg/L long-term (five-year) and 11 µg/L network limits

[Note: Adapted from Julian, 2013.]

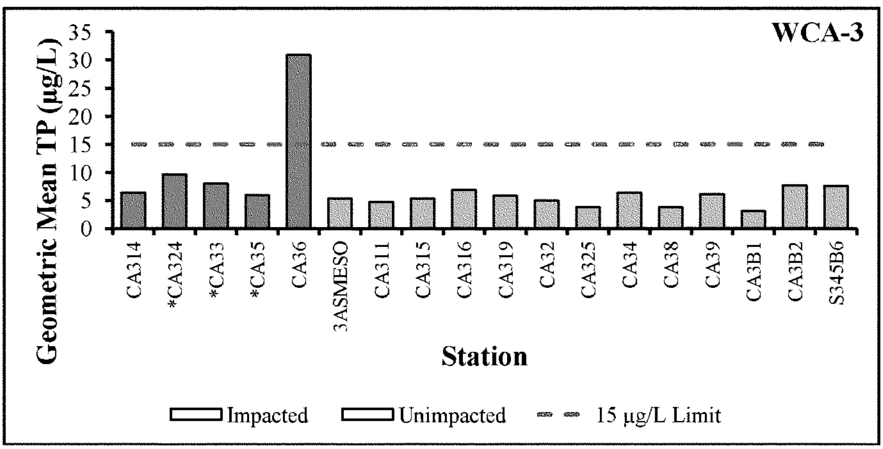


Figure F-10. TP geometric mean (µg/L) for each station during WY2012 for WCA-2 relative to the 15 µg/L annual limit.
[Note: Stations with less than six samples are identified with an asterisk (*) and not included in the compliance calculations; adapted from Julian, 2013.]

A trend analysis was performed using annual compliance TP data for TP Rule monitoring stations in WCA-3 for the period from Florida Water Years 2005 through 2012. The results of this trend analysis are presented in **Table F-5**, **Figure F-12**, and **Figure F-13**. The annual compliance TP data were taken from published South Florida Environmental Reports (SFWMD 2010, SFWMD

2011, SFWMD 2012 and SFWMD 2013). Two statistical tests were used to assess trends of these annual data sets for each monitoring station: 1) a linear regression (and Pearson Correlation); and 2) Spearman's Rank Correlation. A linear regression (parametric method) assumes that the residuals (i.e., regression errors) do not deviate significantly from a normal distribution. On the other hand, Spearman's Rank Correlation makes no assumption regarding the distribution of the residuals. Given the sparse quantity of data for each monitoring station ($n \leq 8$), it is highly improbable that the residuals from these regressions follow a normal distribution. **Table F-5** presents the results from both the parametric and non-parametric trend analyses for these monitoring stations. A graphic presentation of the annual compliance geometric mean TP data for impacted and unimpacted marsh monitoring stations is presented in **Figure F-11**, **Figure F-12A** and **Figure F-12B**. Due to data density and screening protocol requirements for the TP Rule, some water years and one marsh station (CA324) were removed from the trend analyses.

Of the 17 monitoring stations analyzed, 16 stations exhibited a decreasing trend based on linear regression results (**Table F-5**) with six of these stations exhibiting a statistically significant decrease in annual TP concentrations. One marsh station (3ASMESO) exhibited a slight increasing trend that was not statistically significant (p-value = 0.933; **Table F-5**).The results from the Spearman's Rank correlation indicate that all 17 stations exhibited a decreasing trend in annual geometric mean TP concentrations with 10 marsh stations having statistically significant decreases in annual geometric mean TP concentrations (**Table F-5**). Most marsh stations exhibited a slight increase (up to 2 µg/L) in annual geometric mean TP concentration during Florida Water Year 2012. However, three marsh stations (CA36, CA3B2 and S-345B6) exhibited a 4 to 10 µg/L increase in annual geometric mean TP during the last water year. Future changes in historic TP concentrations will likely be more noticeable for marsh stations located adjacent to the major project features such as the Miami Canal backfill, the L-4 levee degrade/spreader, WCA-3B inflows and the Blue Shanty Flow-way. A review of the long-term phosphorus data presented in the 2013 South Florida Environmental Report (SFWMD, 2012) suggests the likelihood of more marsh stations and some of the inflow/outflow structures exhibiting significant decreasing trends if a seasonal Kendall trend analysis were to be performed using monthly TP data over a period longer than the Florida Water Year 2005 to 2012 period presented herein.

Construction of the Miami Canal Backfill component of the CEPP is expected to re-mobilize sediment containing elevated concentrations of TP while construction is being conducted. Depending upon the proximity of the backfill construction to marsh stations, it is possible that the annual geometric mean TP concentrations could exceed or contribute to exceedances of portions of the four part test. With regard to backfilling and re-vegetation, once these activities are complete, marsh stations in the vicinity of the backfill, such as CA36, are likely to experience TP concentrations lower than those historically observed. Once operations commence, stations influenced by the re-introduction of water in northwestern WCA-3A may observe perturbations until such time as fewer dry-outs and stable conditions are established.

The L-4 levee degrade and spreader canal in northwest WCA-3A are likely to impact marsh stations during construction and post construction. Depending upon the proximity of the spreader canal construction to marsh stations, it is possible that the annual geometric mean TP concentrations could exceed or contribute to exceedances of portions of the four part test during construction. Post-construction (i.e., operations), the L-4 Spreader Canal in northern WCA-3A could influence TP Rule compliance since water management activities are expected to have a far reaching effect. While the water discharged to the L-4 Spreader Canal is expected to achieve the WQBEL, the reintroduction of water and alteration of hydroperiods is expected to cause temporary phosphorus reflux in the impacted areas and therefore facilitate temporary mobility of phosphorus in portions of the system. It is expected that the system will stabilize after some period of time and that the mobilization of phosphorus from the impacted areas will be reduced substantially; however, in the interim, it is expected that the mobilized phosphorus will travel within portions of WCA-3 until more stable conditions are established.

Construction of the Blue Shanty levee from L-67C to Tamiami Trail will convert the southwestern corner of WCA-3B into a flow-way. The S-632 and S-633 structures constructed in the L-67A levee will allow L-67A canal flows to be diverted into the Blue Shanty Flow-way before reaching the northern boundary of ENP. Marsh TP concentrations in the northern portion of this flow-way will likely increase. The CEPP Water Quality Monitoring Plan calls for the future establishment of a marsh monitoring station located within the Blue Shanty Flow-way. The geometric mean TP concentration at the S-333 was used to estimate the range of existing annual TP concentrations at the new Blue Shanty marsh monitoring station. From WY2008 – WY2012 the annual geometric mean TP concentration at S-333 varied from 10-16 ppb.

Table F-4. Annual TP criteria compliance assessment for the five-year period from WY2008–WY20012.

Network	WY	Station	Sample Size (N)	Annual Site Geometric Mean (µg/L)	≤15 µg/L Pass/ Fail	Network Annual Average Geometric Mean (µg/L)	≤11 µg/L Pass/ Fail	Network Five-Year Average Geometric Mean (µg/L)	≤10 µg/L Pass/ Fail
Impacted	2008	CA314	11	7.3	Pass	**16.4**	Fail		
		CA324	1	N/A (14)	N/A				
		CA33	7	14.4	Pass				
		CA35	6	8	Pass				
		CA36	6	35.7	Fail				
	2009	CA314	12	4.3	Pass	**10.76**	*Pass*		
		CA324	6	11.1	Pass				
		CA33	14	8.4	Pass				
		CA35	11	6.9	Pass				
		CA36	15	23.1	Fail				
	2010	CA314	12	4.5	Pass	12.3	Fail		
		CA324	5	N/A (12.5)	N/A				
		CA33	8	8.8	Pass				
		CA35	5	N/A (7.1)	N/A				
		CA36	8	23.6	Fail				
	2011	CA314	10	4	Pass	9.8	*Pass*		
		CA324	4	N/A (10.4)	N/A				
		CA33	7	7.5	Pass				
		CA35	6	5.6	Pass				
		CA36	9	22	Fail				
	2012	CA314	10	6.4	Pass	**18.7**	Fail		
		CA324	5	N/A (9.7)	N/A				
		CA33	5	N/A (8)	N/A				
		CA35	3d	N/A (5.9)	N/A				
		CA36	6	30.9	Fail				

Network	WY	Station	Sample Size (N)	Annual Site Geometric Mean (µg/L)	≤15 µg/L Pass/ Fail	Network Annual Average Geometric Mean (µg/L)	≤11 µg/L Pass/ Fail	Network Five-Year Average Geometric Mean (µg/L)	≤10 µg/L Pass/ Fail
	2008 - 2012	Five-Year Network Average						12.9	Fail
		3 of 5 Year Network Average ≤ 10 µg/L				Fail			
Unimpacted	2008	3ASMESO	16	7.3	Pass	7.8	Pass		
		CA311	21	6.9	Pass				
		CA315	22	7.9	Pass				
		CA316	19	10.8	Pass				
		CA319	10	6.8	Pass				
		CA32	8	7.5	Pass				
		CA325	6	5.6	Pass				
		CA34	9	14.5	Pass				
		CA38	13	6.6	Pass				
		CA39	10	6.8	Pass				
		CA3B1	10	6	Pass				
		CA3B2	8	7.6	Pass				
		S-345B6	12	7.4	Pass				
	2009	3ASMESO	16	4.6	Pass	5	Pass		
		CA311	18	4.7	Pass				
		CA315	19	4.9	Pass				
		CA316	19	6.3	Pass				
		CA319	12	4.5	Pass				
		CA32	17	5.7	Pass				
		CA325	7	4.6	Pass				
		CA34	16	6.8	Pass				
		CA38	15	4.9	Pass				
		CA39	11	4.8	Pass				
		CA3B1	10	3.6	Pass				

Network	WY	Station	Sample Size (N)	Annual Site Geometric Mean (µg/L)	≤15 µg/L Pass/ Fail	Network Annual Average Geometric Mean (µg/L)	≤11 µg/L Pass/ Fail	Network Five-Year Average Geometric Mean (µg/L)	≤10 µg/L Pass/ Fail
		CA3B2	11	4.6	Pass				
		S-345B6	17	4.5	Pass				
	2010	3ASMESO	15	4.4	Pass	4.7	*Pass*		
		CA311	10	4	Pass				
		CA315	10	4.3	Pass				
		CA316	10	6.4	Pass				
		CA319	11	4.7	Pass				
		CA32	11	4.9	Pass				
		CA325	11	4.6	Pass				
		CA34	10	7	Pass				
		CA38	9	4.4	Pass				
		CA39	11	4.9	Pass				
		CA3B1	10	3.4	Pass				
		CA3B2	11	4.4	Pass				
		S-345B6	12	3.6	Pass				
	2011	3ASMESO	9	3.5	Pass	4.2	*Pass*		
		CA311	10	4.3	Pass				
		CA315	11	4.3	Pass				
		CA316	10	6	Pass				
		CA319	10	4.4	Pass				
		CA32	7	4.8	Pass				
		CA325	6	4.6	Pass				
		CA34	8	5.4	Pass				
		CA38	8	3.5	Pass				
		CA39	8	4.3	Pass				
		CA3B1	9	3.2	Pass				
		CA3B2	10	3.3	Pass				

Network	WY	Station	Sample Size (N)	Annual Site Geometric Mean (µg/L)	≤15 µg/L Pass/ Fail	Network Annual Average Geometric Mean (µg/L)	≤11 µg/L Pass/ Fail	Network Five-Year Average Geometric Mean (µg/L)	≤10 µg/L Pass/ Fail
		S-345B6	10	3	Pass				
	2012	3ASMESO	9	5.3	Pass	5.5	*Pass*		
		CA311	8	4.8	Pass				
		CA315	9	5.3	Pass				
		CA316	8	6.9	Pass				
		CA319	10	5.8	Pass				
		CA32	8	5	Pass				
		CA325	8	3.8	Pass				
		CA34	7	6.4	Pass				
		CA38	6	3.8	Pass				
		CA39	10	6.1	Pass				
		CA3B1	7	3.1	Pass				
		CA3B2	8	7.7	Pass				
		S-345B6	9	7.6	Pass				
	2011 - 2012	**Five-Year Network Average**						**5.4**	*Pass*
		3 of 5 Year Network Average ≤ 10 µg/L				*Pass*			

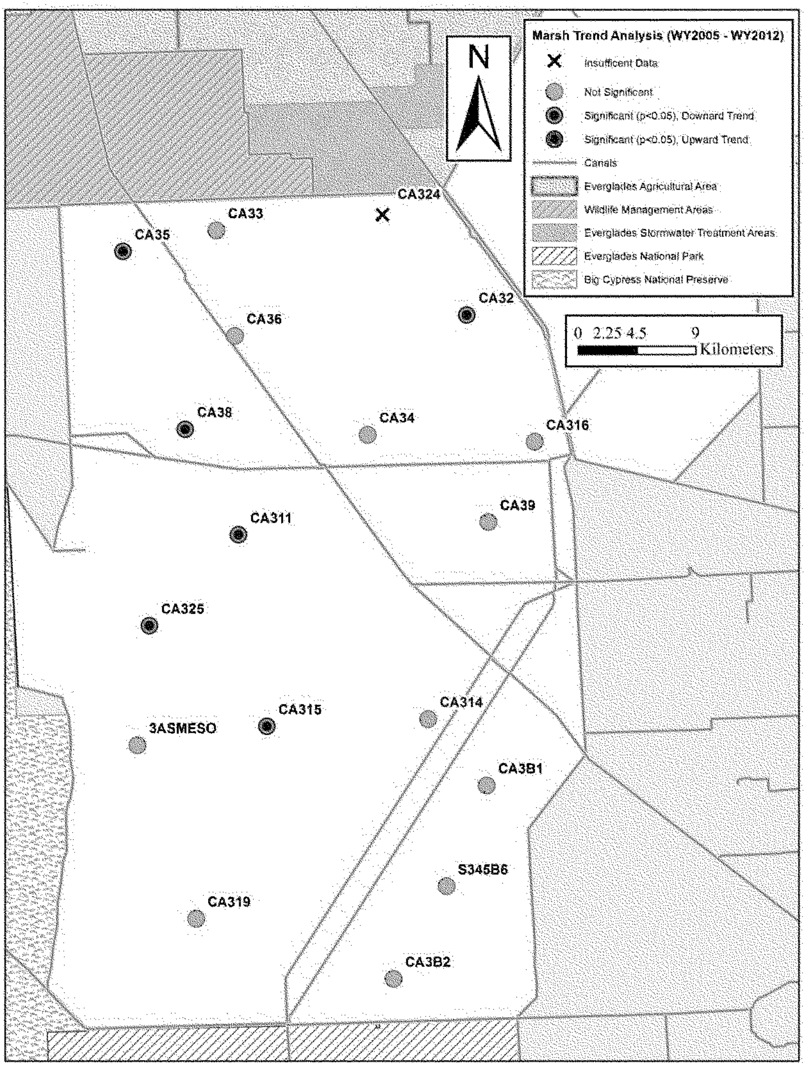


Figure F-11. Trend Analysis for Geometric mean TP concentrations at marsh monitoring stations.

Table F-5. Trend analysis of annual compliance geometric mean TP concentrations for impacted and unimpacted marsh stations in WCA-3 for the period from Florida Water Year 2005 through 2012.

Network	Station	No. Of Obs.	Linear Regression					Spearman's Rank Correlation		
			R^2	m	R_p	df	p-value	R_s	df	p-value
Impacted	CA314	5	0.05	-0.21	-0.23	4	0.713	-0.30	3	0.624
	CA324		*Insufficient Compliance Data to Perform Analysis (n = 1)*							
	CA33	6	0.61	-1.36	-0.78	5	0.066	-0.89	4	***0.019***
	CA35	4	0.91	-0.56	-0.95	[illegible]	***0.046***	-1.00	2	***<0.001***
	CA36	6	0.15	-1.01	-0.39	5	0.444	-0.41	4	0.425
Unimpacted	3ASMESO	8	<0.01	0.02	0.04	7	0.933	0.17	6	0.693
	CA311	8	0.58	-0.44	-0.76	7	***0.028***	-0.76	6	***0.028***
	CA315	8	0.73	-0.62	-0.86	7	***0.007***	-0.75	6	***0.031***
	CA316	8	0.50	-0.60	-0.71	7	***0.049***	-0.74	6	***0.037***
	CA319	5	0.10	-0.21	-0.32	4	0.599	-0.30	3	0.624
	CA32	7	0.49	-0.55	-0.70	6	0.080	-0.79	5	***0.036***
	CA325	5	0.79	-0.36	-0.89	4	***0.042***	-0.89	3	***0.041***
	CA34	6	0.55	-1.21	-0.74	5	0.093	-0.83	4	***0.042***
	CA38	8	0.74	-0.41	-0.86	7	***0.006***	-0.76	6	***0.028***
	CA39	5	0.08	-0.19	-0.29	4	0.635	-0.30	3	0.624
	CA3B1	5	0.65	-0.62	-0.81	4	0.097	-1.00	3	***<0.001***
	CA3B2	5	0.01	-0.11	-0.09	4	0.890	<-0.01	3	1.000
	S345B6	8	0.26	-0.64	-0.51	7	0.192	-0.50	6	0.207

R^2 = Coefficient of Determination; R_P = Pearson Correlation Coefficient; R_S = Spearman' Rank Correlation Coefficient; df = Degrees of Freedom; m = Slope or Inclination of Regression; p-value = probability.

(Note: Trends were determined using a parametric (linear regression) and a non-parametric (Spearman's Rank Correlation) method. A significance level (α) of 0.05 was assumed. Bolded and italicized p-values identify trends that are statistically significant. Data used for these analyses were taken from South Florida Environmental Reports (SFWMD 2010, SFWMD 2011, SFWMD 2012 and SFWMD 2013)).

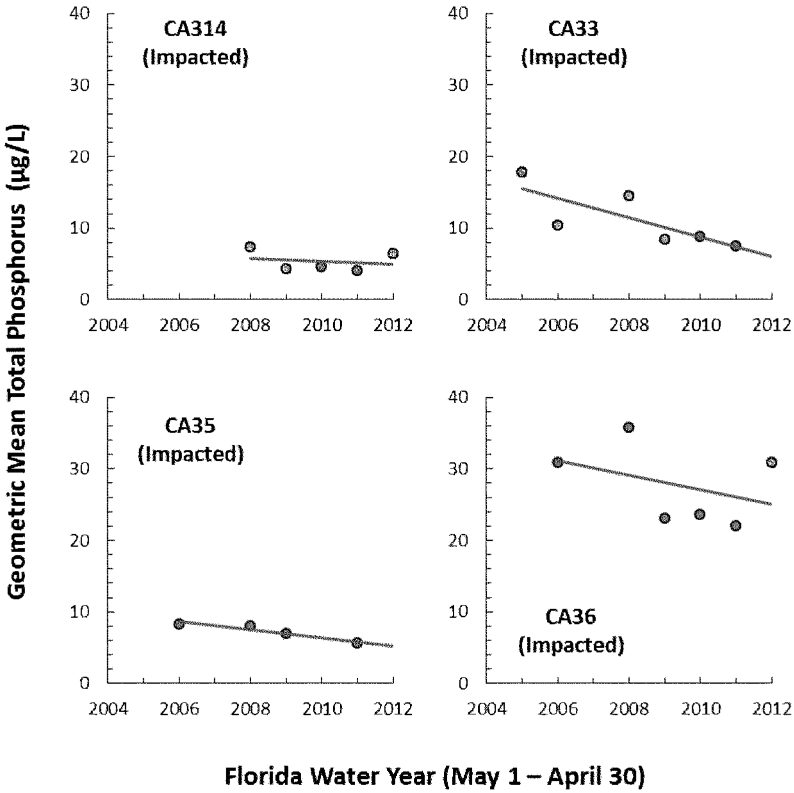


Figure F-12. Annual compliance geometric mean TP concentrations for each impacted marsh station in WCA-3 from Florida Water Years 2005 through 2012.

(Note: Statistics for the linear regression trend lines are summarized in Table F-5. Data used in this analysis were taken from the South Florida Environmental Reports (SFWMD 2010, SFWMD 2011, SFWMD 2012 and SFWMD 2013)).

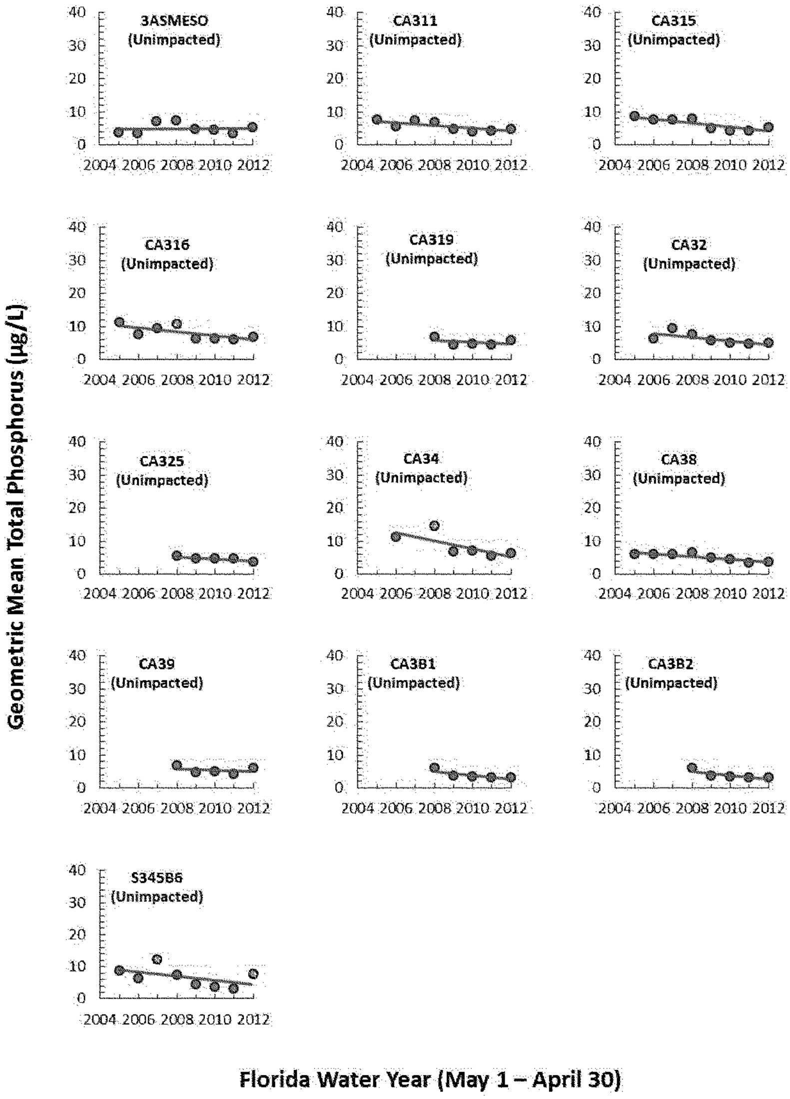


Figure F-13. Annual compliance geometric mean TP concentrations for each unimpacted marsh station in WCA-3 from Florida Water Years 2005 through 2012.

(Note: Statistics for the linear regression trend lines are summarized in Table F-5. Data used in this analysis were taken from the South Florida Environmental Reports (SFWMD 2010, SFWMD 2011, SFWMD 2012 and SFWMD 2013)).

F.4 WATER CONSERVATION AREA 3B (WCA-3B)

Water quality in WCA-3B will be affected by the construction of all the structures in the L-67A levee and the construction of the Blue Shanty Flow-way. The S-631 structure will deliver L-67A canal flows into WCA-3B and structures S-632 and S-633 will deliver water into the Blue Shanty Flow-way (**Figure F-7**). The inflow through these structures is affected by the water quality in the L-67A canal, which is influenced by discharges from the S-9 Pump Station. Channelized discharges from S-9 and S-9x pump stations tend to degrade water quality in the L-67A canal, which may impact water quality within WCA-3B and the Blue Shanty Flow-way.

The Blue Shanty Flow-way will result in hydraulic isolation of the southwest corner of WCA-3B from the eastern portion of this WCA. Nutrient uptake within the Blue Shanty Flow-way marsh will likely lower the concentration of TP in water delivered through this flow-way to ENP. **Table F-4** shows the annual and five-year geometric mean TP concentrations for the three TP Rule marsh stations in WCA-3B. Though the state calculates compliance with the TP rule for WCA-3 (3A & 3B) as a whole, these data show that all stations in WCA-3B currently meet the annual test provisions of the TP Rule. While operations under ALT4R are expected to improve hydroperiods within WCA 3B, the system is primarily rainfall driven. Changes in the operations of this area may or may not affect compliance with the annual tests provisions of the TP Rule for these stations until the system can adapt to the conditions imposed through the implementation of ALT4R2.

Impacts to marsh TP concentrations during construction of the S-631 structure are expected to be minimal given the distance between the feature and the marsh monitoring stations. Releasing L-67A canal flows through the S-631 structure is likely to cause the geometric mean TP concentration of the three WCA-3B marsh stations to increase somewhat. This is particularly true when considering the phased implementation of CEPP components. While uncertainty exists, it is unlikely that discharges into WCA-3B will cause or contribute to violations of the TP Rule, particularly the annual test provisions of the TP Rule. Over the long-term, the risk of exceedances of the TP Rule in WCA-3B and WCA-3A is expected to decrease as upstream concentrations adjust.

Structures S-355A and B are located along the L-29 levee and allow WCA-3B discharges to the L-29 borrow canal and ENP at Tamiami Trail. Under the previous limited test operations, which include limited structural inflows to WCA-3B, the structures can only discharge a small fraction of their design capacity of 1,000 cubic feet per second (cfs) each. Water quality data has been collected at the S-355 A and B structure locations (**Table F-6**). The TP concentrations at these structures are elevated; however, the adjacent marsh concentrations are low. The average annual (Federal Water Year Oct-1 to Sep-30) concentration at the structures varies between approximately 10 and 39 ppb while the adjacent marsh concentrations are typically lower than 10 ppb. The elevated levels at the structures are likely associated with the stagnant, non-flowing conditions and legacy phosphorous that has accumulated in the collection canals. The structures have been operated only a few times. Water quality data collected during operational tests indicated that the TP concentrations typically drop during discharge events. From the limited data collected, the discharge concentrations were in the 7 to 19 ppb range during discharge events. The CEPP Adaptive Management Plan is proposing to dredge out old agricultural canals that are located in southern WCA-3B to help improve the discharge efficiencies of these structures. If this dredging is done it will need additional NEPA analysis and water quality assessments.

Table F-6. Annual Arithmetic average TP concentrations (µg/L) of grab samples at structures at Shark River Slough (SRS) near WCA-3B.

Water Year	S-331/S173	S-334/S-356	S-355A*	S-355B*	S-333
2008	8.2	10.6	22.8	32.9	11.7
2009	8.1	12.0	15.3	19.0	13.0
2010	7.4	9.8	9.6	14.3	11.3
2011	11.4	17.1	25.2	38.7	19.7
2012	7.5	10.2	16.1	16.9	10.5

All averages based on federal water year (Oct-1 to Sep 30)

* These structures are mostly closed so the concentrations are not indicative of water quality in the nearby marsh.

F.5 EVERGLADES NATIONAL PARK (ENP)

Compliance with TP water quality criteria for water entering ENP is specified in Chapter 62-302.540, F.A.C. The rule states that "Achievement of the phosphorus criterion in the Park shall be based on the methods as set forth in Appendix A of the Settlement Agreement unless the Settlement Agreement is rescinded or terminated..... the Department shall review data from inflows into the Park at locations established pursuant to Appendix A of the Settlement Agreement and shall determine that compliance is achieved if the Department concludes that phosphorus concentration limits for inflows into the Park do not result in a exceedance of the limits established in Appendix A."

Construction of ALT4R2 project features such as the Blue Shanty Flow-way, L-29 levee degrade, L-67 Extension canal backfilling, and flow capacity increases at the S-333 and S-356 structures will alter the quality, quantity, timing, and distribution of flows entering SRS in northern ENP. Non-CEPP features, such as the Tamiami Trail 1-one mile bridge that is under construction, and the future Tamiami Trail Next Steps Bridge Project will also alter flow patterns into SRS.

F.5.1 Impact of CEPP on Future Loads into ENP

The CEPP will impact how water is delivered from WCA-3 to the Park. ALT4R includes backfilling the Miami Canal and increasing sheetflow through the marsh area. Backfilling alone will decrease the direct transport of legacy TP to SRS. The improved sheetflow will result in WCA-3A outflow water quality being more influenced by marsh background water quality. ALT4R assumes that marsh uptake of TP occurs in northern WCA-3A. This will likely reduce TP concentrations in southern WCA-3A. After the system stabilizes or responds consistently with lower concentrations as a result of restored hydroperiods, concentrations are expected to be lower than the ECB condition and lower than the FWO condition. Increased TP uptake should improve SRS FWM TP concentrations relative to ECB and FWO.

F.5.2 New Tamiami Trail Inflow Locations

ALT4R2 includes several modifications along and southeast of Tamiami Trail which is the northern boundary of ENP. These modifications include increased capacity at the S-333 and S-356 structures, degrade of the L-29 Levee at the southern boundary of the Blue Shanty Flow-way, backfilling of the L-67A Canal Extension, removal of the temporary S-356 structure and Old Tamiami Trail, operation of the S-355 A and B structures, and installation of a seepage cutoff wall along the L-31 N Levee south and north of Tamiami Trail. In addition to the CEPP-related project features, the U.S. Department of the

Interior's "Tamiami Trail – Next Steps" project will also affect flows across Tamiami Trail into SRS. Existing annual average TP concentrations for existing structures near SRS is provided in **Table F-6**. A short discussion of anticipated changes to TP flows and loads as a result of each of these features is included below.

F.5.2.1 S-333 Structure

The capacity of the S-333 structure will be increased from 1,350 cfs to 2,500 cfs under ALT4R2. **Table F-7** shows that with ALT4R which is similar to ALT4R2, the percentage of the total SRS flows that pass through the S-333 structure will increase from around 17 to 55 percent, while the S-12x structures will pass a substantially decreased fraction of these flows during the calendar year. At present the average TP concentrations at S-333 are greater than those at the S-12x structures because S-333 flows are dominated by canal contributions and the western most S-12x structure flows are dominated by marsh contributions. Future flow to SRS via the L-67A canal is expected to consist of water that has passed through the marsh due to backfilling of the Miami Canal in northern WCA-3A. TP concentrations in CEPP sheetflow could potentially be reduced to historical marsh levels. However, there still exists a potential for an exceedance due to the increased volume over the FWO condition. Prior to and during the project implementation period, TP concentrations may remain somewhat elevated relative to background concentrations due to the transport of legacy TP from impacted areas, re-suspension of canal sediments, and S9x flows and loads delivered prior to full implementation of CEPP and other CERP related projects. Prior to increasing the S-333 capacity, a detailed evaluation as part of the permitting process will be done to ensure that the increased discharge will not impose a problem in terms of water quality compliance for the Park.

Table F-7. Distribution of average flows (ac-ft/(calendar year) through S-333 and S-12A, S-12B, S-12C, and S-12D for ECB, FWO, and ALT4R.

Alternative	Annual Average Discharge Through S-12x and S-333 Structures					
	S-12A	**S-12B**	**S-12C**	**S-12D**	**S-333**	**Total**
ECB	37,328	98,566	172,917	384,881	129,721	823,413
Percent of total	5%	12%	21%	47%	16%	100%
FWO	29,757	92,160	242,851	320,396	137,152	822,317
Percent of total	4%	11%	30%	39%	17%	100%
ALT4R	15,867	48,264	152,743	206,291	522,956	946,122
Percent of total	2%	5%	16%	22%	55%	100%

F.5.2.2 Degradation of the L-29 Levee South of the Blue Shanty Flow-way

ALT4R2 includes degrading the L-29 levee in the stretch between the S-333 structure and the levee that defines the eastern edge of the Blue Shanty Flow-way. Water will enter the Blue Shanty Flow-way through the S-632 and S-633 structures located on the southern end of the L-67A canal. Uptake of TP is expected to occur as this water passes through the flow-way marsh and arrives at the degraded L-29 levee. The water that passes through the flow-way is expected to have lower TP concentrations. The dominant direction of this flow will be north to south. However, there are likely to be periods when the flow pattern is reversed. The 2005-2012 average TP concentrations at SRS marsh monitoring stations, P33, NE1, and NP201 presented in **Table F-8** below. The TP concentrations at these SRS marsh stations are expected to remain at or below existing background levels given the distribution of flows across the length of the degraded levee. However, we may see a slight increase in TP during times when there is increase in total loads and flow. Some SRS marsh stations have been isolated from surface water loading for decades. When more natural overland flow is established with CEPP, there is uncertainty as to how loading and water movement will affect how total phosphorous concentrations in the marsh respond.

Table F-8. WY2005–WY2012 average TP concentrations observed at SRS monitoring stations.

Water Year (Oct-1 to Sep 30)	NE1	NP201	P33	P34	Overall
2005	5.2	10	9.2	3.9	6.9
2006	5.4	7.0	8.4	4.5	6.2
2007	6.4	5.5	7.2	4.3	5.8
2008	6.7	6.1	7.2	4.8	6.2
2009	5.8	3.6	5.8	3.6	4.7
2010	4.5	3.6	6.1	4.9	4.7
2011	3.8	3.8	6.2	5.3	4.6
2012	5.2	5.6	5.4	4.1	5.1

F.5.2.3 L-67A Extension Backfill and Levee Degrade

The L-67A Extension canal connects to the L-29 borrow canal just east of the S-333 structure. Removal of the L-67A Extension levee and canal and the Old Tamiami Trail are included in ALT4R2 because it will allow for sheetflow distribution as flows travels south into SRS. Construction activity during backfilling and degrading of the L-67A Extension and the Old Tamiami Trail may result in the temporary mobilization of legacy phosphorus contained in canal sediments. Impacts from the mobilization of TP during construction may temporarily increase the geometric mean TP concentrations at the ENP NP201 marsh monitoring stations. After the removal of the L-67 Extension and the Old Tamiami Trail are completed, the additional flow dispersion in northern SRS will reduce the likelihood that marsh concentrations within this area are adversely impacted by CEPP flows.

F.5.2.4 Increased Flow Capacity at S-356

The S-356 pump station is intended to return seepage collected in the L-30 and L-31N canals back to the L-29 canal so that it can flow south into northeast SRS. As part of ALT4R2, the capacity of this pump will be increased from 500 cfs to 1,000 cfs in order to capture the additional seepage that results from higher water levels in WCA-3B. There is a sampling station at S-334 and S-356, which is located adjacent to the intake of the S-356 pump station. Data collected at this structure indicates that average TP concentrations varied between 9.7 and 17.1 µg/L for WY2008 through WY2012; however, since the S-356 pump station has not been operated, these values are indicative of S-334 flows and not very useful for estimating future S-356 water quality under CEPP conditions. Further south are the S-331 pump station and the S-173 culvert that also draw water from the L-31N canal. Future water quality at the S-356 structure will reflect a mix of seepage water from the west (WCA-3B, ENP) and L-31N basin runoff from the east. At present, no prediction model is available to assess future quality at the S-356 pump station; however, historic water quality at the S-331/S173 provides the best available indication of future S-356 water quality with CEPP. From **Table F-6**, for the WY2008–WY2012 period the S-331/S173 annual average TP concentrations varied between 7.4 and 11.4 µg/L.

F.5.2.5 Seepage Cutoff Wall in L-31N Levee

ALT4R2 includes a seepage cutoff wall constructed in the northern reach of L-31N levee north of the G-211 structure. This seepage cutoff wall will hydraulically isolate the upper portion of the surficial Biscayne Aquifer from the L-31N canal and presumably reduce seepage losses from northeastern ENP eastward compared to what would be experienced without a seepage wall in the presence of higher Everglades stages. Since TP concentrations in northern L-31N canal reflect a mixture of sources such as ENP seepage, L-31N basin runoff, and C-4 releases, a change in seepage conditions or operations will impact L-31N TP concentrations. The Regional Simulation Model - Glades LECSA (RSMGL) model results show an increase in seepage from an average of 90 to 150 kac-ft/yr, in the northern reach of L-31N canal. It follows that relative to ECB and FWO conditions, the cutoff wall will not eliminate or reduce ENP seepage that flows eastward. Since the cleaner seepage flows will represent a greater portion of total reach flow under ALT4R2, the average TP concentrations in the northern portion of L-31N canal should improve during times where we see increased seepage.

F.5.2.6 Tamiami Trail Bridge Projects

The Modified Waters Delivery Project 1-mile long Tamiami Trail bridge is nearing completion in summer 2013. This bridge is located just west of the S-334 and S-356 structures along U.S. Highway 40 (Tamiami Trail) and will allow flows from the L-29 canal flowing underneath the Bridge into the Park, once the old roadway is removed. The U.S. Department of the Interior has initiated design, planning and authorization for the Tamiami Trail Next Steps Bridge Project. This project includes a 2.65-mile long bridge(s) that will be located just downstream of the Blue Shanty Flow-way. Similar to the MWD 1-mile long Tamiami Trail Bridge, it will improve the distribution of inflows entering northeast SRS from a series of culverts to a widely distributed sheetflow delivery. The 2.65-mile bridge will allow water from WCA-3A, S-333, the Blue Shanty Flow-way, and L-29 canal to enter northeast SRS. Under ALT4R2, the water flowing under these new bridges is expected to reflect decreased TP concentrations from improved marsh hydrological (e.g., sheetflow distribution) and biological (e.g., uptake) processes in WCA-3A and Blue Shanty Flow-way, redistribution of lower-concentration S12x flows to the east (as indicated in **Table F-7**), increased contribution of lower-concentration seepage return flow to L-29 from S-356, and the addition of low-concentration water from WCA-3B via S-355-A/B, which should reduce concentrations relative to those currently observed at the S-333.

F.5.3 Appendix A Compliance at Shark River Slough

The implementation of the CEPP as well as other projects and operational schemes will alter the flow and locations at which these flows enter SRS. These changes will have an impact on SRS compliance with the requirements of state law and Appendix A from the 1991 Settlement Agreement. For CEPP, the three most important aspects of Appendix A compliance assessment are as follows: (1) CEPP-related increases in flow will reduce the Long Term Limit (LTL) for TP; (2) although long-term TP concentrations entering northeast SRS are expected to decrease, there will likely be short-term impacts of CEPP-related project implementation sequence on TP concentrations and loads; and (3) CEPP-related structural changes will alter existing SRS inflow points. All of these will have some effect on Appendix A compliance or the sufficiency of the compliance methodology and are currently undergoing review by a subteam assigned by the Everglades Technical Oversight Committee.

F.5.3.1 Impact of Additional CEPP Flows on SRS Compliance Limit

Appendix A compliance is currently assessed by comparing the Long Term Limit (LTL) against the 12-month flow-weighted mean (FWM) TP concentration in parts-per-billion, calculated using the measured flows from the S12A, S12B, S12C, S12D, and S333 structures that distribute flows from WCA 3A into SRS. The LTL, as defined in Appendix A of the 1991 Settlement Agreement, has an inverse relationship with flow; as flow into SRS increases, the LTL is reduced. Data from **Table F-9** shows that while the LTL concentration decreases as flow increases, the measured FWM concentration (1991-2011) has a similar historical trend of decreasing as flow increases. In addition, under ALT4R2, concentrations are expected to decrease from historical levels. Nonetheless, given that the measured FWM TP concentration at SRS has been very close or equal to the LTL since 2007 (shown in **Figure F-14** and **Table F-9)**, there is concern that the addition of CEPP flows could alter the frequency of compliance with the limit. Proposed CEPP annual flows are greater with ALT4R than for the ECB and FWO as shown in **Figure F-15**. Based on the current Appendix A compliance methodology, this increased flow volume results in a decrease of the LTL by about 2.0 ppb 50% of the time and by 1.0 ppb TP about 10% of the time, depending upon the annual inflow. ALT4R2 has a similar increase in flow at SRS. Furthermore, using the current Appendix A compliance methodology with CEPP, the minimum LTL compliance concentration of 7.6 ppb will be applicable about 20% more frequently. It is possible that exceedances of the LTL would occur due to the increased flow volume; however, the additional CEPP flow will be treated to the WQBEL and then be routed through the northern WCA-3A marsh which should lower TP concentrations relative to present conditions.

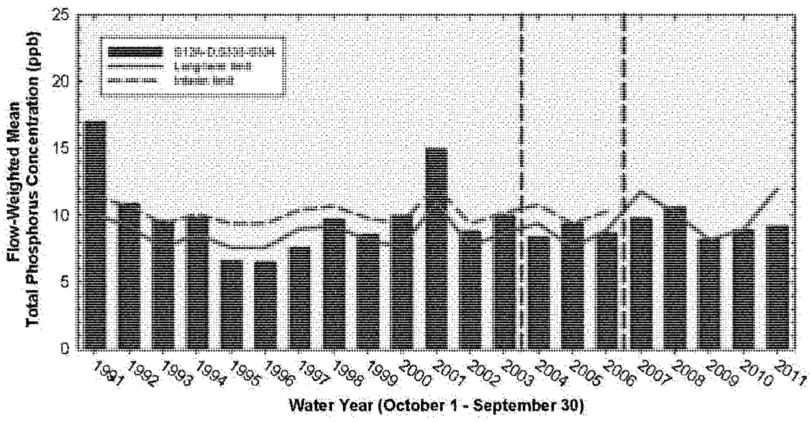


Figure F-14. SRS compliance history (from Settlement Agreement Report, SFWMD, 2011).

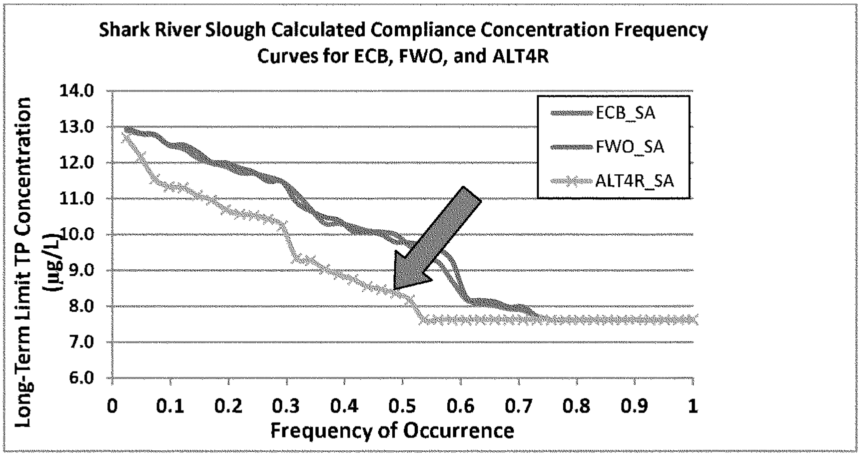


Figure F-15. Impact of increased CEPP flows on compliance criteria.

[Note: Arrow shows effect of increased flows on calculated long-term limit value, which is compared to measured FWM TP concentrations annually to determine compliance.]

Table F-9. SRS compliance history (data from quarterly Settlement Agreement Reports prepared by the SFWMD)

Water Year (Oct 1 to Sep 30)	Total Flow (S-12s+S-333) (kac-ft)	Interim Limit (µg/L)	Long-Term Limit[1] (µg/L)	Flow-Weighted Mean (S-12s+S-333-S-334) (µg/L)
WY1991	581.1	11.4	10.1	17.0
WY1992	738.7	10.7	9.2	10.9
WY1993	1529.6	9.4	7.6	9.6
WY1994	856.1	10.1	8.6	9.8
WY1995	2491.9	9.4	7.6	6.6
WY1996	1478.5	9.4	7.6	6.5
WY1997	786.5	10.4	9.0	7.6
WY1998	737.6	10.7	9.2	9.7
WY1999	939.8	9.8	8.2	8.6
WY2000	1145.3	9.4	7.6	10.0
WY2001	420.5	12.2	11.0	15.0
WY2002	1048.1	9.4	7.7	8.8
WY2003	850.1	10.2	8.7	10.0
WY2004	704.4	10.8	9.4	8.4
WY2005	1345.9	9.4	7.6	9.4
WY2006	814.1	10.3	8.8	8.7
WY2007	289.7	n/a	11.8	9.8
WY2008	562.0	n/a	10.2	10.6
WY2009	945.3	n/a	8.2	8.2
WY2010	809.9	n/a	8.9	8.9
WY2011	247.0	n/a	12.0	9.2

[1]LTL was effective in WY2007. LTL reported prior to WY2007 (shown in gray) are for reference only.

F.5.3.2 Effect of the Implementation Sequence on SRS TP Concentrations and Loads

In development of construction and sequencing implementation plan, a number of non-CEPP projects must be in place before implementing any CEPP features. These non-CEPP project features include Restoration Strategies and the Broward County Water Preserve Area C-11 Impoundment among others (see Section 6.0 Table 6-6 – Project Dependencies) and must be integrated into the sequencing of CEPP to avoid unintended adverse water quality consequences. Several basic principles were considered in development of an implementation plan for CEPP features which include the following:

1. All features of the State's Restoration Strategies must be completed and meet state water quality standards prior to initiating construction of most CEPP project features;
2. Construction of CEPP Project features cannot proceed until it is determined that construction and operation of the feature:
   a. Will not cause or contribute to a violation of State water quality standards; and
   b. Will not cause or contribute to a violation of any applicable water quality permit discharge limits or specific permit conditions ; and
   c. Reasonable assurances exist that demonstrate adverse impacts on flora and fauna in the area influenced by the Project features will not occur.

3. Appendix A water quality compliance must be addressed for new Project water entering Everglades National Park
4. Additional CEPP water quality treatment features, including operational and structural modifications, may need to be constructed if State water quality standards are not met upon operation of CEPP project features
5. Sequencing for the earliest opportunity to realize benefits, including the features that can provide benefits that utilize existing water meeting State water quality standards.

The most recent project implementation plan for ALT4R2 calls for a construction period of 15 to 20 years post-authorization. The proposed construction and sequencing implementation plan sequencing of the various project features in CEPP can have a substantial effect on the projects ability to comply with water quality standards. The construction and sequencing implementation plan is presented in **Table 6-6** in **Section 6.7.2** and was developed to maximize benefits while considering important constraints such as water quality (see **Section 2.0** of this document) and flood protection.

F.5.3.3 Effect of Altered Inflows and New Inflows on Appendix A Compliance Determination

At present, the quantification of flows and loads for Appendix A compliance includes measurement of point source flows and TP concentration at the S-12A-D, S-333, and S-334 structures. Appendix A calculations have included flows through the Tamiami Trail culverts, S-355A and S-355B structures though the flows are limited because either the structures are kept closed or the quantity is hydraulically limited. ALT4R2 includes new features such as the Blue Shanty Flow-way that will affect the location of inflows to SRS at Tamiami Trail. Also, increased marsh stages and altered flow patterns with ALT4R2 will increase flows through the Tamiami Trail culverts and the S-355A, S-355B, and S-356 structures. In addition to the CEPP changes to hydrology, the Tamiami Trail Bridge projects will provide new SRS inflows through sheetflow under these bridges.

It is uncertain how changes in flow distributions proposed under CEPP will impact compliance with Appendix A of the 1991 Settlement Agreement. Over the long-term, distributing the flow over the northern WCA-3A marsh, reducing short-circuiting down the canals to ENP, adding more flow from the lake that is treated to the WQBEL, and distributing these flows over the marsh should result in improvements by lowering the flow weighted mean total phosphorous concentration entering the Park. In the short-term, to address the uncertainty in compliance with Appendix A, the Technical Oversight Committee (TOC) is reviewing applicability of the current Appendix A compliance methodology for a restored ecosystem.

F.6 CONCLUSION

This paper provides evidence that implementation of ALT4R2 is likely to improve water column TP concentrations within most areas of WCA-3 primarily due to the use of state owned water quality treatment facilities and increased upstream storage capacity provided by the A-2 FEB along with backfilling of the Miami Canal and redistributing flows into the northwestern corner of WCA-3A, which should allow for uptake of TP within this marsh. Over the long-term it is likely that the project will beneficially affect WCA-3. However, there may be temporally and spatially limited impacts to TP concentrations within the marsh until more stabilized conditions are established. It is uncertain how changes in flow distributions proposed under CEPP will impact compliance with Appendix A of the 1991 Settlement Agreement.

It is important to note that this paper only includes a qualitative rather than quantitative assessment of Appendix A compliance at SRS. The impact of the project to Settlement Agreement compliance will be uncertain because the analysis is qualitative. A quantitative prediction of future SRS TP concentrations was not done because the uncertainties were considered to be unacceptably high. The limitation of predictive tools, uncertainties in the systems response and the lack of historic data that reflects the substantially altered flow and loading patterns contribute to these uncertainties. Also, with future Appendix A compliance methodology currently under review by the TOC, these quantitative predictions may be premature at this time.

Notwithstanding the inability to confidently predict future SRS inflow concentrations, SRS TP concentrations are expected to improve relative to ECB conditions and are likely to improve under ALT4R2 conditions. ALT4R is expected to improve marsh hydroperiods over FWO conditions, which will reduce the risk of downstream TP spikes caused by dry-out and rewetting. Additional TP uptake is also expected from ALT4R2 features such as Miami Canal Backfill and Blue Shanty Flow-way.

CEPP project features cannot proceed unless/until it is determined through the CERPRA permitting process that construction and/or operation of the feature 1) will not cause or contribute to a violation of water quality standards; 2) will not cause or contribute to a violation of the permit(s) discharge limits or specific conditions; and, 3) reasonable assurances exist that demonstrate adverse impacts on flora and fauna in the area influenced by the project element will not occur. Therefore, increased flows and TP loads associated with ALT4R implementation may be delayed until after the WQBEL is met for existing flows. The tentative feature implementation sequence for ALT4R2 is designed to minimize the potential for temporary increases in TP during project construction, commissioning and long term operations. For example, the hydropattern restoration feature may not be constructed and operated until the Miami Canal backfill and diversion of L-6 flows are complete. These features are expected to improve SRS inflow TP concentrations when complete. Depending on how the system responds to implementation of the first phase of the CEPP ALT4R, revisions to the sequencing of remaining features may be necessary. Given the magnitude of the hydrologic changes proposed in ALT4R2, this project presents some risk of future non-compliance with water quality criteria particularly in WCA-3 and at SRS. With the CEPP extended implementation schedule and initial construction efforts that focus on features with positive water quality impacts such as the Miami Canal Backfilling and the diversion of L-6 flows, there will be an opportunity to address potential water quality concerns before the addition CEPP flows are delivered through the system.

As the CEPP proceeds and data from individual projects are gathered, these data are expected to feed back into the CEPP adaptive management plan. Each individual component of the CEPP will require a Comprehensive Everglades Restoration Plan Regulation Act (CERPRA) permit from the FDEP. Integration of adaptive management/operations/monitoring into the CEPP will help provide reasonable assurance associated with water quality issues and uncertainties. Ideally, adaptive management will be applied iteratively throughout the phasing of the CEPP to address issues early and allow for lessons learned to be applied for future phases. Commitment to adaptive management is key to moving this restoration project forward given the uncertainties associated with water quality.

F.7 REFERENCES

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ANNEX G

INVASIVE AND NUISANCE SPECIES MANAGEMENT PLAN

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G.0 INVASIVE AND NUISANCE SPECIES MANAGEMENT PLAN

In accordance with the Comprehensive Everglades Restoration Plan (CERP) Guidance Memorandum 062.00 (CGM62), Invasive Species, the CEPP will incorporate invasive and nuisance species assessments and management of those species into pertinent planning documents and phases of the project. The Invasive and Nuisance Species Management Plan (INSMP) is a living document and will be updated throughout the Design, Construction and Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) phases.

The Project Partnership Agreement (PPA) and the Construction Phasing, Transfer, and Warranty (CPTW) Plan are developed and agreed to prior to construction. The documents outline the responsibilities of the federal and non-federal sponsor during the construction phase, the operational testing and monitoring period, and the OMRR&R phase, and will include the cost estimates associated with this INSMP. This INSMP must be included with the CPTW Plan.

This plan was developed with the input and guidance of multiple agencies and subject matter experts. The following provided text, technical guidance, and cost estimates.

- South Florida Water Management District – David Black, LeRoy Rodgers
- U.S. Army Corps of Engineers – Jeremy Crossland, Angie Huebner, Jon Morton, Jessica Spencer, Sue Wilcox
- U.S. Fish and Wildlife Service – John Galvez, Art Roybal
- Everglades National Park – Jeff Kline, Jonathan Taylor
- Florida Fish and Wildlife Conservation Commission – Jenny Ketterlin Eckles, Kelly Gestring
- University of Florida – Frank Mazzotti

G.1 INTRODUCTION

The Central Everglades Planning Project (CEPP) encompasses the Everglades Agricultural Area Storage Reservoir, Decompartmentalizaton of Water Conservation Area (WCA) 3, Everglades National Park (ENP) Seepage Management, and Everglades rain driven operations. The components of this plan are highly interdependent features that will be implemented in a comprehensive and integrated manner and are the main portion of CERP.

Nationally, more than 50,000 species of introduced plants, animals, and microbes cause more than $120 billion in economic damages and control costs each year (Pimentel et al., 2005). Not all introduced species become invasive species. According to the Office of Technology Assessment, Harmful Non-indigenous Species in the United States report, approximately 10 to 15% of introduced species will become established and 10% of the established species may become invasive.

Executive Order (E.O.) 13112, entitled *Invasive Species*, signed 03 February 1999, states an "invasive species means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Alien species means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores or other biological material capable of propagating that species, that is not native to that ecosystem. Invasive species are broadly defined and can be a plant, animal, fungus, plant disease, livestock disease or other organism. The terms 'alien' and exotic also refer to non-native species. A native species is defined as a species that historically occurred or currently occurs in a particular ecosystem and is not the result of an introduction.

Invasive non-native species decrease biodiversity, displace native plant and animal communities, reduce wildlife habitat and forage opportunities, alter the rates of soil erosion and accretion, alter fire regimes, upset predator/prey relationships, alter hydrology, degrade environmental quality and spread diseases to native plants, animals and other organisms. Furthermore, invasive species are the second largest threat to biodiversity following only habitat destruction (Wilcove et al., 1998); invasive species are second in destructive nature only to human development. In the United States, invasive species directly contributed to the decline of 49% of the T&E species (Wilcove et al., 1998). In addition to environmental impacts, invasive species impact human health, reduce agricultural production and property values, degrade aesthetic quality, decrease recreational opportunities and threaten the integrity of human infrastructure such as waterways/navigation channels, locks, levees, dams and water control structures.

Florida is particularly vulnerable to the introduction, invasion and naturalization of non-native species. This is due to several factors including a subtropical climate, dense human population centers, major ports of entry and the pet, aquarium and ornamental plant industries. Major disturbance to the landscape has also increased Florida's vulnerability to invasive species. Alteration of the landscape for urban development, flood control and agricultural uses has exacerbated non-native plant and animal invasions. Florida is listed as one of the states with the largest number of invasive species. This list also includes Hawaii, California, and Louisiana. On average, 10 new organisms per year are introduced into Florida that are capable of establishing and becoming invasive and causing environmental harm. Approximately 90% of the plants and animals that enter the continental United States enter through the port of Miami (JP Cuda, 2009a). Stein, Kutner & Adams (2000) estimated that over 32,000 exotic species (25,000 plants and 7,000 animals) have been introduced into Florida. There are approximately 4,000-5,000 native species of plants and animals in Florida. The number of non-native species that have been introduced is eight times the total number of native species in the entire state.

The Atlas of Florida Vascular Plants (Wunderlin and Hansen, 2008) documented 4,289 plant species in Florida. Of the 4,289 plant species, 1,419 were considered non-native and were naturalized (freely reproducing) populations. The Florida Exotic Pest Plant Council (FLEPPC) identifies 76 of the 1,419 species of non-native plants as Category I species in the 2011 Invasive Plant List. Searches through existing data and resources indicate 156 non-native plant species have been documented to occur within the project area (refer to Table G-3: Invasive Plant Species Documented in the Project Area). Other non-native species are probably present; however, documented citations could not be located. Of the 156 species of plants documented to occur within the project area, there are 76 FLEPPC Category I species, 38 FLEPPC Category II species and 28 Florida Noxious Weed species.

Significant scientific evidence and research document invasive non-native plants are degrading and damaging south Florida natural ecosystems (Doren and Ferriter, 2001). Many species are causing significant ecological impacts by crowding out and displacing native plants, altering soil types and soil/water chemistry, altering ecosystem functions such as carbon sequestration, nutrient cycling and fire regimes and reducing gene pools and genetic diversity. Non-native invasive animal distribution, extent and impacts are not well understood, however implications of invasive animals are apparent in south Florida. It has been documented there are 14 non-native species that are causing direct impacts to threatened and endangered species and rare habitats. It has also been documented that 19 species within Florida are among the world's worst weeds (Holm et al., 1977). It is estimated that federal, state and county agencies in Florida spend between $94 million and $127 million each year in an effort to manage invasive non-native plants (GAO, 2000).

Invasive species are a major threat to the success of CERP. "The intent of CERP is to restore, preserve and protect the south Florida ecosystem while providing for other water-related needs of the region. CERP focuses on hydrologic restoration to improve degraded natural habitat in the south Florida ecosystem. Hydrologic restoration alone cannot ensure habitat restoration (USACE and SFWMD, 2010)." In order to restore the Everglades and ensure south Florida's natural ecosystems are preserved and remain intact, invasive species must be comprehensively addressed (Doren and Ferriter, 2001). The lack of management will allow invasive non-native species to flourish and to continue to out-compete native species.

G.2 STATUS OF PRIORITY SPECIES AND THEIR IMPACTS

G.2.1 Plants

Table G-3 (Invasive Plant Species Documented in the Project Area) provides the list of non-native plant species that have been documented to occur within the project area. Searches through existing data and resources indicate 156 non-native plant species have been documented; other non-native species are probably present however documented citations could not be located. Of the 156 species of plants documented to occur within the project area, there are 76 FLEPPC Category I species, 38 FLEPPC Category II species, and 28 Florida Noxious Weed species.

There are four non-native invasive plant species and one native nuisance plant that infest large portions of the project area. These plant species are currently a concern and have the potential to impact project benefits. In addition there are four species of non-native invasive plants that have the potential to be spread by new project features and changes in operational procedures. These plant species are described below.

G.2.1.1 Widely Established Species

According to the 2013 South Florida Environmental Report, there are four species of non-native invasive plants infesting more than 144,770 acres within the Everglades Protection Area. These species include Australian pine (*Casuarina equisetifolia*), Old World climbing fern (*Lygodium microphyllum)*, melaleuca (*Melaleuca quinquenervia)* and Brazilian pepper (*Schinus terebinthifolius)*. The acreage of these plants was estimated by the SFWMD and the National Park Service (NPS) through regional invasive plant surveys utilizing digital aerial sketch mapping (DASM). The inventory was completed within the Everglades Protection Area, which is approximately 2.8 million acres in size, between March 2010 and February 2012. Wildlife management areas surveyed included Holeyland, Rotenberger, and Southern Glades. Other areas surveyed included the Seminole Tribe of Florida's Big Cypress Reservation, Loxahatchee National Wildlife Refuge (LNWR), Everglades Wildlife Management Area (WCAs 2 and 3), the Miccosukee Tribe of Indians of Florida's Reservations, Big Cypress National Preserve, ENP, East Coast Buffer Lands, South Dade Wetlands, and several other areas (SFER, 2013). Summaries on the distribution and impacts of these widely established species are included below. Other non-native plant species with limited or localized distributions or which have a high potential to spread into the project area are also discussed. These include torpedograss (*Panicum repens*), tropical American water grass (*Luziola subintegra*), rotala (*Rotala rotundifolia*), and cogongrass (*Imperata cylindrica*).

G.2.1.2 Australian pine

Australian pine is an evergreen tree that can grow to 150 feet tall. It has inconspicuous flowers and produces tiny fruit, a 1-seeded winged nutlet that is formed in a woody cone-like cluster. Australian pine is a prolific seed producer and seeds are dispersed by birds, wind and water flow. It is native to Australia, the south Pacific Islands and southeast Asia. Australian pine was introduced in the late 1800's and was planted extensively in south Florida as windbreaks and shade trees. It inhabits sandy shores and pinelands and is salt tolerant. It also invades disturbed sites such as filled wetlands, roadsides, cleared undeveloped land, canal banks and levees. Australian pine grows rapidly shading out native species, produces dense litter accumulation, causes beach erosion and produces an allelopathic agent that inhibits growth of other species. In addition it interferes with nesting of sea turtles and the American crocodile (Langeland and Burks, 1998). According to the survey, approximately 6,986 acres of Australian pine are present within the survey area and it is the least abundant of the surveyed species. According to the SFER 2013 report, Australian pine is now at a maintenance control level in many areas within the Everglades. Maintenance control, as defined by the Florida Fish and Wildlife Conservation Commission (FWC), "is the coordinated and consistent management of invasive plants in order to maintain the plant population at low levels." The major infestations, approximately 87%, of Australian pine were present on SFWMD and Miami-Dade County lands in the South Dade Wetlands and Model Lands Basin. In these areas, Australian pine is present in remote mangrove swamps and sawgrass marshes where populations vary from dense stands to widely scattered patches. In ENP, this species is present in the northeastern sawgrass marshes in widely scattered patches (SFER, 2013).

G.2.1.3 Brazilian pepper

Brazilian pepper is an evergreen shrub or tree that can grow up to 40 feet tall. It forms dense thickets and is a prolific seed producer. It produces a small bright red fruit in the form of a spherical drupe. Brazilian pepper is native to Brazil, Argentina and Paraguay and was imported in the 1840's as an ornamental plant (Langeland and Burks, 1998) Brazilian pepper inhabits natural areas such as pinelands, hardwood hammocks and mangrove forests. It is an aggressive pioneer species that quickly colonizes and thrives in disturbed areas (Francis, n.d.) such as fallow farmland, fence lines, right-of-ways, roadsides, canal banks and levees. Seeds are spread primarily by birds and mammals through consumption and deposition of the fruit. Seeds are also spread by flowing water (Langeland and Burks, 1998). Brazilian pepper seedlings will not tolerate inundation and are quickly killed; however large plants can withstand 6 months of flooding (Francis, n.d.) with several feet of inundation. Brazilian pepper forms dense monocultures and completely shades out, crowds and displaces native vegetation. It also produces allelopathic agents that possibly suppress the growth of other plants. Brazilian pepper is a member of the family Anacardiaceae which includes plants such as poison ivy, poison oak and poison sumac. The leaves, flowers and fruits of Brazilian pepper produce a chemical that can irritate and form a rash on human skin and cause respiratory problems (Langland and Burks, 1998). Approximately 75,310 acres of Brazilian pepper are widely distributed throughout the survey area. It is the most abundant of the species surveyed. In ENP, Brazilian pepper is dominant in certain buttonwood swamps and grass marshes along the inner edge of the southwestern mangrove swamps. Nearly 60% of the Brazilian pepper infestation within the survey area is present from the Ten Thousand Islands area to Cape Sable. This was the most severe infestation that was surveyed. Within the Seminole Tribe of Florida's Big Cypress Reservation, dense infestations of Brazilian pepper are present primarily on improved pastures and along the outer edge of cypress swamps. Throughout the central Everglades region, Brazilian pepper was present on small tree islands and in many cases dominant in the canopy. Observations of the tree islands from the ground indicated relatively no understory of native vegetation was present beneath the Brazilian pepper canopy. In Big Cypress National Preserve, Brazilian pepper is widely scattered, but it is present in dense infestations in the western Everglades hardwood hammocks. Little to no Brazilian pepper is present on the tree islands of the LNWR.

G.2.1.4 Melaleuca

Melaleuca is an evergreen tree that can grow up to 100 feet tall. It has white flowers that form spikes often referred to as a "bottle brush." The fruit is a round woody capsule in clusters along the stem; each capsule can contain 200-330 tiny seeds. It is native to Australia and was introduced to Florida in 1906 as an ornamental plant and in the 1930's it was scattered over the Everglades in order to create forests (Langeland and Burks, 1998). Melaleuca inhabits natural areas such as pine flatwoods, hardwood bottomlands, cypress forests, freshwater marshes, sawgrass prairies, and mangrove forests. It also infests disturbed sites such as improved pasture, natural rangeland, idle farmland, canal and levee banks and urban areas. It prefers sites that are seasonally wet. Melaleuca also flourishes in areas with standing water and persists in well-drained upland sites (Langeland and Burks, 1998). Melaleuca displaces native plant species, reduces quality of wildlife habitat, alters fire regimes and potentially alters wetland hydrology (Mazotti, Center, Dray and Thayer, 2008). Within the area surveyed, the infestation of melaleuca present is approximately 45,043 acres. The most extensive infestations are present in the East Coast Buffer Lands, Seminole Tribe of Floirda's Big Cypress Reservation and in northern sections of LNWR. In Big Cypress National Preserve and eastern ENP, melaleuca is present in small scattered stands in sawgrass and cypress swamps. In the Everglades Wildlife Management Area, melaleuca is considered to be at a maintenance control level.

G.2.1.5 Old World Climbing Fern

Old World climbing fern (*Lygodium microphyllum*), is a plant that has long fronds that can grow up to 90 feet. The fronds grow along the ground, over shrubs or climb by twisting and winding around trees, vines and other structures. The rhizomes and rachis are wiry and they are brown to black in color. The leafy branches that form along the rachis are 2 to 5 inches in length and have many pairs of leaflets. It produces spores that are dispersed by the wind. In south Florida, the plant produces spores throughout the year. Each fertile leaflet of Old World climbing fern can produce up to 28,600 spores. Old World climbing fern is native to Africa, Asia and Australia and the first record of it being found in Florida was in 1958. It was collected from a Delray Beach plant nursery where it was being cultivated (Langeland and Hutchinson, 2005). Old World climbing fern has been documented to occur in hardwood hammocks, mesic flatwoods, forested swamps, wet flatwoods, hydric hammocks, floodplain forests and strand swamps. It can completely overgrow the vegetation in these areas which allows the plant to compete with canopy trees and understory vegetation for light. The growth in the tree canopy provides an avenue for fire spread into the canopy which damages or even kills the trees. Over time, rhizomes accumulate in mats 3 feet or more thick on top of the soil (Langeland et al., 2008) which can prevent new growth of native plants. This plant is a threat to many areas within the project site but in particular to the Everglades tree islands (Ferriter et al., 2005) and disturbed sites. Approximately 17,431 acres of Old World climbing fern infestation are estimated to be present within the area surveyed. Approximately 75% of the Old World climbing fern present occurs within the LNWR. Within this area, dense mats have formed over the tree island canopies. Approximately 1,988 acres of ENP are infested with Old World climbing fern. It is present in the grass and prairie marsh in the southwestern portions of ENP. This survey was conducted in March 2010, following a frost in this region. Acreage estimates are expected to be low for percent cover and aerial extent due to substantial reductions of Old World Climbing fern from frost damage. This species was not located in WCA 3 while completing the DASM, however ground surveys confirmed Old World Climbing fern was present in the sub-canopy of tree islands.

G.2.1.6 Cattail

Cattails (*Typha* spp.) are native to Florida and occur in wetlands, lakes, rivers, canals, storm water treatment areas and other disturbed sites. Cattails grow up to 12 feet tall and have strap-like leaf blades. The inflorescence is spike-like with very tiny flowers. This plant is a primary native nuisance species within the project area. Many areas within the project area have been invaded by cattails. This is attributed to water with increased phosphorus being delivered to these areas which began in the late 1950's (Holmes et al., 2002). Areas where water control structures, conveyance features and levees exist provide a suitable habitat for invasion and expansion of cattail. An example of areas that have been impacted include WCA 2, the north east corner WCA 3A, ENP canal and levee banks. One heavily impacted area within the project site is the northern portion of WCA 2 and the Hillsboro Canal. Phosphorus rich water enters WCA 2 through the Hillsboro Canal. Effects of the water extend approximately 3.7 miles south of the canal. The nutrient rich water promoted cattail growth and has allowed cattails to become the dominant plant community within 1.5 miles immediately south of the northern boundary. A mixed community of cattail and sawgrass is present from 1.5 miles to 3.7 miles south of the boundary (Holmes et al., 2002).

G.2.1.7 Localized/Early Detection Rapid Response Species

G.2.1.7.1 Tropical American Watergrass

Tropical American watergrass (*Luziola subintegra*) is a perennial grass that is usually rooted but sometimes grows in floating mats. This plant can also grow in terrestrial sites. It produces a panicle type inflorescence. Tropical American watergrass spreads vegetatively and by seed. It is an aggressive grass that competes with both native and non-native invasive plants. It is native to Mexico, Central America, the Caribbean Basin with its range extending south through South America to Argentina (Krunzer and Bodle, 2008). The first record of occurrence was in Lake Okeechobee in 2007 when two large mats of tropical American watergrass (approximately two and eighty hectares each) were found near Harney Pond Canal in Fisheating Bay at Lake Okeechobee. From the initial population identified, this plant quickly spread and by July 2009 more than 2,000 acres of the plant were treated in the Lake. The plant was also found at the mouth of Fisheating Creek in both emergent and terrestrial forms. Since Fisheating Creek is the only unregulated flow into Lake Okeechobee, it is thought this area was the point of introduction. Since the initial sighting of tropical American watergrass in December 2007, other populations have been found in the Cody's Cove-Eagle Bay area, near Observation Shoal and inside Lake Okeechobee near the S-77 Structure and downstream in the Caloosahatchee River, C-43 canal. The majority of the populations of plants have occurred in areas that receive water flow from Fisheating Bay however one terrestrial population (in two small areas) was identified in the 8.5 Square Mile Area (SMA) adjacent to ENP. Through Early Detection and Rapid Response (EDRR) procedures, this plant was treated and appears to be eradicated in the 8.5 SMA. The source for the introduction of tropical American watergrass into 8.5 SMA is not known at this time, although contaminated equipment is highly suspected.

G.2.1.7.2 Torpedograss

Torpedograss (*Panicum repens*), is a perennial grass that can grow up to 3 feet tall. It has extended rhizomes that can be rooted or floating. It has a panicle-type inflorescence that is 3-9 inches long. It flowers nearly year round. Torpedograss reproduces primarily through rhizome extension and fragmentation. It is native to Africa and Asia and was introduced into the Gulf Coast of the United States before 1876. Torpedograss seed was introduced as a forage crop in the south and was planted in almost every southern Florida County by 1950. It is drought tolerant and grows in upland areas but thrives in areas with moist to wet sandy or organic soil. It inhabits scrub, coastal flatwoods, upper tidal marshes, mesic flatwoods, herbaceous wetlands, wet prairies, swales, lake shores, canals and other disturbed sites.

Torpedograss can quickly form a monoculture and displace native vegetation. In 1992, it was present in approximately 70% of the public waters in Florida. The largest population of torpedo grass was present in Lake Okeechobee. Approximately 14,000 acres of torpedograss displaced native plants in the Lake's marsh (Langeland et al., 2008). Torpedograss is present in agricultural and water conveyance canals throughout the project area and has potential to spread into areas with the removal of levees and backfilling canals.

G.2.1.7.3 Rotala

Rotala is an aquatic creeping perennial plant (Puri and Haller, 2010). It grows both submersed and emergent (Puri and Haller, 2010). Rotala has a soft stem that is dark pink in color. It branches many times and exhibits a creeping pattern. Aerial leaves are almost round in shape and attach directly to the stem (Jacono and Vandiver, 2007). The submersed leaves are more linear to elongate (Ervin and Madsen, n.d.). Rotala grows approximately 4 to 5 inches in a week. It produces many purple/pink flowers in spikes at the tips of the stems. Rotala is a prolific flower producer; both rooted and floating plants produce flowers. Flowering occurs in spring and early summer and the plant produces fruit that are small capsules (Jacono and Vandiver, 2007). The capsules split along four sides to release the viable seeds. The plant spreads through fragmentation. Since it produces viable seeds it is capable of sexual reproduction but little is known about reproduction in the United States. Rotala is native to southeast Asia, southern India and Japan. In its native range it primarily occurs in mountainous areas. Rotala has been documented to occur in wetlands, low-lying fields, moist pond margins and adjacent to dams and reservoirs (Ervin and Madsen, n.d.). The first plant population in Florida was found in March 1996 in a canal in Coral Springs which is located in Broward County. Other plant populations were found in 2001 in Palm Beach County and 2002 in Lehigh Acres which is in Lee County (Jacono and Vandiver, 2007). The plant is also known to inhabit the L-29 canal which is adjacent to the Tamiami Trail and ENP. When growing as an emergent plant, it forms dense mats that extend across the surface of the water and along shorelines (Ervin and Madsen, n.d.) and shades out submersed species (Puri and Haller, 2010). It is a serious threat for expansion into other areas due to its high growth rate (Ervin and Madsen, n.d.) and ability to reproduce via fragmentation. The growth of this plant has been compared to and exceeds the growth rate of alligatorweed.

G.2.1.7.4 Cogongrass

Cogongrass (*Imperata cylindrica*) is a perennial grass that grows in compact bunches and produces extensive rhizomes. The leaf blades are erect and narrow with a whitish midvein off center and leaves can be one to four feet in length. The inflorescence is narrow, white and plume-like. Cogongrass flowers in the spring, fall and sometimes year round. It produces seeds that are spread by wind, animals and equipment. Congongrass is native to southeast Asia and was introduced into Florida in the 1930's and 1940's for forage and soil stabilization in Gainesville, Brooksville and Withlacoochee. More than 1,000 acres of cogongrass was established in central and northwest Florida by 1949. Cogongrass inhabits dry to moist sites and has been documented to occur in xeric hammocks, mesic flatwoods, herbaceous marshes, and floodplain forests (Langeland et al., 2008). It has extensively invaded disturbed areas such as fallow pastures (FDEP, n.d.) and is commonly found along transportation and utility corridors (Langeland et al., 2008). Cogongrass forms dense stands which results in almost complete displacement of native plants. Dense stands of cogongrass also create a severe fire hazard, especially when mixed with other volatile fuels (FDEP, n.d.).

G.2.1.8 Other Species of Concern

Other species that are present within, or are likely to invade, the CEPP footprint and cause environmental harm include napier grass (*Pennisetum purpureum*), water hyacinth (*Eichhornia crassipes*), climbing cassia

(*Senna pendula var. glabrata*), lakeshore nutrush (*Scleria lacustris*), castor bean (*Ricinus communis*), crested floating heart (*Nymphoides cristata*), hydrilla (*Hydrilla verticillata*), West Indian marsh grass (*Hymenachne amplexicaulis*), wild taro (*Colocasia esculenta*) and para grass (*Urochloa mutica*).

G.2.2 Animals

Searches through existing data and resources indicate 89 animal species have been documented to occur within the project area (refer to Table G-4 Invasive Animal Species Documented in the Project Area). Other non-native animal species are probably present; however documented citations could not be located. Information regarding species presence and distribution is largely incomplete for most taxonomic groups of animals. Not all of the 89 non-native animal species identified and documented to occur in the CEPP area will have a significant impact on the ecosystem.

Species that are currently widespread within the project area include the redbay ambrosia beetle (*Xyleborus glabratus) and* associated fungus (*Raffaelea lauricola)* (laurel wilt), Cuban treefrog (*Osteopilus septentrionalis*), Burmese python *(Python molurus bivittatus*), and feral pig (*Sus scrofa*). Localized and/or EDRR species include the Asian swamp eel (*Monopterus albus)*, island apple snail (*Pomacea insularum*), purple swamphen (*Porphyrio porphyrio)*, Argentine black and white tegu *(Tupinambis merianae*), Nile monitor *(Varanus niloticus*), and northern African python (*Python sebae*). Other species of concern include the green iguana (*Iguana iguana*), brown hoplo (*Hoplosternum littorale*), bullseye snakehead (*Channa marulius*), sailfin catfish (*Pterygoplichthys disjunctivus*), and Gambian pouched rat (*Cricetomys gambianus*).

Of the species previously identified there are four key carnivorous reptiles that are currently present within or in close proximity to the project area and have potential to cause significant ecological impacts. The four species include the Argentine black and white tegu, the Burmese python, the northern African python, and the Nile monitor. These reptiles are among south Florida's most threatening invasive animals. These species are considered top predators and increase additional pressures on native wildlife populations, particularly threatened and endangered species (SFER, 2013).

G.2.2.1 Widely Established Species

G.2.2.1.1 Redbay Ambrosia Beetle (laurel wilt)

Laurel wilt is a lethal disease of redbay (*Persea borbonia*) and other members of the Laurel family (*Lauraceae*). The disease is caused by a fungus (*Raffaelea lauricola*) that is introduced into trees by the wood-boring redbay ambrosia beetle (*Xyleborus glabratus*) (FDACS, 2011b). *Xyleborus glabratus* is the twelfth species of non-native ambrosia beetle known to have become established in the US since 1990. All are suspected to have been introduced in solid wood packing materials, such as crates and pallets (Haack 2003). Most native ambrosia beetles attack stressed, dead or dying woody plants, but *X. glabratus* attacks healthy Florida trees. Once infected, susceptible trees rapidly succumb to the pathogen and die. Besides redbay, it impacts other native and non-native members of the Lauraceae (Hanula et al., 2008) including swamp bay (*P. palustris*), an important species of many Everglades plant communities. Since its arrival in 2002, the redbay ambrosia beetle and laurel wilt have spread quickly throughout the southeastern U.S. In March 2010, the beetle was found in Miami-Dade County. Laurel wilt disease was subsequently confirmed on nearby swamp bay trees in February 2011. Aerial reconnaissance identified symptomatic swamp bay trees scattered throughout the Bird Drive Basin, northward into the Pennsuco Wetland area, and westward into ENP and WCA 3B. In February 2012, laurel wilt was also confirmed in the LNWR. There is currently no feasible method for controlling this pest or associated disease in natural areas. A systemic fungicide (propiconazole) can protect individual trees for up to one year, but widespread utilization in natural areas is impractical (Mayfield et al., 2009). State and federal agencies are monitoring the spread of laurel wilt disease and the redbay ambrosia beetle through the Cooperative Agricultural Pest Survey (CAPS) program. There is little to no research underway to assess the ecological impacts of laurel wilt disease. Interagency coordination is limited to the exchange of reporting information and some coordinated research. The redbay ambrosia beetle is considered a plant pest, so screening for additional introductions is carried out but is inadequate. Critical research areas include: (1) evaluating Persea resistance, (2) Persea seed/genetic conservation efforts, (3) potential chemical or biological control tools, (4) impacts on native plant communities, and (5) impacts on the Palamedes swallowtail butterfly (*Papilio palamedes*) and other host-specific herbivores.

G.2.2.1.2 Asian Swamp Eel

The Asian swamp eel (*Monopterus albus*) is a versatile animal, capable of living in extremely shallow water, traveling over land when necessary, and burrowing into mud to survive periods of drought (Shafland et al., 2010). This species is a generalist predator with a voracious appetite for invertebrates, frogs, and fishes (Hill and Watson 2007; Shafland et al., 2010). Wild populations in Florida originated as escapes or releases associated with aquaculture, the pet trade, or live food markets. Regional biologists are concerned that this species may become widely established, since the diverse wetland habitats of the Greater Everglades may be suitable for the species. Additionally, Asian swamp eels have a broad salinity tolerance giving concern that this species could also establish populations in estuaries (Schofield and Nico, 2009). There are at least four reproducing populations of Asian swamp eels in Florida: north Miami canals, canal networks near Homestead adjacent to the ENP, eastern ENP, and in water bodies near Tampa (Collins et al., 2002; Nico, USGS, personal communication; Jeff Kline, USNPS, personal communication). The impact of Asian swamp eels to Everglades fauna is undocumented and management options are currently limited to monitoring and electrofishing in canals. The species' generalist diet and adaptations to low water events suggests that native fishes, aquatic invertebrates, and frogs could be threatened. Nico et al. (2011) also report high parasitism rates in wild caught Asian swamp eels in Florida, raising concern that the species could be a vector for macroparasites to native fishes.

G.2.2.1.3 Cuban Treefrog

The Cuban treefrog is the largest species of treefrog in Florida and range from 1-4 inches in length. The Cuban treefrog has expanded pads on the ends of their toes which are exceptionally larger than toepads of Florida's native treefrogs. Cuban treefrogs have large eyes and usually have rough somewhat warty skin. Sometimes Cuban treefrogs have a pattern of large wavy marks or blotches on their back and have stripes or bands on their legs. The color of the treefrogs varies from creamy white to light brown but Cuban treefrogs can be green, beige, yellow, dark brown or combination thereof. It is native to Cuba, the Cayman Islands, and the Bahamas. It was first reported in Florida in the 1920s in the Florida Keys, and was likely transported in cargo or ornamental plant shipments. Cuban treefrogs inhabit natural areas such as pine forests, hardwood hammocks and swamps. They also inhabit disturbed sites such as urban and suburban developments, agricultural areas such as orange groves and plant nurseries (Johnson, 2007). Cuban treefrogs inhabit areas throughout most of the CEPP footprint. These treefrogs are introduced to new areas as stowaways on cars, trucks, boat trailers and through shipment of ornamental plants and trees. Cuban treefrogs consume a variety of invertebrates and native treefrog species (Maskell et al., 2003). Native green and squirrel treefrogs (*Hyla cinerea* and *H. squirella)* are less likely to be found when Cuban treefrogs are present (Waddle et al., 2010), and when Cuban treefrogs are removed from an area, the abundance of native treefrogs increases (Rice et al., 2011). In addition, tadpoles of Cuban treefrogs are fierce competitors and can inhibit the growth and development of two species of native treefrogs (Johnson, 2007). Effects of CEPP projects on the distribution and abundance of Cuban treefrogs should be assessed given the Cuban treefrog's wide distribution and habitat tolerances, mounting evidence of direct impacts to native anuran species, and the lack of regional monitoring and control programs.

G.2.2.1.4 Burmese Python

Burmese pythons are large (up to 5.5 meters) constrictors that are native to Southeast Asia (Dorcas et al., 2012) and are top predators (SFER, 2013). For 20 years prior to being considered established, python sightings occurred intermittently in south Florida. In 2000, the Burmese python was considered established in south Florida and since that time, the population has increased significantly in abundance and geographic range. (Dorcas et al., 2012). The Burmese python is found throughout the southern Everglades, particularly in ENP and adjacent lands including the East Coast Buffer lands and the northern ENP boundary along Tamiami Trail. Sightings have also been documented in the Key Largo region (SFER, 2013). Pythons consume a wide variety of mammals and birds. More than 100 species have been identified as a food source and these include the endangered Key Largo woodrat (*Neotoma floridana smalli*) and the wood stork (*Mycteria americana).* In addition, American alligators (*Alligator mississippiensis*) are infrequently preyed upon by the python. Little is known about the impacts of predation by pythons on native species; however a recent study by Dorcas et al indicates there has been a dramatic decline in mammal populations that coincides with the increase of pythons in ENP (Dorcas et al., 2012). The increase in the population size of pythons has been linked to a regional decline in small and medium mammals (Dorcas et al., 2012), but has not been distinguished from possible effects of changes in habitats and hydrology on mammal populations that also occurred during this time period.

G.2.2.1.5 Feral Hog

Feral hogs (*Sus scrofa*), also known as wild pigs, have existed on the Florida landscape since their introduction four centuries ago. They are reported in all 67 Florida counties within a wide variety of habitats, but prefer oak-cabbage palm hammocks, freshwater marshes and sloughs and pine flatwoods. Although they do not favor marshes with deep water, during the dry season the make extensive use of partially dried out wetlands. Feral hog populations are particularly high in the counties immediately north and west of Lake Okeechobee, and in the Big Cypress and East Coast Regions. Hogs commonly grow 5-6 feet long with weights over 150 pounds. With a keen sense of smell and a powerful snout, they can detect and root up buried food. The diet of feral hogs includes vegetation, earthworms, insects, reptiles, frogs, bird eggs, rodents, small mammals, and carrion (Laycock, 1966; Baber and Coblentz, 1987). This invasive mammal is also known to prey on sea turtles, gopher tortoises, and other at-risk wildlife (Singer, 2005). No animal native to North America creates the kind of disturbance when feeding that hogs do (Baber and Coblentz, 1986). Rooting by feral hogs can convert native grassland and other low vegetation to what looks like plowed fields. Hog rooting may facilitate establishment of invasive plant species because invasive exotics typically favor disturbed areas and colonize more quickly than many native plants (Belden and Pelton, 1975; Duever et al., 1986). Feral hogs are unusually prolific for large mammals. This is because they reach sexual maturity at an early age (6-10 months) (Barrett, 1978), can farrow more than once a year (Springer 1977; Taylor et al., 1998), have large litters (4-8) (Sweeny et al., 2003), and often experience low natural mortality rates (Bieber and Ruf, 2005). Recreational hunting is often a major source of mortality (Barrett and Pine, 1980). In favorable habitat, however, hog populations are typically not greatly reduced by hunting (Bieber and Ruf, 2005). There is no regional, coordinated monitoring program for the ubiquitous feral hog. Monitoring is limited to efforts associated with trapping programs and game management. Numerical monitoring of hogs present challenges because they are wary and adaptable animals that change their activity patterns and feeding areas in response to changing needs and threats from humans (Hughs 1985, Sweeny et al., 2003).

G.2.2.2 Localized/Early Detection Rapid Response Species

G.2.2.2.1 Island Apple Snail

The island apple snail (*Pomacea maculata*) is a freshwater mollusk. This large snail can grow up to 10 centimeters in length. It is native to South America (SFER, 2013). Mating and egg-laying begins in March and can continue through October. It is thought the island apple snail was introduced in Florida in the early 1980's through the tropical pet industry (Fasulo, 2004). This species has been globally introduced through releases associated with aquariums and intentional releases as a food crop. The island apple snail is considered as one of the 100 World's Worst Invasive Alien Species. Potential impacts to Florida flora and fauna include destruction of native aquatic vegetation by consumption and competition with native aquatic fauna. The island apple snail has a voracious appetite for vegetation and in other countries has converted lush ecosystems into barren areas. It is likely the island apple snail will continue to spread and possibly out-compete the native apple snail (*P. paludosa*). The native apple snail is the primary food source for the Everglade snail kite (*Rostrhamus sociabilis*) which is an endangered species (SFER, 2013). The Everglade snail kite is also known to feed on the island apple snail, which has been found in several canals within the CEPP project area. Specifically, it has been documented to occur in the L-29 canal, Old Tamiami Trail canal which is just inside the northern boundary of the park and in marshes along the Shark Valley tram road which includes ENP along Tamiami Trail. It is also thriving in Lake Okeechobee.

G.2.2.2.2 Purple Swamphen

The purple swamphen (*Porphyrio porphyrio*) is a member of the rail family native to Australia, Europe, Africa, and Asia. It is noticeably larger than its Florida native relatives, the American coot (*Fulica americana*), the common moorhen (*Gallinula chloropus*), and the purple gallinule (*Porphyrio martinica*). The swamphen and the gallinule both have purple plumage and red bills, but the face shield above the bill is red and the legs are pink in the swamphen while the face shield is pale blue, the legs are yellow and the bill has a yellow tip in the gallinule. Introduction of the swamphen was likely due to escapes from the Miami zoo and private aviculturists in Broward County. The purple swamphen feeds on shoots and reeds, invertebrates, small mollusks, fish, snakes, and the eggs and young of waterfowl (Pranty et al., 2000). Nests are typically large mounds of vegetation in wetlands. Known to be highly aggressive and territorial, the purple swamphen could negatively affect native water birds through competition for food and space and through direct predation. Rapid response efforts between 2006 and 2009 did not successfully reduce the abundance or distribution of this species. The management goal for the species has shifted from eradication to suppression (Jenny Ketterlin Eckles, FWC, personal communication). Efforts to remove birds by hunting did not significantly deplete the population. No other control tools are currently developed for this species. In recent years, purple swamphens have been sighted in the WCAs, ENP, Big Cypress National Preserve, Lake Okeechobee, and in all Everglades stormwater treatment areas. The FWC is currently conducting prey and habitat analyses to support a risk assessment, which will guide future management strategies (Jenny Ketterlin Eckles, FWC, personal communication). There are currently no coordinated monitoring efforts for purple swamphens.

G.2.2.2.3 Argentine Black and White Tegu

The Argentine black and white tegu is a large South American lizard that can reach 1.5 meters in length in the wild. Tegus seem to prefer savannas and other grassy open areas in its native range (SFER, 2013). In Florida, tegus seem to prefer disturbed upland areas adjacent to wetlands or permanent bodies of water. These types of habitats are frequently found adjacent to canals and rock pits and occur throughout the South Florida landscape. Tegus are generalist predators with a diet that includes a variety of fruits, vertebrates, invertebrates and eggs. Because the tegu is a predator of eggs, it threatens native ground nesting birds and reptiles which includes threatened and endangered species such as the American crocodile (*Crocodylus acutus*) and Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*). Endangered snail species such as *Liguus fasciatus* are also potential prey. There are two known established populations in Florida, one in Hillsborough and Polk counties and one in southern Miami-Dade County. The population in Miami-Dade County seems to be increasing and expanding its range both to the west towards ENP and east toward Turkey Point. Both areas are home to endangered wildlife that may be threatened by tegus. Continued monitoring and removal efforts are needed to prevent the expansion into natural areas and control the population. Recently, there has been an increase in sightings near ENP which suggests the population is expanding. Systematic surveys of the species are needed to validate the population is expanding near ENP (SFER, 2011), and to provide early detection of possible range expansion to new areas.

G.2.2.2.4 Nile Monitor

The Nile monitor (*Varanus niloticus*) is a large, carnivorous lizard from sub-Saharan Africa that is capable of reaching 2.4 meters (FWC bioprofile). It is a generalist feeder and an egg specialist in its native range (SFER, 2013) that will feed on a wide variety of invertebrates and vertebrates it acquires by either predation or scavenging (FWC bioprofile). As such, the Nile monitor could impact a variety of native and threatened species in Florida through both competition and predation. The Nile monitor may pose a serious threat to a number of wading birds, marsh birds, gopher tortoises (*Gopherus polyphemus*), burrowing owls (*Athene spp.*), Florida gopher frogs (*Lithobates capito*), sea turtles and other ground nesting species. They may negatively impact populations of American alligators and American crocodiles via egg predation and competition (FWC bioprofile). The Nile monitor has been well established in the Cape Coral area since the 1990s. There is also a small breeding population near Homestead Air Force base in Miami Dade County (SFER, 2011). More recently, a breeding population of Nile monitors has been discovered in Palm Beach County and numerous reports of the species throughout Broward County also suggest a breeding population. Because of their threat to our native wildlife, this species has potential to impact restoration efforts.

G.2.2.2.5 Northern African Python

The northern African python (*Python sebae*) is a large bodied python native to sub-Saharan Africa. It is considered to be one of the largest species of python, with a maximum size of about 20 feet (Alexander and Marais, 2007). Northern African pythons appear to prefer mesic savannah, evergreen forests, mangrove forests, and rocky areas, and typically prefer to be in close proximity to permanent water features (Branch, 1995). Like the Burmese python, the northern African python is an opportunistic predator, consuming a wide variety of prey including small to medium sized mammals, wading birds, lizards, fish, crocodilians, and frogs (Reed and Rodda, 2009). The establishment of northern African pythons in southern Florida was confirmed in 2009. Since then, more than 20 specimens have been collected in the Bird Drive Basin in Miami-Dade County (Jenny Ketterlin Eckles, FWC, personal communication), including multiple large adults, a pregnant female, and two hatchlings. The northern African python is considered a high risk for establishment and expansion throughout southern Florida (Reed and Rodda, 2009). As such, rapid response efforts to delineate and eradicate this population are now of highest priority to local, state, and federal agencies. The SFWMD, Miccosukee Tribe of Indians of Florida, and Miami-Dade County, the primary land owners within the Bird Drive Basin, are working closely with the FWC and other agencies to address this emerging threat. The FWC, Miami-Dade County, SFWMD, UF, and other partnering agencies regularly deploy trained python surveyors to the area (SFER, 2013). The northern African python is now classified as a conditional reptile by the State of Florida, and is therefore illegal for personal possession. In 2012, the US Department of the Interior listed this species as an injurious species under the Lacey Act, thereby banning importation and interstate commerce of northern African pythons.

G.2.2.2.6 Other Species of Concern

Other species that are present within, or are likely to invade, the CEPP footprint and cause environmental harm include the green iguana (*Iguana iguana*), brown hoplo (*Hoplosternum thoracatum*), bullseye snakehead (*Channa marulius*), sailfin catfish (*Pterygoplichthys disjunctivus*), and Gambian pouch rat (*Cricetomys gambianus*).

G.3 INTRODUCTION TO MANAGEMENT

G.3.1 Prevention

Prevention is the first-line of defense and the most efficient and cost effective approach to reduce the threat of invasive non-native species. Successful prevention will reduce the rate of introduction and establishment and thereby reduce the impacts of invasive species. One essential element to prevention is identifying the high risk pathways that facilitate introductions and implementing actions to impede those introductions. Other critical elements include using effective management tools to reduce unintentional introductions and using risk assessment for both intentional and accidental introductions of non-native species. Baseline data and monitoring systems are required in order to evaluate the success of preventative measures.

G.3.2 Monitoring

Natural resource managers need spatial data on invasive species populations to develop management strategies for established populations, direct rapid response efforts for new introductions, and evaluate the success of control efforts (Myers et al., 2000; Dewey and Andersen, 2004; Barnett et al., 2007). Several approaches may be taken to document the spatial distribution and population trends of invasive species. Each method has strengths and weaknesses and should be utilized according to specific management objectives. Monitoring is the collection and analysis of population measurements in order to determine changes in population status and progress towards meeting a management objective (Elzinga et al., 1998). This type of monitoring is usually intended to detect relatively small changes in populations over time and often utilize small scale plots and/or transects. Invasive species surveys and inventories may be preferred when the objective is to detect populations and describe their spatial distributions over large landscapes, especially when early detection of new populations is desired (see EDRR discussion below).

Optimally invasive plant mapping methods have high positional accuracy, high species detection accuracy (particularly for low-density infestations), rapid turnaround time, relatively low cost, and the ability to quantify the degree of infestation (USDA, 2012). Ground-based surveys can provide high positional accuracy and species detection, but can be time consuming and logistically unrealistic for large landscapes (Rew et al., 2005). Stratified subsampling approaches to ground surveys can mitigate some of these limitations but probabilistic mapping may be ineffective for early detection needs of land managers (Barnett et al., 2007) and may not provide sufficient fine scale information over large areas.

Developments in remote sensing technology have greatly improved opportunities for rapidly obtaining spatially-precise data on invasive plant populations, particularly for large areas (Lass et al., 2005). However, the ability to detect target species using remote sensing is still limited to conditions where the species has a unique spectral signature or is a dominant canopy species and is often ineffective at detecting target species at low densities (Shafii et al., 2003). This inability to detect target species at low densities is a significant limitation for land managers focused on containment of expanding populations and detection of new invasions. Visual surveys from aircraft have been effectively used to map invasive plant distributions in the Everglades since 2008 (Rodgers and Pernas, in press). While visual aerial surveys may provide cost-effective information on landscape distributions of targeted plants, it has limited value for long-term change detection or fine scale assessments of abundance. This method may also lack sufficient detection precision for small plant species or species that occupy understories. Use of UAV's may also provide relatively inexpensive invasive plant monitoring data and video documentation provides a permanent record of conditions. However, detection accuracy may be less than that of visual surveys, especially at low densities or new species introductions.

G.3.3 Early Detection and Rapid Response

Once a species becomes widespread, the cost to control it will more than likely require significant and sustained funding. Early detection and rapid response (EDRR) may be a cost-effective strategy to locate, contain, and eradicate invasive species early in the invasion process in order to minimize ecological and economic impacts of non-indigenous species (Rejmanek and Pitcairn, 2002).

The three components of EDRR are *Early Detection*, *Rapid Assessment*, and *Rapid Response*. Early detection is defined as a comprehensive and integrated system of active or passive surveys to locate, identify and report new invasive species as quickly as possible in order to implement procedures when it is feasible and less costly. Rapid Assessment includes the actions necessary to determine the appropriate response. This assessment identifies the current and potential range of the infestation, an analysis of the risks associated with the invasion, and timing and overall strategy for the appropriate actions. Rapid response is defined as a systematic approach to control, contain or eradicate these species while the infestation is still contained in a particular area. Based on the results of the rapid assessment, a rapid response may be implemented to address new introductions or isolated infestations of a previously established species invading a new site (i.e., containment strategy).

Another critical element to rapid response is having the infrastructure in place to quickly implement management actions while new invasions can still be eradicated or contained. Effectively implementing EDRR will require coordination and collaboration among federal, tribal, state, local governments, nongovernment organizations (NGOs) and the private sector (National Invasive Species Council 2008).

G.3.4 Control and Management

Integrated Pest Management (IPM) is an effective approach to manage invasive species. IPM is the coordinated use of the most appropriate strategy to prevent or reduce unacceptable levels of invasive species and their damage by utilizing the most economical means, and with the least possible hazard to people, property and the environment. Physical, mechanical, chemical and biological control methods are utilized in IPM.

Physical control, sometimes referred to as cultural control, is the physical manipulation of an invasive species or their habitat. A number of techniques are used for physical control. These include manual removal, installing barriers and environmental alterations such as water level manipulation, prescribed fire and light attenuation.

Mechanical control refers to the use of machinery designed to cut, shear, shred, uproot, grind, transport and remove invasive species. Equipment used to complete mechanical control may include but is not limited to heavy equipment such as an excavator or front-end loader (with a root rake, grinding heads or other attachments), cutter boats, dredges and mechanical harvesters (Haller, 2009).

Chemical control is the use of a specially formulated pesticide to control an invasive species. The United States Environmental Protection Agency defines a pesticide as "a substance or mixture of substances intended for the prevention, destruction, repulsion, or mitigation of any pest". The term pesticide encompasses a broad range of substances including herbicides, insecticides, fungicides etc. Pesticides are applied through ground and aerial applications.

Biological control, also known as bio-control, is the planned use of one organism to suppress the growth of another. Biological control is primarily the search for and purposeful introduction of species-specific organisms that selectively attack a single target species. Organisms such as insects, animals or pathogens that cause plant diseases are used as biological controls (Cuda, 2009).

Objectives of management can include complete eradication within a given area, population suppression, limiting spread and reducing effects of invasive species. Once an invasive species becomes widely established complete eradication is usually not feasible. The most effective action for managing widely spread invasive species is often preventing the spread and reducing the impacts by implementing control measures. This concept is known as maintenance control. Maintenance control is defined as controlling an invasive species in order to maintain the population at the lowest feasible level.

G.3.5 Risk and Uncertainties Related to Invasive Species

As with most land management activities, there are a number of risks and uncertainties associated with invasive species management. The use of an adaptive management approach will help develop and prioritize invasive species control strategies. As restoration proceeds, invasive species may establish and/or spread as a direct result or independently of restoration activities. In the context of CEPP and the long-term management of the natural resources within the study area, risks include but are not limited to:

- Introduction of new invasive species which are difficult or impossible to control.
- Restoration activities which unintentionally facilitate the spread of invasive species via contaminated earth moving equipment.
- Undetected spread of invasive species into new areas, making containment of populations more costly and less likely to succeed.
- Uncontrolled invasive species which create disturbances or alter ecosystems such that desired restoration outcomes are not achieved.
- Failure to secure necessary funding to control invasive species.
- Undesirable impacts on non-target species and ecosystem functions resulting from invasive species control efforts.
- Not taking action to manage a species due to inaccurate assessments of the species impact on restoration activities.

The major uncertainty is that in most cases we do not have necessary information for detailed, specific pre-project evaluations of the need for management activities to control invasive species. With the exception of a few well-established and well-studied species (e.g., melaleuca), there is an information deficit on the status, potential impact, and effective control techniques for priority species. This is particularly true for non-indigenous animals. Current knowledge on invasion mechanisms suggests that some restoration activities may facilitate the spread of certain priority species in the Everglades. For example, partial removal of canals and levees could encourage spread of or provide sites for colonization by numerous invasive species, including Brazilian pepper, Old World climbing fern, tegus, Nile monitors, pythons, and Cuban treefrogs. However, there remains considerable uncertainty regarding the degree to which different species will respond, if at all, to restoration activities and how these responses will impact achievement of restoration goals.

Given the high degree of uncertainty, the most effective and lowest cost management option is early detection and rapid removal of invasive species during and post project. Central to this strategy is the implementation of a rigorous monitoring program (discussed below).

Several specific uncertainties have been identified in the initial analysis of the selected plan. They are listed here to provide a starting point for developing monitoring, control and BMP strategies for the construction and operations phases of the restoration.

- Will Rotala and other aquatic weeds expand into ENP with expanded conveyance capacity and flow distribution?
- Will increased flow result in increased nutrient loading thereby increasing spread of invasive and/or nuisance plants (e.g., torpedograss, cattail)?
- Will constructed tree islands associated with Miami Canal backfill create desirable habitat for certain invasive plants and animals?
- Will changes in hydrology in WCA 3B promote expansion of Old World climbing fern in tree islands?
- Will non-indigenous fish species spread into new areas as a result of decompartmentalization activities?
- Will there be secured and available funding for management and control of invasive species? Will other priorities outcompete for funds?
- How will the introduction of new invasive species affect ecosystem restoration efforts?
- How will the lack of biological information for new introduced species affect invasive species management?

G.4 EXISTING MANAGEMENT PROGRAMS

G.4.1 South Florida Water Management District

The SFWMD manages invasive exotic aquatic and terrestrial plants in canals and on levees of the C&SF Project, WCAs 2 and 3, stormwater treatment areas (STAs), and interim project lands and on public conservation lands. Most of the vegetation management is outsourced through the Vegetation Management Division and includes herbicide application contractors, mechanical removal contractors, and use of biological controls such as plant specific insects and herbivorous fish. The Melaleuca Control Program is a major focus for the SFWMD, but other priority plant species are controlled within the CEPP study area as funding resources allow.

G.4.2 U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) manages floating vegetation on Lake Okeechobee, the Okeechobee Waterway and associated tributaries. The USACE also conducts treatments of priority species on the Herbert Hoover Dike. In addition to the operations and maintenance program on Lake Okeechobee, the USACE conducts treatments of vegetation during the construction phase of CERP and Modified Water Deliveries to ENP projects in south Florida. Vegetation treated includes FLEPPC Category I and II species, as well as native nuisance species.

G.4.3 Everglades National Park

The ENP Exotic Plant Management Team is actively engaged in treatment of numerous priority invasive plant species, primarily melaleuca, Old World climbing fern, and Australian pine. In recent years, ENP has focused invasive plant control efforts in the northeastern sections of the park and in the extreme southwestern sections where Old World climbing fern aggressively invades marsh communities. Brazilian pepper is also managed as part of the Hole-in-the-Donut restoration program.

G.4.4 U.S. Fish and Wildlife Service

Invasive plant management in the LNWR is carried out by the U.S. Fish and Wildlife Service (USFWS) under a 50-year license agreement with SFWMD. The USFWS invasive plant management strategy addresses control of all invasive, non-indigenous species but the primary focus is on melaleuca, Brazilian pepper, Australian pine, and Old World climbing fern. Brazilian pepper and Australian pine are currently managed at low levels (maintenance control) and melaleuca is nearing low levels in most sections of the refuge. Old World climbing fern remains a significant management challenge given its aggressive invasion in tree islands and limited control options.

G.4.5 U.S. Department of Agriculture / University of Florida

The SFWMD, USACE, NPS, USFWS, FWC, and other agencies provide financial support to the U.S. Department of Agriculture – Agricultural Research Service (USDA-ARS) and the University of Florida (UF) for the development of invasive plant biological controls. Efforts to identify safe and effective biological controls have led to important advancements in the integrative management of several invaders, including melaleuca, Old World climbing fern, water hyacinth, and alligator weed. The *CERP Melaleuca Eradication and Other Exotic Plants – Implement Biological Controls Project* is dedicated to the implementation of biological control agents once overseas surveys and quarantine testing has developed agents deemed safe for release in Florida. The project included the construction of a mass rearing annex to the existing USDA-ARS biological control facility in Davie, Florida, in support of implementing the mass rearing, field release, establishment, and field monitoring of approved biological control agents for melaleuca and other invasive nonindigenous species. The construction of the mass rearing facility is and therefore mass rearing and release operations are scheduled to commence.

G.4.6 Florida Fish and Wildlife Conservation Commission

The FWC's Invasive Plant Management Section is the designated lead entity in Florida responsible for coordinating and funding the statewide control of invasive aquatic and upland plants in public waterways and on public conservation land. In addition to funding the SFWMD melaleuca control program, FWC annually awards funding for individual invasive plant management projects in the Everglades region.

Allocation of control funding is determined by an interagency regional working group. FWC land managers also implement control programs for other invasive plant species in wildlife management areas (WMA) within the CEPP footprint, including Holeyland, Rotenberger, Everglades, and Southern Glades WMAs.

G.4.7 Invasive Animals

Efforts to develop control tools and management strategies for several priority species are underway for a few priority animal species. These include the Burmese python and other giant constrictors, the Nile monitor, and the Argentine black and white tegu. Control tools are very limited for free-ranging reptiles, and the application of developed methods is often impracticable in sensitive environments where impacts to non-target species are unacceptable. Available tools for removing large constrictor snakes and lizards currently include trapping, detection dogs, and visual searching. Potential tools include the use of toxicants, introduced predators, and pheromone attractants, but these have not been fully explored to date.

Regional invasive biologists have developed a conceptual response framework for established priority invasive animals in south Florida. Objectives within this framework are classified into three main categories—containment (slow the spread), eradicating incipient populations (remove outliers), and suppression (reduce impact in established areas). The resources to implement this strategic framework remain insufficient, but close collaboration between agencies has allowed for some coordinated efforts. Currently, FWC, NPS, UF, and SFWMD are conducting trapping and visual searching for Burmese pythons, northern African pythons, Argentine black and white tegus, spectacled caimans, and Nile monitors.

G.5 EXISTING MONOTORING PROGRAMS

Since 2008, the SFWMD and USNPS, along with other partner agencies, have utilized digital aerial sketch mapping (DASM) for a region-wide mapping program over 728,000 ha in the Everglades. DASM is a method for mapping plant infestations "on-the-fly" using GPS-linked computers and trained biologists. Visual surveys allow an observer to learn to recognize targeted species, sometimes at low densities, under a range of environmental and phenological conditions. Visual aerial surveys also may provide data more rapidly than other methods, which is important when rapid responses to newly established threats are expected. The primary objective of the DASM inventory program is to determine the distributions of four priority invasive plant species on managed conservation lands in the region. These are Australian pine, Brazilian pepper, melaleuca, and Old World climbing fern. A secondary objective of the program is to detect new plant species invasions in remote areas to facilitate rapid response efforts. This data is currently collected on a two year cycle.

There are no system-wide ground based monitoring programs for invasive plants in the Everglades region. Individual agencies may collect spatial information on infestations, but these efforts are not part of a formalized, systematic monitoring network. Interagency working groups (e.g., Everglades Cooperative Invasive Species Management Area (ECISMA)) regularly meet to exchange information on new or potential invasive plants. As these species are detected, ad hoc efforts to conduct rapid assessment (monitoring and risk assessment) and containment are pursued. However, a lack of dedicated funding for rapid response limits the effectiveness of these initiatives.

In 2010, the UF, FWC, and SFWMD began collaboration on the Everglades Invasive Reptile, Amphibian, and Mammal Monitoring Program (EIRAMMP). The purpose of the project is to develop a monitoring program for priority invasive reptiles and amphibians and their impacts to south Florida. Specifically, the program seeks to (1) determine the status and spread of existing populations and the occurrence of new populations of invasive reptiles and amphibians, (2) provide additional EDRR capability for removal of invasive reptiles and amphibians, and (3) evaluate the status and trends of populations in native reptiles, amphibians, and mammals. The monitoring program involves visual searches for targeted invasive species on fixed routes along levees and roads within Arthur R. Marshall LNWR, WCA's-2&3, Big Cypress National Preserve, and ENP. Visual searches and call surveys, in addition to trapping, are conducted to monitor invasive reptile and amphibian species. Thirteen routes have been established.

G.6 MANAGEMENT STRATEGY AND PLAN

Many of the new features of the water management system, as well as construction and operations and maintenance activities, have the potential to spread and promote establishment of non-native invasive and native nuisance species. Proposed restoration activities may affect ecosystem drivers that directly or indirectly influence the invasiveness of non-native species. These factors may affect invasive species positively or negatively, depending on the unique characteristics of individual species and the environmental conditions for a given biological invasion (Doren et al., 2009). Many of the areas where features are proposed are currently inhabited by non-native invasive and native nuisance species. Construction of the proposed features has the potential to spread the existing non-native invasive and native nuisance species on site as well as introduce new invasive species via contaminated equipment. Disturbed areas resulting from construction are likely to become established with non-native invasive and native nuisance species. New flows created by operations of the proposed features may serve as vectors to spread invasive and native nuisance species into new areas. Monitoring is a critical component of the management strategy. Information on distribution and restoration responses of invasive species should be used to inform decisions on control strategies Invasive species surveillance, monitoring, and control should be carried out within the construction footprints, as well as impacted areas. Species of non-native vegetation to be treated include, but are not limited to, species listed in the current version of the FLEPPC invasive plant lists and the Florida Department of Environmental Protection prohibited plant list. The priorities for managing vegetation include FLEPPC category I and II species, new invasive plant introductions, native nuisance species and plants that impact project operations. Management of animal species will include surveillance, control, and monitoring.

The strategy for managing invasive species will be to utilize an IPM approach. Objectives of management will include complete eradication, population suppression, limiting spread and reducing effects of invasive species. Eradication will be the objective for new established species that are localized. The objective for wide spread invasive species will be to implement control measures to suppress and prevent the spread of identified priority invasive species.

G.6.1 Surveillance – Early Detection and Rapid Response

EDRR should be implemented during every phase, for the life of a project. EDRR is an effective management measure to controlling and containing invasive species that were not previously within the project area. EDRR minimizes the negative impacts the invasive species has on the ecosystem and economy, and reduces future treatment and management costs. It is very difficult to predict when and where an invasive species may appear. As such, estimating a needed budget is near impossible. However, to assist managers, a priority list of species to immediately respond to under EDRR management strategy has been developed (refer to Table G-2: Priority Species / Areas for Early Detection and Rapid Response).

A framework for establishing an EDRR program in the Everglades was recently drafted by an interagency team of invasive species experts and land managers (see ECISMA EDRR Plan at http://www.evergladescisma.org/ECISMA_EDRRPlan_2009-2011.pdf). As discussed above (Section G.3.3 Early Detection and Rapid Response), EDRR includes three strategy elements: 1) early detection, 2) rapid assessment, and 3) rapid response.

1.) Early Detection: This plan proposes implementation of routine surveillance in the project area in order to minimize the time between initial introduction and detection of a new species. Strategic surveillance by trained biologists in proximity to the CEPP project elements should greatly increase the probability of detection of new species. In many cases, existing programs could be expanded to include focused monitoring in the CEPP footprint. For example, the EIRAMMP is well suited for enhanced surveillance for numerous invasive animal species (see Section G.4 EXISTING MANAGEMENT PROGRAMS).

2.) Rapid Assessment: Following the detection of new invasions (or expansion of formerly contained invasions), it is important to gather and process available information to determine the potential risk and control options in the face of high uncertainty. Critical questions must be answered in a relatively short period of time. Example questions include:

- What is the spatial extent and abundance of the non-indigenous species?
- What is the likelihood that the species will impact native species, ecosystem function, operations infrastructure, or human health?
- What are the management options for containment or eradication?

Numerous tools are available to assist natural resource managers with the assessment phase of EDRR, though none of them is likely to be 100% accurate in assessing the risk of a species. This plan proposes utilization of the IFAS Assessment of Non-native plants in Florida's Natural Areas, the Florida Exotic Pest Plant Council's Invasive Species List, the FWC Non-native Animal Bioprofile protocol, and the ECISMA Rapid Response Plan for assessing the risks of non-indigenous species in the CEPP footprint. These assessments should be conducted with CEPP biologists, subject matter experts, and stakeholders.

3.) Rapid Response: This is the "risk management" component of EDRR. Once a species is determined to have a high probability of ecological impact and control options are available, rapid response strategies aimed at containment, and ultimately eradication, can be formulated and implemented. To be effective, rapid response programs must have built in procedural, financial and logistical capacity to respond quickly to newly established threats. Since it is not possible to accurately predict the number and severity of new invasions during the project, this plan proposes contingency funding for rapid response activities in the event new, high-priority species establish in the project area. During the pre-construction phase, protocols for implementing rapid response should be developed.

G.6.2 Control

A combination of biological, physical, mechanical, and chemical control methods will be utilized to manage invasive species.

Biological control agents will be used to decrease the targeted invasive species competitive advantages over native species and to weaken the invading population by increasing leaf mortality, decreasing plant size, reducing flower and seed production, and/or limiting population expansion. Biological control agents will be acquired through the Melaleuca Eradication and Other Exotic Plants – Implement Biological Controls project which is a component of CERP. One element of this CERP component includes the implementation of biological control agents which involves mass rearing, field release, establishment and monitoring of approved biological controls in south Florida and the Everglades. The four main invasive plant species targeted for control through this component include melaleuca, Australian pine, Brazilian pepper and Old World climbing fern.

It is anticipated that physical control methods will be limited. Prescribed burns will be conducted in order to promote native plant growth and should be planned, if possible, to target invasive species when they are most susceptible to fire. Hand pulling of melaleuca and other non-native plant species will occur when it is feasible. Weed/debris barriers will be placed at water control structures when it is required to minimize dispersal of floating vegetation. Physical control measures will be utilized for invasive animal control. Examples of these measures include trapping of feral hogs, controlled harvest/overfishing (nets, fishing tournaments specific to invasive fish species) and compliance with FWC Fishing Regulation release/movement of fish (no return to water/used as bait).

Mechanical control will be implemented to remove non-native plant species when the construction of project features requires such removal. Heavy equipment such as bulldozers, front-end loaders and trackhoes (with or without grinding heads) will be utilized to uproot, grind and/or clear and grub. It is expected this type of control method will be utilized during levee degrades, canal backfilling and during construction of new project features such as water control structures.

Chemical control will be utilized to treat aquatic and terrestrial invasive plants. Methods for treatment will include hack-n-squirt, basal bark, cut-stump, foliar and aerial application. EPA approved herbicides will be utilized to control invasive plants. Chemical control will be utilized to treat invasive plants in canals, along levees, in wetland/natural areas as well as WCA's, FEB's, etc.

G.6.3 Monitoring

Monitoring of invasive species populations will be conducted through DASM, Unmanned Aircraft System (UAS) surveys, electrofishing and EIRAMMP. Invasive species will also be identified through monitoring for the Adaptive Management Plan. This information will be provided to invasive species managers to ensure appropriate management measures are implemented.

G.6.4 Pre-construction Phase

Baseline conditions need to be established prior to the construction phase. Existing monitoring programs should be used as much as possible to establish baseline conditions prior to construction activities beginning. Although there are no system-wide monitoring programs for invasive species in the Everglades region, several individual agencies collect data. Data mining will be the primary resource to obtain baseline data, via collaboration with the individual agencies and the ECISMA. In areas with data gaps, surveys will need to be accomplished by the most cost-effective method (e.g. ground survey, Unmanned Aircraft Systems survey, DASM).

Existing monitoring and management programs should continue to be implemented. The existing programs help maintain invasive and nuisance species at a controlled level.

A significant length of time lapses from the time a project is planned to when it receives congressional authorization and appropriations, and ultimately goes to construction. As property (lands and structures) sit with no activity, vegetation and wildlife changes can occur. Unmanaged areas become inhabited by many species of flora and fauna, native and non-native. Older growth vegetation is more difficult and more costly to treat / remove versus lands that are managed along the way. As these lands become established with invasive species, there is an increased risk of spreading the invasive species to neighboring lands. Therefore, it is beneficial, ecologically and economically, to manage the lands early on. Managing invasive vegetation throughout the interim phase reduces construction costs since mowing is much less costly than clearing/grubbing and treating, and rapid response of new infestations helps reduce spread into environmentally sensitive areas. Site 1 Impoundment is an excellent example. $2.9M is estimated to manage invasive species during construction and until turnover to the local sponsor. The property's prior use included plant nurseries and pasture. Once project lands were acquired by the sponsor, the land sat unused until the Site 1 project was ready to begin construction. By this time, the project lands became highly vegetated, primarily by invasive species. It would have been significantly less expensive to have maintained the lands until the time of construction versus waiting until construction started.

G.6.5 Design and Construction Phases

The best method of controlling invasive and nuisance species is to prevent non-native species from being introduced and established to begin with. Incorporation of invasive species prevention and control into project designs, alternatives analysis, and operational plans has the potential to save significant resources during the long-term. The plans and specifications phase should simply design "with the end in mind." When the end goal is ecosystem restoration, the designers should periodically obtain input from invasive species experts to identify design features and operation strategies that could potentially favor the establishment and spread of invasive species. An example of design influences on invasive species is levee removal without backfill of canals. Without canal backfilling, deep water refuges for non-native fishes and invertebrates (from both seasonal cold temperatures and seasonal drying) are maintained, and barriers to dispersal from canal waters to marsh habitats are removed. Design alternatives should be explored that would allow seasonal cooling of water in the canals. Cooler water temperatures will reduce the refuge capacity for cold temperature sensitive non-native fishes. In some cases, such as the coastal canals, aquatic barrier technologies could be used to mitigate the spread of non-indigenous aquatic species.

Below are examples of cost-saving measures to consider during design and construction.

- Include invasive species management staff from the Corps, SFWMD, and other partner agencies throughout the design and construction phases.
- Work with subject matter experts to identify design features that may create habitat or entry points for invaders. Evaluate design alternatives to mitigate potential design vulnerabilities.
- Design to promote the establishment of native species.
- Use construction methods that minimize ground disturbance whenever possible.
- Contain mobilized nutrients resulting from soil disturbances.
- Require all construction contractors to follow vehicle and equipment decontamination protocols prior to deployment. Coordinate with invasive species specialists for decontamination protocol specifications.
- Evaluate cost/benefit ratios for treating invasive/nuisance species prior to construction activities. In some cases, pre-construction removal of a species may significantly reduce its spread.
- Implement a monitoring and rapid response protocol aimed at detecting and controlling new invasions early.
- Manage and control invasive/nuisance species during the entire construction phase.
- When native planting is specified in the plans, use plant material from regional sources that are weed and pathogen free.

Construction will be the responsibility of either the Corps or the SFWMD. This will be determined at a future time. Regardless of which agency will be responsible, both agencies commit to requiring the construction contractor to implement preventive measures and best management practices that will minimize the potential introduction and spread of invasive and nuisance species due to construction equipment (including personal protective equipment) and activities. This commitment is also included in the Project Implementation Report/Environmental Impact Assessment (Section 5.2.5 Environmental Commitments).

The Corps currently includes the following language in all of their specifications (Specification # 01 57 20 Environmental Protection, "Prevention of Invasive and Nuisance Species Transfer"):

> *The Contractor shall thoroughly clean equipment prior to and following work on the project site to ensure that items/materials including, but not limited to, soil, vegetative debris, eggs, mollusk larvae, seeds, and vegetative propagules are not transported from a previous work location to this project site, nor transported from this project site to another location. Prevention protocols require cleaning all equipment surfaces, including but not limited to, undercarriages, tires, and sheet metal. All equipment, including but not limited to, heavy equipment, vehicles, trailers, ATV's, and chippers must be cleaned. Smaller equipment, including, but not limited to, chainsaws, loppers, shovels, and backpack sprayers, must be cleaned and inspected to ensure they are free of eggs, vegetative debris, vegetative propagules, etc. The Contractor may utilize any method accepted by the Government; common accepted methods include pressure washing and steam cleaning/washing equipment. Prevention protocols should also address clothing and personal protective equipment.*
>
> *Prior to the commencement of work, the Contractor shall complete and provide an invasive and nuisance species transfer prevention plan to the Corps for approval. This plan shall be part of the Environmental Protection Plan as defined in subparagraph "Environmental Protection Plan" of paragraph SUBMITTALS (Part 1.5) above. The invasive and nuisance species transfer prevention plan shall identify specific transfer prevention procedures and designated cleaning sites/locations. Prevention protocols may vary depending upon the nature of the project site. It will be the responsibility of the Contractor to ensure all equipment coming onto and leaving the project site is inspected and not harboring materials that would spread, or potentially spread, invasive and nuisance species onto or off the project site. The Contractor shall provide a report verifying equipment brought on site was cleaned and shall provide a report verifying equipment was cleaned prior to removal from the project site.*

G.6.6 Operational Testing and Monitoring Period

The operational testing and monitoring period is the timeframe from the end of construction until the project is transferred and accepted by the local sponsor. EDRR is very critical and the most cost-effective management measure during this period. Disturbed areas, such as areas impacted from construction activities, are prone to the establishment of invasive and nuisance species. Early detection of invasive and nuisance species and immediate treatment/control measures prevent these species from establishing and becoming long-term problems, ecologically and economically.

G.6.7 OMRR&R Phase

"Prevention of Invasive and Nuisance Species Transfer" language applies not only to the construction phase, but also to the OMRR&R phase. The preventive measure applies to contractors and government employees. Maintenance equipment and rental equipment are often used at multiple locations. As equipment is moved from one location to another, this potential spread vector can easily be reduced / prevented simply by ensuring the equipment is clean prior to arrival on site and prior to leaving the site.

In addition, numerous operational aspects of the restoration can influence mechanisms of invasion. For example, many non-indigenous species become more invasive in environments with elevated nutrient availability. With large pulses of only slightly elevated phosphorus levels, some invasive plant species could establish and spread.

G.6.8 Specific Control by Project Feature – Construction Phase

G.6.8.1 Lake Okeechobee and the Northern Estuaries

Several agencies manage vegetation on Lake Okeechobee and associated water bodies. It is recommended the agencies continue to aggressively treat priority species to achieve maintenance control in order to minimize spread of those species to other areas.

G.6.8.2 A-2 Flow Equalization Basin

During the construction phase, thorough surveys should be conducted to identify and treat high priority species, which could proliferate after construction phase and impact FEB operations. Depending on design of the FEB, it may or may not be necessary to treat Brazilian pepper or other priority species along the agricultural ditches. If the ditches are filled with existing spoil then Brazilian pepper and other species would be removed by the scraping of material to fill the ditches. If the spoil is not used to fill the ditches then treatment or removal of Brazilian pepper other species should be completed. Management options include aerial herbicide application and mechanical removal via heavy equipment. The levee should be maintained throughout the construction phase to prevent invasion of plant species such as cogongrass. The spreader canal may require maintenance of emergent or other species during the construction phase.

G.6.8.3 Diversion of L-6 Flows and L-5 Improvements

Surveys of the L-5 canal should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. New growth of priority plant species on spoil areas should be treated throughout the construction phase. Woody vegetation should not be piled/disposed of on spoil areas because it could create habitat for certain invasive animal species such as the Burmese python. Electrofishing should be conducted prior to construction to determine the baseline of non-native fish species. Periodic electrofishing should be conducted throughout the construction phase to identify high priority non-native invasive fish species. Coordination with other agencies should be conducted to determine the appropriate measures to be implemented to address the high priority non-native invasive fish species.

G.6.8.4 L-4 / L-5 – Spreader Canal and Levee Degradation

Baseline levels of plants should be established prior to construction in L-4 and L-5. Surveys of the L-5 canal and levee should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Periodic surveys of the spreader canal, the marsh immediately downstream of the spreader canal, degraded areas and remnant levee portions should be conducted throughout the construction phase to identify growth of priority species. Priority plant species in these areas should be treated.

G.6.8.5 Miami Canal Backfill – S-8 to I-75

Baseline levels of plants in the Miami Canal should be established prior to construction. Surveys of Miami Canal and the levee should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Periodic surveys of the backfill/degraded areas, remnant levee portions, and constructed tree islands should be conducted throughout the construction phase to identify growth of priority species. Priority plant species in these areas should be treated. It is recommended the adjacent areas within 0.5 mile of the canal and levee be systematically surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper. Diligent monitoring and prompt control of invasive species on constructed tree islands should be a priority during the construction phase as these disturbed soils are very likely to be colonized by invasive plant and animal species.

G.6.8.6 L-28 Levee Degradation / Backfill

Baseline levels of plants in L-28 should be established prior to construction. Surveys of the L-28 levee should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Periodic surveys of the backfill/degraded areas and remnant levee portions should be conducted throughout the construction phase to identify growth of priority species. Priority plant species in these areas should be treated. It is recommended the adjacent areas within 0.5 mile of the levee be systematically surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper.

G.6.8.7 Increase Capacity of S-333

Monitoring during de-watering operations or other construction activities should occur in order to identify and potentially remove priority fish and other non-native animal species. Priority species present near the water control structure that could be spread by construction equipment and associated construction activities should be treated or removed.

G.6.8.8 L-67A Gated Structures / Spoil Removal

Surveys of the L-67A levee and canal should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Periodic surveys of the degraded areas, the remnant levee portions, spoil islands and the areas adjacent to the structures should be conducted throughout the construction phase to identify growth of priority species. Priority plant species in these areas should be treated. It is recommended the adjacent areas within 0.5 mile of the levee be systematically surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper.

G.6.8.9 L-67C Levee Degradation

Baseline levels of plants in L-67C should be established prior to construction. Surveys of the L-67C levee should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Periodic surveys of the degraded areas, remnant levee portions, spoil islands, the spreader canal and the area adjacent to the spreader canal should be conducted throughout the construction phase to identify growth of priority species. Priority plant species in these areas should be treated. It is recommended the adjacent areas within 0.5 mile of the levee be systematically surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper. Monitoring throughout the construction phase adjacent to the spreader canal and north and south of the new structures should be conducted in order to identify and treat cattail expansion or other priority species.

G.6.8.10 Build North-South Levee in WCA 3B

During the construction phase, the area impacted by construction should be monitored to identify priority species. In addition, as portions of the levee are completed periodic surveys should be conducted to identify priority species. Such species should be treated throughout the construction phase.

G.6.8.11 L-67 Extension – Levee Degradation / Backfill

Enhance existing monitoring and removal efforts (EIRAMMP) targeting non-native invasive animals such as the Burmese python prior to beginning levee degradation and canal backfill construction activities. Multiple monitoring and removal efforts should be conducted in order to minimize dispersal of non-native animals due to construction. Surveys of the L-67 Extension levee and canal should be completed prior to construction to identify priority plant species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Remaining spoil, levee remnants, degraded and backfill areas should be surveyed during construction and priority species should be treated and/or removed.

G.6.8.12 L-29 Levee Degradation

Surveys of the L-29 levee and canal should be completed prior to construction to identify priority plant species that may be spread (e.g. rotala) by construction activities. Such species should be treated prior to the beginning of construction. Remaining levee remnants, degraded areas and the canal should be surveyed during construction and priority species should be treated and/or removed. Periodic electrofishing should be conducted throughout the construction phase to identify and remove high priority non-native invasive fish species. The area adjacent to the L-29 canal should be monitored for encroachment of cattail and other non-native obligate wetland species. Priority species should be treated. Monitoring for invasive species of apple snail should be conducted and control measures should be implemented if effective control measures are identified.

G.6.8.13 Divide Structure on L-29

A survey of the installation area should be completed prior to construction to identify priority plant species that may be spread (e.g. rotala) by construction activities. These species should be treated prior to beginning construction activities. Monitoring and treatment of submersed and floating plant species that could impact construction should occur throughout the construction phase.

G.6.8.14 Increase S-356 Capacity to 1,000 cfs

A survey of the area surrounding S-356 should be completed prior to construction to identify priority plant species that may be spread (e.g. rotala) by construction activities. These species should be treated prior to beginning construction activities. Monitoring and treatment of submersed and floating plant species that could impact construction should occur throughout the construction phase.

G.6.8.15 Remove ~6 Miles of Old Tamiami Trail Roadway from L-67 Extension to Tram Road

Enhance existing monitoring and removal efforts (EIRAMMP) targeting non-native invasive animals such as the Burmese python prior to beginning roadway degradation construction activities. Multiple monitoring and removal efforts should be completed in order to minimize dispersal of non-native animals due to construction. Surveys of the Old Tamiami Trail should be conducted prior to construction to identify priority plant species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Remaining spoil, roadway remnants and degraded areas should be surveyed during construction and priority species should be treated and/or removed. Monitoring for invasive species of apple snail should be conducted and control measures should be implemented if effective control measures are identified.

G.6.8.16 G-211 Operational Modifications / Coastal Canals Conveyance

Monitor and treat submersed and floating plant species that could impact the structure throughout the construction phase.

G.6.8.17 Seepage Barrier

A survey of the installation area should be completed prior to construction to identify priority plant species that may be spread by construction activities. These species should be treated prior to beginning construction activities. Monitoring and treatment of priority plant species within the construction footprint should be conducted throughout the construction phase.

G.6.9 Specific Control by Project Feature – OMRR&R Phase

G.6.9.1 A-2 Flow Equalization Basin

Vegetation within the FEB will be difficult to manage due to high nutrient loading from surface water inflows. Similar conditions are experienced in the storm water treatment areas (STA), and maintenance control of many invasive plant species have proven difficult and not cost-effective. In addition, most of these species have not spread downstream of the STAs into the WCA. Vegetation management within the FEB should focus on maintaining FEB functionality. Vegetation should be controlled to ensure adequate surface water conveyance and minimal impact to infrastructure (e.g., levee instability, floating tussocks). However, any invasive species capable of establishing in the FEB and spreading to natural areas should be a priority for control. Chemical treatments of floating and submersed vegetation should be performed upstream and downstream of water control structures. Occasional mechanical removal of tussocks or uprooted submersed species may be required in order to maintain operations and the function of the FEB. It is recommended to utilize best management practices such as strategic management of vegetation in strips immediately in front of water control structures to prevent floating vegetation and mats from blocking the structures. This has been demonstrated to be an effective management practice in STA's and reduces the cost of operations and maintenance. Levee vegetation should be maintained throughout the OMRR&R phase, with an emphasis on minimizing the spread of invasive plants capable of spreading to natural areas (e.g., cogongrass). The spreader canal will require maintenance of floating, emergent and submersed plant species in order to maintain the function of the canal.

G.6.9.2 Diversion of L-6 Flows and L-5 Improvements

Monitoring of the L-5 canal should be conducted on a regular basis to identify invasions of priority species. Such species should be treated based on their priority level (i.e. maintenance control or EDRR). Priority species of vegetation on spoil areas should be treated throughout the construction phase. Periodic electrofishing should be conducted to identify high priority non-native invasive fish species. Coordination with other agencies should be conducted to determine the appropriate measures to be implemented to address the high priority non-native invasive fish species.

G.6.9.3 L-4 / L-5 – Spreader Canal and Levee Degradation

This feature will require periodic surveys of the spreader canal, the marsh immediately downstream of the spreader canal, degraded areas and remnant levee portions throughout the OMRR&R phase. The detection of priority invasive plant animal species should trigger prompt control efforts. Regular mowing of any "dead end" levees is recommended to limit the establishment of invasive plant and animal species on the artificially high ground.

G.6.9.4 Miami Canal Backfill – S-8 to I-75

Periodic surveys of the backfill/degraded areas, remnant levee portions and tree islands should be conducted throughout the OMRR&R phase to identify growth of priority species. Priority plant species in these areas should be treated. It is recommended the adjacent areas within 0.5 mile of the canal and levee be systematically surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper.

G.6.9.5 L-28 Levee Degradation / Backfill

Periodic surveys of the backfill/degraded areas and remnant levee portions should be conducted during the OMRR&R phase to identify growth of priority species. Such species should be treated. It is recommended the adjacent areas within 0.5 mile of the levee be systematically surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper.

G.6.9.6 Increase Capacity of S-333

Monitoring during de-watering operations or other maintenance activities should occur in order to identify and potentially remove priority fish and other non-native animal species. Priority species present near the water control structure that could be spread by construction equipment and associated activities should be treated or removed.

G.6.9.7 L-67A Gated Structures / Spoil Removal

Periodic surveys of the degraded areas, the remnant levee portions, spoil islands and the areas adjacent to the structures should be conducted throughout the OMRR&R phase to identify growth of priority species. Priority plant species in these areas should be treated. The remnant levee portions and spoil islands should be monitored for new colonization of invasive animal species; priority species should be removed.

G.6.9.8 Build North-South Levee in WCA 3B

The area impacted by construction and the levee should be monitored throughout the OMRR&R phase to identify growth of priority species. Priority species should be treated or removed. Cattail growth and expansion is expected along the toe of the levee and should be target for control.

G.6.9.9 L-67 Extension – Levee Degradation / Backfill

Conduct periodic monitoring and removal efforts (EIRAMMP) targeting non-native invasive animals such as the Burmese python on remnant levee portions during the OMRR&R phase. Monitor remaining spoil, levee remnants, degraded and backfill areas for priority species. Priority species should be treated and/or removed.

G.6.9.10 L-29 Levee Degradation

Remaining levee remnants, degraded areas and the canal should be surveyed during the OMRR&R phase and priority species should be treated and/or removed. Periodic electrofishing should be conducted to identify high priority non-native invasive fish species. Coordination with other agencies should be conducted to determine the appropriate measures to be implemented to address the high priority non-native invasive fish species. The area adjacent to the L-29 canal should be monitored for encroachment of cattail and other non-native obligate wetland species. Priority species should be treated. Monitoring for invasive species of apple snail should be conducted and control measures should be implemented if effective control measures are identified.

G.6.9.11 Divide Structure on L-29

Monitoring and treatment of submersed and floating plant species that could impact the structure should occur throughout the OMRR&R phase.

G.6.9.12 Increase S-356 Capacity to 1,000 cfs

Monitoring and treatment of submersed and floating plant species that could impact the structure should occur throughout the OMRR&R phase.

G.6.9.13 Remove ~6 Miles of Old Tamiami Trail Roadway from L-67 Extension to Tram Road

Perform monitoring and removal efforts (EIRAMMP) targeting non-native invasive animals such as the Burmese python throughout the OMRR&R phase. Remaining spoil, roadway remnants and degraded areas should be monitored during the OMRR&R phase and priority species should be treated and/or removed. Monitoring for invasive species of apple snail should be conducted and control measures should be implemented if effective control measures are identified.

G.6.9.14 G-211 Operational Modifications / Coastal Canals Conveyance

Monitor and treat submersed and floating plant species that could impact the structure throughout the OMRR&R phase.

G.6.9.15 Seepage Barrier

Monitoring and treatment of priority plant species within the project footprint should be conducted throughout the OMRR&R phase in order to maintain the integrity of the seepage barrier.

G.7 EDUCATION / OUTREACH

G.7.1 Education / Outreach Opportunities at Recreational Areas

Recreational opportunities will be created by the Central Everglades Planning Project. Recreation areas such as boat ramps, hiking trails, and hunting areas can serve as vectors and pathways for aquatic and terrestrial invasive species. For example, invasive species can be transferred from one area to another by hikers and by boats/trailers. Many recreational users are unaware of their role in the spread of unwanted species. Hence, educating the public on preventing the spread of invasive species can be a cost effective component of the overall management strategy. The recreation access points can be used to display educational information on invasive species identification, prevention/control measures, and awareness of the invasive species programs in the area, and how individuals can contribute to invasive species prevention. Educational kiosks are recommended and should include information on:

- Specific priority invasive species in the area
- Impacts and costs of invasive species on conservation, human health, and recreation
- Preventative measures, such as removing vegetation from boats/trailers before leaving the boat ramp or removing vegetation from shoes and clothing before leaving the area.
- Ways to report invasive species observations
- Programs that citizens can get involved with and learn more about invasive species
- Laws against the release of non-native wildlife

G.8 COSTS

A summary of costs are below in Table G-1: Invasive and Nuisance Species Management Costs. Detailed costs can be found in Tables G-5 and G-6 (Table G-5: Invasive and Nuisance Species Management Costs – Construction Phase and Table G-6: Invasive and Nuisance Species Management Costs – OMRR&R Phase). It was assumed that in the field baselines and potential invasive species treatments and management would need to occur starting about 2 years prior to the actual construction start date. Costs were estimated for the life of the project, assuming a 50-year life. However, due to size, the OMRR&R table only shows years 1 through 3.

TABLE G-1: INVASIVE AND NUISANCE SPECIES MANAGEMENT COSTS

Invasive and Nuisance Species Management	
2 Years Pre-Construction	$4,946
1 Year Pre-Construction	$719,216
Construction Phase	$4,012,555
Operational Testing & Monitoring Phase	$3,104,255
1 Year OMRR&R Phase	$3,053,740
50-Year OMRR&R Phase (Includes Year 1)	$190,695,832
Total Management Cost	**$198,536,804**
Invasive and Nuisance Species Management Monitoring	
2 Years Pre-Construction	$124,800
1 Year Pre-Construction	$0
Construction Phase	$0
Operational Testing & Monitoring Phase	$356,626
1 Year OMRR&R Phase	$356,626
10-Year OMRR&R Phase (Includes Year 1)	$3,731,096
Total Monitoring Cost	**$4,212,522**

TABLE G-2: PRIORITY SPECIES / AREAS FOR EARLY DETECTION AND RAPID RESPONSE

Species	Natural Area Threat	Structural / Operational Threat
Plants		
Australian pine (*Casuarina spp.*)	X	X
bishopwood (*Bischofia javanica*)	X	
Brazilian pepper (*Schinus terebinthifolius*)	X	X
Burma reed (*Neyraudia reynaudiana*)	X	
climbing cassia (*Senna pendula*)	X	X
cogongrass (*Imperata cylindrica*)	X (uplands only)	X
floating heart (*Nymphoides cristata*)	X	X
melaleuca (*Melaleuca quinquenervia*)	X	
napier grass (*Pennisetum purpureum*)	X (disturbed soils)	X
Old Word climbing fern (*Lygodium microphyllum*)	X	
para grass (*Urochloa mutica*)	X	X
roundleaf toothcup (*Rotala rotundifolia*)	X	X
schefflera (*Schefflera actinophylla*)	X	
shoebutton Ardisia (*Ardisia elliptica*)	X	
torpedograss (*Panicum repens*)	X	X
tropical American watergrass (*Luziola subintegra*)	X	X
West Indian marsh grass (*Hymenachne amplexicaulis*)	X	
wetland nightshade (*Solanum tampicense*)	X	
Wright's nut-rush (*Scleria lacustris*)	X	
Invertebrates		
ambrosia beetle (*Xyleborus glabratus*)	X	
island apple snail (*Pomacea insularum*)	X	
Amphibians		
Cuban treefrog (*Osteopilus septentrionalis*)	X	
Reptiles		
Argentine black and white tegu (*Tupinambis merianae*)	X	
Burmese python (*Python malurus bivittatus*)	X	
green iguana (*Iguana iguana*)		X
Nile monitor (*Varanus niloticus*)	X	
Fish		
asian swamp eel (*Monopterus albus*)	X	
brown hoplo (*Hoplosternum littorale*)	X	
bullseye snakehead (*Channa marulius*)	X	
sailfin catfish (*Pterygoplichthys disjunctivus*)	X	X
Mammals		
feral hog (*Sus scrofa*)	X	X
Gambian pouched rat (*Cricetomys gambianus*)	X	

TABLE G-3: INVASIVE PLANT SPECIES DOCUMENTED IN THE PROJECT AREA

Invasive Plant Species		Region Documented In				FLEPPC Category	Florida Noxious Weed List
Common Name	Scientific Name	LO	NE	EAA	GE		
rosarypea	*Abrus precatorius*	x	x	x	x	I	
Florida Keys Indian mallow	*Abutilon hirtum*				x		
velvetleaf	*Abutilon theophrasti*		x	x	x		
earleaf acacia	*Acacia auriculiformis*	x	x	x	x	I	
bee wattle	*Acacia sphaerocephala*				x		
foxtail copperleaf	*Acalypha alopecuroidea*				x		
sisal	*Agave sisalana*	x	x	x	x	II	
mimosa	*Albizia julibrissin*	x	x	x	x	I	
woman's tongue tree	*Albizia lebbeck*	x	x	x	x	I	
golden trumpet	*Allamanda cathartica*	x	x	x	x		
alligatorweed	*Alternanthera philoxeroides*	x	x	x	x	II	
sessile joyweed	*Alternanthera sessilis*	x	x		x		x
common ragweed	*Ambrosia artemisiifolia*	x	x	x	x		
coral vine	*Antigonon leptopus*	x	x	x	x	II	
coral ardisia	*Ardisia crenata*	x	x	x	x	I	
shoebutton ardisia	*Ardisia elliptica*	x	x	x	x	I	x
Sprenger's asparagus fern	*Asparagus aethiopicus*	x	x	x	x	I	
Chinese violet, ganges primrose	*Asystasia gangetica*	x	x	x	x	II	
mountain ebony	*Bauhinia variegata*	x	x	x	x	I	
hairy beggarticks	*Bidens pilosa*	x	x	x	x		
Javanese bishopwood	*Bischofia javanica*	x	x	x	x	I	
Browne's blechum, green shrimp plant	*Blechum pyramidatum*	x	x	x	x	II	
bottlebrush	*Callistemon viminalis*	x	x	x	x	II	
Alexandrian laurel	*Calophyllum inophyllum*				x	I	
Brazilian jackbean	*Canavalia brasiliensis*				x		
river sheoak	*Casuarina cunninghamiana*	x	x	x	x	II	
Australian-pine	*Casuarina equisetifolia*	x	x	x	x	I	
gray sheoak	*Casuarina glauca*	x	x	x	x	I	x
Madagascar periwinkle	*Catharanthus roseus*	x	x	x	x		
day jessamine	*Cestrum diurnum*	x	x	x	x	II	
camphortree	*Cinnamomum camphora*	x	x	x	x	I	
turk's turbin	*Clerodendrum indicum*	x	x	x	x		

Invasive Plant Species		Region Documented In				FLEPPC Category	Florida Noxious Weed List
Common Name	Scientific Name	LO	NE	EAA	GE		
coco yam, wild taro	*Colocasia esculenta*	x	x	x	x	I	
Asian nakedwood	*Colubrina asiatica*	x	x	x	x	I	x
Benghal dayflower	*Commelina benghalensis*		x				x
smooth crotalaria	*Crotalaria pallida*	x	x	x	x		
showy rattlebox	*Crotalaria spectabilis*	x	x	x	x		
carrotwood	*Cupaniopsis anacardioides*	x	x	x	x	I	x
tarweed cuphea	*Cuphea carthagenensis*	x	x	x	x		
umbrella plant	*Cyperus involucratus*	x	x	x	x	II	
miniature flatsedge, dwarf papyrus	*Cyperus prolifer*	x	x	x	x	II	
crowfootgrass	*Dactyloctenium aegyptium*	x	x	x	x	II	
Indian rosewood	*Dalbergia sissoo*	x	x	x	x	II	
pangolagrass	*Digitaria eriantha*	x	x	x	x		
violet crabgrass	*Digitaria vialascens*	x	x	x	x		
winged yam	*Dioscorea alata*	x	x	x	x	I	
air-potato	*Dioscorea bulbifera*	x	x	x	x	I	x
waterhyacinth	*Eichhornia crassipes*	x	x	x	x	I	
goosegrass	*Eleusine indica*	x	x	x	x		
Cupid's-shaving-brush	*Emilia fosbergii*	x	x	x	x		
centipede tongavine	*Epipremnum pinnatum*	x	x	x	x	II	
Surinam cherry	*Eugenia uniflora*	x	x	x	x	I	
Chinese banyan	*Ficus microcarpa*	x	x	x	x	I	
limpograss	*Hemarthria altissima*	x	x	x	x	II	
hydrilla	*Hydrilla verticillata*	x	x	x	x	I	
miramar weed, green hygro, Indian swampweed	*Hygrophila polysperma*	x	x		x	I	
West Indian marsh grass	*Hymenachne amplexicaulis*	x	x	x	x	I	
jaraguagrass	*Hyparrhenia rufa*	x	x		x	II	
Brazilian satintail	*Imperata brasiliensis*	x	x	x	x		
cogongrass	*Imperata cylindrica*	x	x	x	x	I	x
hairy indigo	*Indigofera hirsuta*	x	x	x	x		
swamp morning glory	*Ipomoea aquatica*	x	x	x	x	I	
ivyleaf morning glory	*Ipomoea hederacea*		x		x		
threelobe morning glory	*Ipomoea triloba*	x	x	x	x		x
Gold Coast jasmine	*Jasminum dichotomum*	x	x	x	x	I	
jazmin de trapo	*Jasminum fluminense*	x	x	x	x	I	

Invasive Plant Species		Region Documented In				FLEPPC Category	Florida Noxious Weed List
Common Name	Scientific Name	LO	NE	EAA	GE		
chandelier plant	*Kalanchoe delagoensis*	x	x	x	x		
life plant, cathedral bells	*Kalanchoe pinnata*				x	II	
Lantana, shrub verbena	*Lantana camara*	x	x	x	x	I	
white leadtree	*Leucaena leucocephala*	x	x	x	x	II	x
glossy privet	*Ligustrum lucidum*		x		x	I	
Chinese privet	*Ligustrum sinense*	x	x		x	I	
limnophila	*Limnophila sessiliflora*	x	x	x	x	II	
Japanese honeysuckle	*Lonicera japonica*		x		x	I	
primrose-willow	*Ludwigia peruviana* (	x	x	x	x	I	
black mangrove	*Lumnitzera racemosa*				x	I	
watergrass	*Luziola subintegra*				x	I	
Japanese climbing fern	*Lygodium japonicum*	x	x	x	x	I	x
old world climbing fern	*Lygodium microphyllum*	x	x	x	x	I	x
catclaw-vine	*Macfadyena unguis-cati*	x	x	x	x	I	
sapodilla	*Manilkara zapota*	x	x	x	x	I	
black medic	*Medicago lupulina*		x		x		
guineagrass	*Megathyrsus maximus*	x	x	x	x	II	
melaleuca	*Melaleuca quinquenervia*	x	x	x	x	I	x
chinaberry	*Melia azedarach*	x	x	x	x	II	
molassesgrass	*Melinis minutiflora*	x	x	x	x	II	
natalgrass	*Melinis repens*	x	x	x	x	I	
yellow sweetclover	*Melilotus officinalis*	x	x	x	x		
mile-a-minute	*Mikania micrantha*				x	II	
catclaw mimosa	*Mimosa pigra*	x	x	x	x	I	x
balsamapple	*Momordica charantia*	x	x	x	x		
sacred bamboo	*Nandina domestica*		x			I	
Asian swordfern	*Nephrolepis brownii*	x	x	x	x	I	
narrow swordfern	*Nephrolepis cordifolia*	x	x	x	x	I	
burmareed	*Neyraudia reynaudiana*	x	x	x	x	I	x
white Egyptian lotus	*Nymphaea lotus*		x		x		
crested floating heart	*Nymphoides cristata*	x	x	x	x	I	
brown-beard rice	*Oryza rufipogon*				x		x
sewer vine	*Paederia cruddasiana*				x	I	x
skunk-vine	*Paederia foetida*	x	x	x	x	I	x
torpedo grass	*Panicum repens*				x	I	

Invasive Plant Species		Region Documented In				FLEPPC Category	Florida Noxious Weed List
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**		
vaseygrass	*Paspalum urvillei*	x	x	x	x		
mission grass	*Pennisetum polystachion*		x		x		x
elephant grass, napier grass	*Pennisetum purpureum*	x	x	x	x	I	
common reed	*Phragmites australis australis*	x	x	x	x		
golden bamboo	*Phyllostachys aurea*	x	x		x		
monarch fern	*Phymatosorus scolopendria*				x	I	
waterlettuce	*Pistia stratiotes*	x	x	x	x	I	
strawberry guava	*Psidium cattleianum*	x	x	x	x	I	
guava	*Psidium guajava*	x	x	x	x	I	
ladder brake	*Pteris vittata*	x	x	x	x	II	
kudzu	*Pueraria montana var. lobata*	x	x		x	I	x
castorbean	*Ricinus communis*	x	x	x	x	II	
downy rose myrtle	*Rhodomyrtus tomentosa*	x	x	x	x	I	x
roundleaf toothcup	*Rotala rotundifolia*	x	x	x	x	II	
itchgrass	*Rottboellia cochinchinensis*	x	x	x	x		x
Mexican petunia	*Ruellia brittoniana*	x	x	x	x	I	
glenwoodgrass	*Sacciolepis indica*	x	x	x	x		
water fern	*Salvinia minima*	x	x	x	x	I	
iguanatail	*Sansevieria hyacinthoides*	x	x	x	x	II	
snake plant	*Sansevieria trifasciata*	x	x		x		
beach naupaka	*Scaevola sericea var. taccada*	x	x		x	I	
beach naupaka	*Scaevola taccada*	x	x	x	x	I	
octopus tree	*Schefflera actinophylla*	x	x	x	x	I	
Brazilian pepper	*Schinus terebinthifolius*	x	x	x	x	I	
Brazilian pepper	*Schinus terebinthifolius var. raddianus*	x	x	x	x	I	
lakeshore nutrush	*Scleria lacustris*	x	x	x	x	I	
climbing cassia, Christmas cassia, Christmas senna	*Senna pendula var. glabrata*	x	x	x	x	I	
red sesbania, purple sesban, rattlebox	*Sesbania punicea*	x	x	x	x	II	
yellow foxtail	*Setaria pumila*	x	x	x	x		x
two leaf nightshade	*Solanum diphyllum*	x	x	x	x	II	
Jamaican nightshade	*Solanum jamaicense*	x	x				
wetland nightshade	*Solanum tampicense*	x	x	x	x	I	x
turkeyberry	*Solanum torvum*	x	x	x	x	II	x
tropical soda apple	*Solanum viarum*	x	x	x	x	I	x

Invasive Plant Species		Region Documented In				FLEPPC Category	Florida Noxious Weed List
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**		
annual sowthistle	*Sonchus oleraceus*	x	x	x	x		
johnsongrass	*Sorghum halepense*	x	x	x	x		
Bay Biscayne creeping-oxeye; wedelia	*Sphagneticola trilobata ; Wedelia trilobata*	x	x	x	x	II	
cayenne porterweed	*Stachytarpheta cayennensis*	x	x	x	x	II	
American evergreen, arrowhead vine	*Syngonium podophyllum*	x	x	x	x	I	
queen palm	*Syagrus romanzoffiana*	x	x	x	x	II	
Java plum	*Syzygium cumini*	x	x	x	x	I	
sea hibiscus	*Talipariti tiliaceum var. tiliaceum*	x	x	x	x	II	
incised halberd fern	*Tectaria incisa*	x	x	x	x	I	
tropical almond	*Terminalia catappa*	x	x	x	x	II	
portia tree, seaside mahoe	*Thespesia populnea*	x	x	x	x	I	
white-flowered spiderwort	*Tradescantia fluminensis*	x	x	x	x	I	
boatlily	*Tradescantia spathacea*	x	x	x	x	II	
Chinese tallow	*Triadica sebifera*	x	x		x	I	x
Jamaica feverplant, puncture vine, burr-nut	*Tribulus cistoides*	x	x	x	x	II	
coat buttons	*Tridax procumbens*	x	x	x	x		x
Caesarweed	*Urena lobata* L.	x	x	x	x	I	
tropical signalgrass	*Urochloa distachya*	x	x	x	x		
guinea grass	*Urochloa maxima*				x	II	
paragrass	*Urochloa mutica*	x	x	x	x	I	
simpleleaf chastetree	*Vitex trifolia*	x	x	x	x	II	

TABLE G-4: INVASIVE ANIMAL SPECIES DOCUMENTED IN THE PROJECT AREA

Invasive Animal Species		Region Documented In			
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**
BIRDS					
chestnut-fronted macaw	*Ara severa*				x
muscovy duck	*Cairina moschata*	x	x	x	x
rock dove	*Columba livia*	x	x	x	x
scarlet ibis	*Eudocimus ruber*		x		x
hill myna	*Gracula religiosa*	x	x	x	x
spot-breasted oriole	*Icterus pectoralis*	x	x	x	x
budgerigar	*Melopsittacus undulatus*	x	x		x
monk parakeet	*Myiopsitta monachus*	x	x	x	x
house sparrow	*Passer domesticus*	x	x	x	x
purple swamphen	*Porphyrio porphyrio*	x	x	x	x
red-whiskered bulbul	*Pycnonotus jocosus*				x
Eurasian collared-dove	*Streptopelia decaocto*	x	x	x	x
European starling	*Sturnus vulgaris*	x	x	x	x
white-winged dove	*Zenaida asiatica*	x	x	x	x
REPTILES & AMPHIBIANS					
African redhead agama	*Agama agama*	x	x	x	x
giant ameiva	*Ameiva ameiva*				x
Hispaniolan green anole	*Anolis chlorocyanus*				x
Puerto Rican crested anole	*Anolis cristatellus cristatellus*				x
largehead anole	*Anolis cybotes*	x	x		
bark anole	*Anolis distichus*	x	x	x	x
knight anole	*Anolis equestris equestris*	x	x	x	x
Jamaican giant anole	*Anolis garmani*	x	x	x	x
Cuban green anole	*Anolis porcatus*				x
brown Aanole	*Anolis sagrei*	x	x		
brown basilisk	*Basiliscus vittatus*	x	x	x	x
common boa	*Boa constrictor*	x	x	x	x
spectacled caiman	*Caiman crocodilus*				x
oriental garden lizard	*Calotes versicolor*	x	x		
veiled chameleon	*Chamaeleo calyptratus*	x	x	x	x
rainbow lizard	*Cnemidophorus lemniscatus*				x
giant whiptail	*Cnemidophorus motaguae*				x
Mexican spinytail iguana	*Ctenosaura pectinata*				x
black spinytail iguana	*Ctenosaura similis*	x	x		x
greenhouse frog	*Eleutherodactylus planirostris*		x		
green anaconda	*Eunectes murinus*				x
yellow anaconda	*Eunectes notaeus*				x
Tokay gecko	*Gekko gecko*	x	x	x	x
common house gecko	*Hemidactylus frenatus*				x
Indo-Pacific gecko	*Hemidactylus garnotii*		x		x

Invasive Animal Species		Region Documented In			
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**
REPTILES & AMPHIBIANS (continued)					
tropical house gecko	*Hemidactylus mabouia*	x	x	x	x
Mediterranean gecko	*Hemidactylus turcicus*	x	x	x	x
green iguana	*Iguana iguana*	x	x	x	x
northern curlytail lizard	*Leiocephalus carinatus armouri*	x	x	x	x
red-sided curlytail lizard	*Leiocephalus schreibersii schreibersii*		x		x
butterfly lizard	*Leiolepis belliana belliana*				x
many-lined grass skink	*Mabuya multifasciata*				x
Cuban treefrog	*Osteopilus septentrionalis*	x	x	x	x
giant day gecko	*Phelsuma madagascariensis grandis*				x
Texas horned lizard	*Phrynosoma cornutum*	x	x	x	x
reticulated python	*Python reticulatus*				x
northern African python	*Python sebae*				x
Burmese python	*Python molurus bivittatus*	x	x	x	x
Brahminy blind snake	*Ramphotyphlops braminus*	x	x		x
giant toad	*Rhinella marina*	x	x	x	x
white-spotted wall gecko	*Tarentola annularis*		x		x
red-eared slider	*Trachemys scripta elegans*				x
black and white tegu	*Tupinambis merianae*				x
Nile monitor	*Varanus niloticus*	x	x	x	x
FISH					
oscar	*Astronotus ocellatus*				x
pike killifish	*Belonesox belizanus*	x	x	x	x
bullseye snakehead	*Channa marulius*				x
clown knifefish	*Chitala ornata*	x	x	x	x
butterfly peacock	*Cichla ocellaris*				x
black acara	*Cichlasoma bimaculatum*				x
midas cichlid	*Cichlasoma citrinellum*				x
jaguar guapote	*Cichlasoma managuense*	x	x	x	x
yellowbelly cichlid	*Cichlasoma salvini*				x
Mayan cichlid	*Cichlasoma urophthalmus*				x
walking catfish	*Clarias batrachus*				x
african jewelfish	*Hemichromis letourneuxi*	x	x	x	x
brown hoplo	*Hoplosternum littorale*				x
suckermouth catfish	*Hypostomus sp.*				x
Asian swamp eel	*Monopterus albus*				x
blue tilapia	*Oreochromis aureus*				x
Orinoco sailfin catfish	*Pterygoplichthys multiradiatus*				x
spotted tilapia	*Tilapia mariae*				x
MAMMALS					
coyote	*Canis latrans*	x	x	x	x

Invasive Animal Species		Region Documented In			
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**
vervet monkey	*Chlorocebus aethiops*	x	x	x	x
ninebanded armadillo	*Dasypus novemcinctus*				x
black rat	*Rattus rattus*				x
squirrel monkey	*Saimiri sciureus*		x		x
Mexican red-bellied squirrel	*Sciurus aureogaster*				x
wild hog, feral pig	*Sus scrofa*	x	x	x	x
OTHER					
spiketop applesnail	*Pomacea diffusa*	x	x	x	x
titan apple snail	*Pomacea haustrum*	x	x	x	x
island applesnail	*Pomacea maculata*	x	x	x	x
Asian tiger mosquito	*Aedes albopictus*	x	x	x	x
Mexican bromeliad weevil	*Metamasius callizona*	x	x	x	x
redbay ambrosia beetle	*Xyleborus glabratus*				x
fungus (causes laurel wilt)	*Raffaelea lauricola*				x

TABLE G-5: INVASIVE AND NUISANCE SPECIES MANAGEMENT COSTS – CONSTRUCTION PHASE

Invasive and Nuisance Species Management - Construction Phase					
Feature / Area	**Management Activity**	**Pre-Construction 2 Years**	**Pre-Construction 1 Year**	**Construction**	**Operational Testing & Monitoring Phase**
A-2 Flow Equalization Basin (14,000)	EDRR Surveillance - Plants		$20,880	$92,800	$74,240
Construction Period - 2.5 years	Plant Control/Treatment		$241,500	$282,555	$209,300
	EDRR Surveillance and Removal Animals			$58,325	$58,325
	Coordination/Inspection /Contract Implementation		$65,595	$93,839	$70,885
L-5 (Improvements / Modifications)	EDRR Surveillance - Plants		$1,856	$11,136	$14,848
Construction Period - 1.5 years	Plant Control/Treatment		$523	$3,140	$2,093
	EDRR Surveillance and Removal Animals				$4,800
	Electrofishing		$24,000	$36,000	$48,000
	Coordination/Inspection /Contract Implementation		$6,595	$12,569	$17,435
L-6	EDRR Surveillance - Plants		$1,856	$7,424	$14,848
Construction Period - 1 year	Plant Control/Treatment		$1,196	$2,392	$4,784
	Coordination/ Inspection/ Contract Implementation		$763	$2,454	$4,908
L-4 Levee Degrade (2.9 miles)	EDRR Surveillance - Plants		$928	$7,424	$7,424
Construction Period - 2 years	Plant Control/Treatment		$1,610	$1,387	$19,320
	EDRR Surveillance and Removal Animals				$1,160
	Electrofishing		$9,600	$19,200	$19,200
	Coordination/Inspection /Contract Implementation		$3,035	$7,003	$11,776

Invasive and Nuisance Species Management - Construction Phase					
Feature / Area	**Management Activity**	**Pre-Construction 2 Years**	**Pre-Construction 1 Year**	**Construction**	**Operational Testing & Monitoring Phase**
Divide Structure on L-4 *(Assuming Construction Period 1 year)*	EDRR Surveillance - Plants		$928	$1,856	$3,712
	Plant Control/Treatment		$288	$575	$1,150
	Coordination/Inspection /Contract Implementation		$304	$608	$1,216
WCA-3A	EDRR Surveillance - Plants		$25,520	$111,360	$55,680
	Plant Control/Treatment			$598,000	$299,000
	Electrofishing		$32,000	$64,000	$64,000
	Coordination/Inspection /Contract Implementation		$14,380	$193,340	$104,670
Miami Canal Backfill (13.5 miles - Table 5-1 PIR) *Construction Period - 4 years*	EDRR Surveillance - Plants		$2,784	$44,544	$22,272
	Plant Control/Treatment		$7,590	$22,770	$11,385
	EDRR Surveillance and Removal Animals				$28,000
	EDRR Surveillance and Removal Animals				$2,700
	Electrofishing		$21,600		
	Coordination/Inspection /Contract Implementation		$7,994	$16,829	$16,089
Increase Capacity of S-333 *Construction Period - 4 years*	EDRR Surveillance - Plants		$928	$7,424	$3,712
	Plant Control/Treatment		$575	$4,600	$2,300
	Coordination/Inspection /Contract Implementation		$376	$3,006	$1,503
L-67A -2 gated structures *Construction Period*	EDRR Surveillance - Plants		$928	$1,856	$3,712
	Plant Control/Treatment		$575	$1,150	$2,300

Invasive and Nuisance Species Management - Construction Phase					
Feature / Area	**Management Activity**	**Pre-Construction 2 Years**	**Pre-Construction 1 Year**	**Construction**	**Operational Testing & Monitoring Phase**
- 1/2 year					
	Coordination/Inspection /Contract Implementation		$376	$752	$1,503
L-67-A - Spoil Removal	EDRR Surveillance - Plants		$928	$1,856	$7,424
Construction Period - 1/2 year	Plant Control/Treatment		$920	$3,128	$25,024
	Coordination/Inspection /Contract Implementation		$462	$1,246	$8,112
L-67C Levee Degrade (6,000 feet)	EDRR Surveillance - Plants		$928	$3,712	$3,712
Construction Period - 2 years	Plant Control/Treatment		$1,012	$10,157	$10,157
	Coordination/Inspection /Contract Implementation		$485	$3,467	$3,467
Gated Structure N/Blue Shanty Levee	EDRR Surveillance - Plants		$928	$1,856	$3,712
Construction Period -1/2 year	Plant Control/Treatment		$575	$1,150	$2,300
	Coordination/Inspection /Contract Implementation		$376	$752	$1,503
L-67C Levee Degrade	EDRR Surveillance - Plants		$928	$3,712	$3,712
8 miles	Plant Control/Treatment		$5,382	$53,544	$53,544
Construction Period -2 years	Coordination/Inspection /Contract Implementation		$1,578	$14,314	$14,314
Construction of N/S Levee	EDRR Surveillance - Plants			$55,680	$27,840
	Plant Control/Treatment			$862,077	$646,558
	Coordination/Inspection			$275,327	$202,319

Invasive and Nuisance Species Management - Construction Phase					
Feature / Area	**Management Activity**	**Pre-Construction 2 Years**	**Pre-Construction 1 Year**	**Construction**	**Operational Testing & Monitoring Phase**
	/Contract Implementation				
L-67 Extension - Levee Degrade / Backfill *Construction Period -1 year*	EDRR Surveillance - Plants		$1,856	$7,424	$14,848
	Plant Control/Treatment		$3,105	$15,525	$31,050
	EDRR Surveillance and Removal Animals	$1,100	$1,100	$550	$2,200
	Coordination/Inspections/ Contract Implementation	$275	$1,051	$4,019	$8,313
L-29 Levee Degrade 4.3 miles *Construction Period - 1 year*	EDRR Surveillance - Plants		$1,856	$7,424	$14,848
	Plant Control/Treatment		$3,864	$14,490	$28,980
	EDRR Surveillance and Removal Animals	$860	$860	$430	$1,720
	Electrofishing		$32,000	$64,000	$64,000
	Coordination/Inspection /Contract Implementation	$387	$14,787	$28,994	$29,574
Divide Structure on L-29 *Construction Period -1 year*	EDRR Surveillance - Plants		$928	$1,856	$3,712
	Plant Control/Treatment		$575	$1,150	$2,300
	Coordination/Inspection /Contract Implementation		$376	$752	$1,503
Increase Capacity S-356 *Construction Period -3 years and 3 months*	EDRR Surveillance - Plants		$928	$6,496	$3,712
	Plant Control/Treatment		$575	$4,025	$2,300
	Coordination/Inspection /Contract Implementation		$376	$2,630	$1,503
Old Tamiami Trail	EDRR Surveillance -		$4,640	$27,840	$18,560

Invasive and Nuisance Species Management - Construction Phase					
Feature / Area	Management Activity	Pre-Construction 2 Years	Pre-Construction 1 Year	Construction	Operational Testing & Monitoring Phase
	Plants				
Construction Period -3 years	Plant Control/Treatment		$5,336	$23,920	$47,840
	EDRR Surveillance and Removal Animals	$1,200	$1,200	$1,800	$2,400
	Coordination/Inspection /Contract Implementation	$300	$2,794	$13,390	$17,200
G-211 Modifications	EDRR Surveillance - Plants		$928	$1,856	$3,712
Construction Period -1 year	Plant Control/Treatment		$575	$1,150	$2,300
	Coordination/Inspection /Contract Implementation		$376	$752	$1,503
Seepage Barrier	EDRR Surveillance - Plants		$928	$1,856	$3,712
Construction Period -1 year	Plant Control/Treatment		$575	$1,150	$2,300
	Coordination/Inspection /Contract Implementation		$376	$752	$1,503
Everglades National Park	EDRR Surveillance - Plants		$4,640	$55,680	$18,560
	Plant Control/Treatment			$30,139	$24,111
	Coordination/Inspection /Contract Implementation		$1,160	$21,455	$10,668
		$4,122	**$599,346**	**$3,343,796**	**$2,586,880**
Other Cost		$824	$119,869	$668,759	$517,375
	Management Activities Oversight Revise/Update INSMP Development of EDRR Framework Budget, Contract, Administrative Support Assessment of Species				
	Total	**$4,946**	**$719,216**	**$4,012,555**	**$3,104,255**

Invasive and Nuisance Species Management - Construction Phase					
Feature / Area	Management Activity	Pre-Construction 2 Years	Pre-Construction 1 Year	Construction	Operational Testing & Monitoring Phase
	Total Cost Estimate	$7,840,973			

TABLE G-6: INVASIVE AND NUISANCE SPECIES MANAGEMENT COSTS – OMRR&R PHASE

Invasive and Nuisance Species Management - OMRR&R Phase			
Feature / Area	**Management Activity**	**Year 1 OMRR&R**	**50-Year OMRR&R**
A-2 FEB	EDRR Surveillance - Plants	$18,560	$1,196,437
	Plant Control/Treatment - Floating/Emergent	$125,580	$8,095,286
	Plant Control/Treatment - Submersed	$14,375	$926,658
	EDRR Surveillance/Removal Animals	$58,325	$3,759,815
	Coordination/Inspections/Contract Implementation	$43,368	$2,795,639
L-5	EDRR Surveillance - Plants	$7,424	$478,575
	Plant Control/Treatment (14a)	$8,372	$539,686
	EDRR Surveillance/Removal Animals	$1,200	$77,356
	Electrofishing	$24,000	$1,547,116
	Coordination/Inspections/Contract Implementation	$8,199	$528,547
L-6	EDRR Surveillance - Plants	$7,424	$478,575
	Plant Control/Treatment	$9,568	$616,784
	Coordination/Inspections/Contract Implementation	$3,398	$219,072
L-4 Levee Degrade	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment (28a)	$9,660	$622,714
	EDRR Surveillance/Removal Animals	$290	$18,694
	Electrofishing	$9,600	$618,847
	Coordination/Inspections/Contract Implementation	$4,652	$299,909
Divide Structure on L-4	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$575	$37,066
	Coordination/Inspections/Contract Implementation	$857	$55,271
WCA-3A	EDRR Surveillance - Plants	$55,680	$3,589,310
	Plant Control/Treatment	$179,400	$11,564,695
	Electrofishing	$32,000	$2,062,822
	Coordination/Inspections/Contract Implementation	$53,416	$3,443,365
Miami Canal Backfill	EDRR Surveillance - Plants	$11,136	$717,862
	Plant Control/Treatment (165a)	$28,463	$1,834,783

Invasive and Nuisance Species Management - OMRR&R Phase			
Feature / Area	**Management Activity**	**Year 1 OMRR&R**	**50-Year OMRR&R**
	EDRR Surveillance/Removal Animals	$14,000	$902,485
	EDRR Surveillance/Removal Animals	$1,350	$87,025
	Electrofishing	$21,600	$1,392,405
	Coordination/Inspections/Contract Implementation	$15,310	$986,912
Increase S-333 Capacity	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$2,300	$148,265
	Coordination/Inspections/Contract Implementation	$1,202	$77,511
L-67A 2 gated structures	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$2,300	$148,265
	Coordination/Inspections/Contract Implementation	$1,202	$77,511
L-67A - Spoil Removal	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$12,512	$806,563
	Coordination/Inspections/Contract Implementation	$3,245	$209,170
L-67C Levee Degrade	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$10,157	$654,740
	Coordination/Inspections/Contract Implementation	$2,774	$178,805
Gated Structure N/Blue Shanty Levee	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$2,300	$148,265
	Coordination/Inspections/Contract Implementation	$1,202	$77,511
L-67C Levee Degrade	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment (97a)	$2,677	$172,581
	Coordination/Inspections/Contract Implementation	$1,278	$82,374
N/S Levee WCA-3B	EDRR Surveillance - Plants	$27,840	$1,794,655
	Plant Control/Treatment	$862,077	$55,572,214
	Coordination/Inspections/Contract Implementation	$177,983	$11,473,374

Invasive and Nuisance Species Management - OMRR&R Phase			
Feature / Area	**Management Activity**	**Year 1 OMRR&R**	**50-Year OMRR&R**
L-67 Extension Levee Degrade / Backfill	EDRR Surveillance - Plants	$7,424	$478,575
	Plant Control/Treatment	$31,050	$2,001,582
	EDRR Surveillance/Removal Animals	$550	$35,455
	Coordination/Inspections/Contract Implementation	$7,805	$503,122
L-29 Levee	EDRR Surveillance - Plants	$7,424	$478,575
	Plant Control/Treatment	$19,320	$1,245,429
	Plant Control/Treatment - Submersed	$8,625	$555,995
	EDRR Surveillance/Removal Animals	$430	$27,719
	Electrofishing	$32,000	$2,062,822
	Coordination/Inspections/Contract Implementation	$13,560	$874,108
L-29 Divide Structure	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$1,150	$74,133
	Coordination/Inspections/Contract implementation	$972	$62,684
Increase Capacity S-356	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$1,150	$74,133
	Coordination/Inspections/Contract Implementation	$972	$62,684
Old Tamiami Trail	EDRR Surveillance - Plants	$9,280	$598,218
	Plant Control/Treatment	$47,840	$3,083,919
	EDRR Surveillance/Removal Animals	$1,200	$77,356
	Coordination/Inspections/Contract Implementation	$11,664	$751,899
G-211 Modifications	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$1,150	$74,133
	Coordination/Inspections/Contract Implementation	$972	$62,684
Seepage Barrier	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$1,150	$74,133
	Coordination/Inspections/Contract Implementation	$972	$62,684

Invasive and Nuisance Species Management - OMRR&R Phase			
Feature / Area	**Management Activity**	**Year 1 OMRR&R**	**50-Year OMRR&R**
Everglades National Park	EDRR Surveillance - Plants	$18,560	$1,196,436
	Plant Control/Treatment	$24,111	$1,554,295
	Coordination/Inspections/Contract Implementation	$8,534	$550,146
		$2,181,243	$140,609,877
Other Costs			
	Oversight of Management Activities Revise/Update INSMP Budget, Contract, Administrative support Assessment of Species Coordination with other agencies/EDRR response		
	Total Other Cost	$872,497	$49,213,457
	Total Cost Estimate	**$3,053,740**	**$190,695,832**

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ANNEX H

HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

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H.1 A-2 Flow Equalization Basin Lands Hazardous, Toxic and Radioactive Waste Audits

PHASE II
ENVIRONMENTAL SITE ASSESSMENT

For the

A-2 FLOW EQUALIZATION BASIN
PALM BEACH COUNTY, FLORIDA

Prepared for

SOUTH FLORIDA
WATER MANAGEMENT DISTRICT
ENVIRONMENTAL SCIENCE UNIT
MAINTENANCE MANAGEMENT SECTION
3301 GUN CLUB ROAD
WEST PALM BEACH, FLORIDA 33406

Prepared by

Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634
Telephone (813) 886-1075

PSI PROJECT NO. 05521114

March 25, 2013

Information To Build On
Engineering • Consulting • Testing

March 25, 2013

South Florida Water Management District
Environmental Science Unit
Maintenance Management Section
3301 Gun Club Road
West Palm Beach, Florida 33406

Attn: Mr. Robert Kukleski

Re: Phase II Environmental Site Assessment Report
A-2 Flow Equalization Basin
Palm Beach County, Florida
PSI Project No.: 05521114
SFWMD Work Order #8

Dear Mr. Kukleski:

In accordance with our agreement, Professional Service Industries, Inc. (PSI) has performed a Phase II Environmental Site Assessment for the above referenced project. The Phase II ESA Report is attached.

Thank you for choosing PSI as your consultant for this project. If you have any questions, or if we can be of additional service, please call us at (813) 886-1075.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Stephen P. Long, P.E. P.G.
Chief Engineer

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Information To Build On
Engineering • Consulting • Testing

PHASE II
ENVIRONMENTAL SITE ASSESSMENT

For the

A-2 FLOW EQUALIZATION BASIN
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Professional Service Industries, Inc.
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Telephone (813) 886-1075

PSI PROJECT NO. 05521114

March 25, 2013

Andrew Cadle
Project Scientist

Steve Long
Chief Engineer

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1. INTRODUCTION

1.1 PROPERTY/PROJECT DESCRIPTION

The proposed A-2 Flow Equalization Basin (FEB) project encompasses approximately 14,408 acres of agricultural land located between US Highway 27 and the Miami Canal, in southern Palm Beach County. A USGS Topographic Map and Site Vicinity Map showing the property boundaries are provided on **Figures 1 and 2**.

The property has been cultivated in sugar cane since the early 1960's. PSI has previously completed a draft Summary Environmental Report for the A-2 FEB, dated September 17, 2012. The report describes the due diligence assessment that was performed by the District when the property was acquired, as well as further assessment and remediation efforts that were performed by PSI, on behalf of Talisman Sugar Corporation. The Summary Environmental Report documents that all known point sources on the property have been addressed and the Florida Department of Environmental Protection (FDEP) has issued Site Rehabilitation Completion Orders (SRCOs) for all known point sources within the project boundary. However, no broad cultivated area sampling was performed on the property at the time the pre-acquisition assessment was completed. Therefore, sampling of the cultivated areas was requested by the United States Fish and Wildlife Service (USFWS) and FDEP.

1.2 AUTHORIZATION

This Phase II ESA was performed in substantive compliance with Work Order #8 under SFWMD Contract No. 4600002399.

1.3 SCOPE OF WORK

The scope of work for this Phase II ESA has been divided into three tasks, as follows:

Task 1 Phase II ESA Field and Laboratory Services
Task 2 SLERA and Geostatistical Analysis
Task 3 Report Preparation

A general description of the services included in these tasks is described below. A more detailed description is provided in Section 3.1 of this report.

<u>Task 1 Soil Sampling</u>

PSI collected soil samples in general accordance with the current *Protocol for Assessment, Remediation and Post-Remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects*. The sampling procedures for composite sampling for large properties of greater than 1,000 acres was utilized, which required the collection of 50-acre composite samples from a representative fraction of the property. Based upon agreement with SFWMD and USFWS, PSI collected samples from 10% of the property during the initial assessment.

All composite soil samples were analyzed for organochlorine pesticides by EPA method 8081, chlorinated herbicides by EPA method 8321, organophosphorus pesticides by EPA method 8270, total organic carbon (TOC), and RCRA 8 metals plus copper by EPA method 6010/7471.

Task 2 SLERA and Geostatistical Analysis

PSI contracted with Formation Environmental to conduct a geostatistical analysis of the data and to prepare a Screening Level Ecological Risk Assessment (SLERA).

Once the composite soil sampling data was received, Formation performed standard statistical evaluation of the data to evaluate distribution, standard deviation, probability plots, and general statistical parameters.

The soil results were initially compared to human health cleanup target levels (e.g., SCTLs and GCTLs) and ecological screening values (e.g., SQAGs). Formation conducted a screening level ecological risk assessment (SLERA) on any constituents of potential ecological concern (COPECs) within the agricultural areas that exceeded the ecological screening levels. The SLERA was performed to determine whether the contaminant concentrations present a significant ecological concern. The SLERA consisted of the following tasks:

- A statistical evaluation of the sample results was prepared in order to calculate a mean and 95% upper confidence limit (UCL) estimate of the mean.
- 95% UCL values and maximum detected values of each COPEC were input into the USFWS/SFWMD Ecological Food Web Model (aka/ Goodrich model). Hazard quotients were calculated for each COPEC.
- Alternate cleanup target levels were proposed for any COPEC with a hazard quotient above one.
- The SLERA assumed worst-case conditions (i.e., that the property shall be flooded for significant portions of the year).
- The SLERA did not include any biological testing, bioaccumulation testing, desorption testing or other laboratory studies.

Task 3 Report Preparation

Task 3 included the preparation of this written report. The primary objective for the written report is to describe the methodology and results of the Phase II ESA investigation. The report does not include significant discussion of point sources within the project footprint. These point source areas were all discussed in detail in the draft Summary Environmental Report, dated September 17, 2012. All of the point sources have been granted closure by the FDEP.

2. PROPERTY DESCRIPTION AND PHYSICAL SETTING

2.1 PROPERTY DESCRIPTION

The A-2 FEB project lands consist of eight separate parcels. The tract numbers, prior ownership, and acreage are shown in the table below.

A-2 FEB		
Tract No.	Former Owner	Acreage
D7100-044	TALISMAN SUGAR CORPORATION	2
D7100-047	TALISMAN SUGAR CORPORATION	10
D7100-066	TALISMAN SUGAR CORPORATION	12
D7100-067	TALISMAN SUGAR CORPORATION	1
D7100-104	TALISMAN SUGAR CORPORATION	14,371.53**
D7100-139	TALISMAN SUGAR CORPORATION	1
D7100-141	WEINLEIN, JOAN	10
D7200-005	TALISMAN SUGAR CORPORATION	1
A-2 Total		**14,408.53**

** Note: Acreages shown include only the portion of the tract that is within the proposed limits of construction for the A-2 FEB project. The total acreage of Tract D7100-104 is 20,525 acres, and includes lands outside the current project footprint.

Most of the project area has been historically cultivated in sugar cane, with occasional rotational crops of rice or corn. The property is being leased to New Hope Sugar Corporation for sugar cane cultivation. There are no significant remaining structures on the property with the exception of a few pump stations, and all of the point sources on the property have been addressed and SRCOs have been issued by FDEP for all. A Site Plan is provided as **Figure 2**.

The primary parcel (Tract D7100-104) was acquired from Talisman Sugar Company in 1999 by the District. Several of the smaller parcels listed above were also owned and operated by Talisman Sugar Corporation, but these parcels were deferred from transfer during the original transaction until environmental concerns on these small areas could be addressed. The Weinlan parcel (Tract D7100-141) was leased to Talisman Sugar at the time of the 1999 acquisition and was evaluated with the remainder of Tract D7100-104.

Since the acquisition, the lands have been cultivated in sugar cane, with rotational crops of rice, beans, or corn. At the time of PSI's Phase II ESA, most of the sugar cane had been recently harvested from the fields, and replanting had been conducted. While agrochemical application may occur at any time during the life cycle of sugar cane, the agrochemical application schedule during replanting and early development is most intensive. Agrochemicals were being actively applied in some areas of the property during the Phase II ESA, and PSI was instructed to refrain from sampling in fields that were marked with placards indicating application within the last two weeks.

The proposed project will consist of the construction of a Flow Equalization Basin (FEB) for water quality pre-treatment and storage. However, the project design is not yet complete and PSI was not provided with design details indicating the exact limits of the FEB or the expected depth to water or hydroperiod for the FEB. For the purposes of this document, PSI has assumed worst-case conditions that the entirety of the property will be inundated for at least a significant portion of each year.

2.2 Physical Setting

2.2.1 Regional Geology

The region is overlain by layers of Peat known locally as "muck". Muck is an organically rich soil that forms when the rate of accumulation of organic matter exceeds the rate of decay. The accumulation rate can vary, but can be as much as 10 centimeters per 100 years. Much of the muck has been subjected to subaerial exposure since the dewatering of large areas of marshland through water drainage canals. This exposure has had the effect of causing the muck volume to steadily decrease through biochemical oxidation, compaction, erosion, and fire. It is estimated that the muck soil in these dewatered areas diminishes by as much as 1 inch per year.

Underlying the muck is the Fort Thompson Formation, which is locally referred to as the "cap rock" and is primarily dense, fossiliferous limestone. The Fort Thompson Formation is considered to be Pleistocene in age.

The Caloosahatchee Formation underlies the Fort Thompson Formation. The Caloosahatchee Formation is a marl that is composed of a sequence of sandy limestone lenses that are interbedded with layers of calcareous clays and sands. The Caloosahatchee Formation appears to straddle the Pliocene/Pleistocene boundary.

Underlying the Caloosahatchee Formation, the Tamiami Formation is a complex Pliocene age unit of sand, clay, and reef facies, all of which contain at least small amounts of phosphate. The Tamiami Formation occurs over much of southern Florida and is unconformably overlain by the Caloosahatchee and Fort Thompson Formations, which consist of highly fossiliferous carbonates and siliclastic sediments.

Underlying the Tamiami Formation is the Miocene-age Hawthorn Group, which is composed of a variety of sediments including carbonates, quartz sands, clay, and phosphate. The Hawthorn Group has been subdivided into two formations; the Peace River Formation forming the upper Hawthorn siliclastic section and the Arcadia Formation, which forms the lower Hawthorn carbonate section.

The Hawthorn Group is underlain by a 3000-feet thick carbonate sequence consisting of Oligocene and Eocene aged sediments. The Suwannee Limestone, the Ocala Limestone, and the Avon Park Formation comprise the Oligocene sediments. The Eocene sediments are made up of the Oldsmar Formation.

2.2.2 *Regional Hydrogeology*

The underlying hydrogeologic formations of the area may best be categorized as two aquifers separated by an impermeable confining zone.

The shallow, non-artesian aquifer system extends to a depth of approximately 150 feet BLS and is recognized as the northernmost extension of the Biscayne Aquifer. It consists primarily of the Fort Thompson, Caloosahatchee, and Tamiami Formations. The base of the shallow aquifer is marked by the top of the Hawthorn Group, which is the intermediate confining unit for the underlying Floridan aquifer.

The deep, artesian aquifer is known as the Floridan Aquifer and is the most productive aquifer in the area, with permeable zones as deep as 1,200 feet BLS. The Floridan Aquifer consists of the lower units of the Hawthorn Group, the Suwannee Limestone, the Ocala Group, and the Avon Park Limestone.

Groundwater levels throughout the area vary from one to six feet BLS. Groundwater flow in the surficial aquifer is generally to the south-southeast; however, flow direction is strongly influenced by the system of canals and pumping stations present throughout the area. When the canals are pumped and water levels in the canals are lowered, shallow groundwater tends to flow toward the canals.

3. PHASE II ESA METHODOLOGY

The intent of the Phase II ESA was to conduct sampling and laboratory analysis of representative soil samples from the cultivated areas of the subject property. No point source samples were collected as part of this assessment. PSI understands that data from this Phase II ESA will be used by SFWMD and USACE to evaluate whether residual agrochemicals are present in the surficial soils at concentrations that might pose potential human health and/or ecological risks associated with the use of these soils in the construction of the proposed A-2 Flow Equalization Basin.

3.1 SOIL SAMPLING METHODOLOGY

Field investigation and sampling activities were directed by Mr. Drew Cadle and Mr. Ryan Fetter of PSI during the days of January 22 through 25, 2013. The assessment was performed in general accordance with the authorized scope of work. All field sampling activities was performed in accordance with the FDEP Standard Operating Procedures for Field Investigation Activities (DEP-SOP 001/01).

Additionally, the U.S. Fish and Wildlife (FWS) has established a protocol for evaluation and sampling of historical agricultural properties in South Florida, titled *Protocol for Assessment, Remediation, and Post-Remediation Monitoring for Environmental Contamination on Everglades Restoration Projects (AKA/the ERA Protocol)*, which is an attachment to the Draft Memorandum of Agreement between United States Fish and Wildlife Service (USFWS or the Service) and SFWMD, dated March 13, 2008. PSI typically performs due diligence investigations on behalf of the District in strict accordance with the ERA Protocol. However, a less stringent investigation was agreed upon by SFWMD, FDEP, and USFWS in order to provide a general indication of large scale concerns on the property. The following requirements under the ERA Protocol were not met by this investigation:

- For very large properties (>1,000 acres), the ERA Protocol recommends dividing the property into 50 acre grids and collecting composite samples from a percentage of the grids. The percentage is not defined, but is to be agreed upon by SFWMD, USFWS, and FDEP, and has typically ranged from 25% to 50%. In this case, PSI sampled 10% of the grids. Based on previous experience with sugar cane cultivated areas with no history of row crops, we expected the chemical concentrations to be relatively uniform.

- For sites where composite samples are collected, the ERA Protocol requires analysis of discrete aliquots on a limited number of "clean grids", as part of a false negative analysis. This false negative sampling was not performed as part of this investigation.

- For sites where composite samples are collected, the ERA Protocol requires analysis of discrete aliquots within sampling grids where composite results indicate exceedances of the risk thresholds, in order to delineate the extent of impacted soil. This discrete sampling effort was not performed, therefore the entirety of any grids with exceeding results were assumed to be impacted.

The property was divided initially divided into 30 super-grids, each encompassing approximately 500 acres. Each super-grid was further subdivided into ten 50-acre grids. One grid was selected at random from each super-grid for sampling (i.e., 10%). In a few cases, the randomly selected grids were moved to another location within the super-grid due to remaining mature sugar cane or very recent agrochemical application within the selected grid. A composite sample was collected representing each selected 50-acre grid for laboratory analysis as described below:

- The samples were collected from the surficial soils at a depth of 0-6 inches. Samples were collected using a stainless steel hand auger and were composited in the field.
- In order to collect the composite samples, PSI further divided each 50-acre grid into ten, 5-acre sub-grids. PSI collected a close-proximity soil sample from approximately the center of each 5-acre sub-grid cell. Within each sub-grid cell, PSI collected a 5-point close-proximity composite sample by collecting equal aliquots from the center of the sub-grid cell, and five feet away in all four cardinal directions. The aliquots were homogenized in a stainless steel bowl using a stainless steel spatula or spoon. A 4-ounce aliquot of each sub sample was placed into a larger mixing bowl which was utilized to collect the composite samples. Once all ten subsamples were collected in the mixing bowl, the sample was further homogenized and a composite sample representing the entire 50-acre grid was collected in a 4 ounce glass laboratory container. The composite samples were labeled as Comp-1 through Comp-30. The soil sampling locations were recorded on a global positioning system (GPS) receiver with an accuracy of +/- 1 meter. The soil sampling locations are shown on **Figure 3**.
- The collected samples were placed in an iced cooler and shipped to the primary or secondary laboratory (splits) for laboratory analysis under chain of custody protocols. The soil samples were analyzed for organochlorine pesticides by EPA method 8081, chlorinated herbicides by EPA method 8321, organophosphorus pesticides by EPA method 8270, total organic carbon (TOC), and RCRA 8 metals plus copper and selenium by EPA method 6010/7471. The samples were immediately placed on ice and submitted to the analytical laboratory under chain of custody procedures.
- Duplicate and split soil samples and equipment blanks were collected for quality assurance purposes.
    - Duplicate samples were collected at a frequency of 10% of the collected samples by collecting an aliquot from the same mixing bowl as the primary sample. The duplicate samples were collected and analyzed using the

same procedures and methods as the primary sample, and were analyzed by the same laboratory.

- Split samples were collected at a frequency of 10% of the collected samples by collecting an aliquot from the same mixing bowl as the primary sample. The split samples were collected using the same methods as the primary samples, but the split samples were submitted to a different, secondary laboratory for analysis.

- One pre-cleaned equipment blank was collected prior to the initial sample collection event to evaluate the efficacy of the decontamination cleaning procedures used in PSI's office to pre-clean the equipment prior to mobilization. Field cleaned equipment blanks were also collected at a rate of one blank per sampling team per day during the sampling. The pre-cleaned and field cleaned equipment blanks were collected by running analyte free water over the decontaminated sampling equipment and then collecting the water in laboratory provided containers. The equipment blanks were analyzed for the same analytes as the soil samples.

4. PHASE II ESA RESULTS

4.1 REGULATORY GUIDANCE CONCENTRATIONS

Analyte concentrations in all media were compared to applicable or relevant and appropriate requirements, depending upon current and future proposed usage of each tract. These criteria are summarized below.

4.1.1 SOIL

The following human-health based criteria are established by the FDEP in Chapter 62-777 of the Florida Administrative Code (FAC 62-777), for both direct exposure and leachability.

- ***Residential*** – The Soil Cleanup Target Level for direct exposure in a residential setting (SCTL-RDE) is the default standard for site screening purposes in Florida, and assumes potential contact with soils on a regular basis by adults and children.
- ***Industrial*** – The Soil Cleanup Target Level for direct exposure in a non-residential setting (SCTL-IDE) assumes extended contact with soils on a daily basis by adult workers at commercial/industrial sites, or on agricultural properties where farming practices result in frequent site contact. Use of this standard requires that a deed restriction be recorded against the property.
- ***Leaching to Groundwater*** – The Soil Cleanup Target Level for leaching to groundwater (SCTL-LGW) also represents a default standard for site screening purposes in Florida, and is based on soil concentrations which are considered likely to result in an exceedance of the groundwater quality standard for a particular chemical.
- ***Leaching to Surface Water*** – The Soil Cleanup Target Level for leaching to surface water (SCTL-LSW) is applicable where impacted soils may be in contact with a surface water body. These criteria were deemed appropriate for comparison because the entirety of the subject property may become inundated at the time of project construction. However, it should be noted that the SCTL-LSW criteria were developed based on soil proximity to Class III fresh water bodies. In this case, the FEB would not likely be considered as a Class III water body. While the SCTL-LSW are not directly applicable, they were used for comparison screening purposes.

4.1.2 SEDIMENT

The FDEP has previously indicated that soils within proposed wetland or water storage areas should be regulated as sediments, as these soils will ultimately become inundated. For sediments, the Sediment Quality Assessment Guidelines (SQAGs) as defined in *Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4*, (MacDonald, 2000) have generally been applied for screening purposes. The SQAGs are not a human health-based criteria, but are instead relevant only to the evaluation of ecological risk. The referenced guideline outlines two potential standards which were developed specifically with respect to benthic macroinvertebrate species, which represent the bottom of the food chain, as follows:

- ***No Observed Adverse Effects Level*** – The threshold effects concentration (SQAG-TEC) is the more conservative value and is utilized as a screening tool in evaluating sediments. Contaminant concentrations below the SQAG-TEC generally do not warrant further investigation.
- ***Lowest Observed Adverse Effects Level*** – The probable effects concentration (SQAG-PEC) represents the level above which adverse effects are likely to occur. It should also be noted here that SFWMD and FWS have agreed to an Interim Effects Concentration for copper only, which replaces the SQAG-PEC for copper recommended in MacDonald 2000.

However, it should be noted that SQAGs may not be established for all analytes of interest. FWS protocols for ecological risk assessment (FWS, March 2004) recommend consideration of Ecological Screening Values (ESV) established by EPA Region IV in *Ecological Screening Values or Surface Water, Sediment, and Soil* (WSRC, November 1998) when Florida SQAGs are not available.

In the case of copper, the USFWS utilizes an interim screening value (ISV) of 85 mg/kg, for protection of the endangered Everglades Snail Kite. Measured copper concentrations are compared with both the ISV and the SQAGs.

No SQAGs have been established for selenium. However, an ecological screening criterion of 4.2 mg/kg was negotiated with USFWS for organic soils on the C9/C11 project, and it appears that a similar level would be appropriate on the A-2 FEB project.

4.1.3 Applicable Criteria

All of the above criteria will be considered in evaluating the analytical results obtained during the soil sampling activities described herein. Since some portions of the site may not become inundated, it is appropriate to compare analyte concentrations in the soil to the human health-based SCTLs established in Chapter 62-777, FAC. Therefore, soil data were compared to both the SCTLs for residential direct exposure (SCTL-RDE) and to the SCTLs for leaching to groundwater (SCTL-LGW) and leaching to surface water (SCTL–LSW).

It is likely that most of the site will be inundated; at least for a portion of each year, and that important ecological receptors will utilize the property. Therefore, it is also necessary to compare the site data to the SQAGs. For most analytes of interest (arsenic being the notable exception), the SQAG-TEC criteria are more stringent than the SCTL-RDE criteria. Therefore, in most cases, a cleanup to SQAG-TEC criteria is also protective of human health. It should also be noted that the SQAGs are not standards or deterministic values (i.e., an exceedance does not indicate absolutely that adverse effects will occur); the SQAGs are merely screening values. Data exceeding the SQAG values generally indicate the need for further study. Conversely, chemical concentrations which do not exceed the SQAGs are generally screened out from any further consideration with respect to ecological risk.

Since the soils will also need to be handled by construction workers during project construction and may be relocated off-site or placed in areas of the proposed project that are not inundated and which are accessible to the public, the soil data was also compared to both the SCTLs for residential direct exposure (SCTL-RDE) and to the SCTLs for leaching to groundwater (SCTL-LGW) and leaching to surface water (SCTL–LSW).

4.2 SAMPLING RESULTS

Laboratory analytical results for the soil samples are summarized on **Table 1**. Laboratory reports are provided in **Appendix B**. These results have been evaluated by comparison with the appropriate human-health based SCTLs established in Chapter 62-777, FAC and the ecologically-based SQAG criteria recommendations for sediments.

Organics Results

- 2-4' D (2-4-Dichlorophenoxyacetic acid) was detected in one composite sample at a concentration of 940 µg/kg, which exceeds the SCTL-LGW criterion of 700 ug/kg and the SCTL-LSW criterion of 900 µg/kg. Another sample was detected at a concentration of 860 µg/kg, which exceeds only the SCTL-LGW criterion. Both concentrations were below the SCTL-RDE criteria and SQAG criteria have not been established. The analyte was detected in three other samples above the laboratory method detection limit (MDL) but below all applicable regulatory criteria. The remaining samples were all below the laboratory MDL.
- Metribuzin was detected in two composite samples at concentrations of 1,700 µg/kg and 1,100 µg/kg, which exceed the SCTL-LSW criteria of 800 µg/kg, but are below all other SCTL criteria. SQAG criteria have not been established for this analyte. The analyte was detected in ten other samples above the laboratory MDL but below all applicable regulatory criteria. The remaining samples were all below the laboratory MDL.
- Phorate was detected in two composite samples at concentrations of 120 µg/kg and 93 µg/kg, which exceed the SCTL-LSW criterion of 1 µg/kg, but are below all other SCTL criteria. SQAG criteria have not been established for this analyte. The analyte was detected in one other sample above the laboratory MDL but below all applicable regulatory criteria. The remaining samples were all below the laboratory MDL.
- Atrazine was detected in 16 composite samples (including 2 split samples and 1 duplicate sample) at concentrations exceeding the SQAG-TEC criterion of 0.30 µg/kg (no SQAG-PEC criterion has been established). The atrazine concentrations in the 16 samples ranged from 27 µg/kg to 3,500 µg/kg. Twelve of the sixteen samples were also detected at concentrations exceeding the SCTL-LSW and SCTL-LGW criteria of 40 µg/kg and 60 µg/kg, respectively. Atrazine was detected in another sample at a concentration of 55 µg/kg which exceeds the SCTL-LSW criteria of 40 µg/kg, but is below all other SCTL criteria. None of the detected atrazine concentrations exceed the SCTL-RDE.

- Dieldrin was detected in four samples at concentrations exceeding the SQAG-TEC criterion of 1.9 µg/kg, but below the SQAG-PEC criteria of 62 µg/kg. The dieldrin concentrations were also above the SCTL-LGW and SCTL-LSW criteria of 2 µg/kg and 0.1 µg/kg, respectively. The concentrations in the four samples ranged from 2.7 µg/kg to 5.1 µg/kg. Dieldrin was not detected in any of the other samples above the laboratory MDL.
- Due to the detection of multiple samples containing atrazine and dieldrin at concentrations significantly exceeding the SCTL-LGW and/or SCTL-LSW, PSI subsequently conducted Synthetic Precipitation Leaching Procedure (SPLP) in order to evaluate the potential for leaching of atrazine and dieldrin from the soils into surface water or groundwater. The SPLP test is intended to simulate the leaching of contaminants from soil into groundwater or surface water under typical acid rainfall conditions. PSI analyzed two soil samples containing the highest atrazine concentrations (Comp-8 and Comp-15) by the SPLP for atrazine and two samples containing the highest dieldrin concentrations (Comp-10 and Comp-15) by the SPLP for OCPs. The SPLP test is conducted by adding an acidic solution to the soil sample and mixing the slurry for an extended period of time, before re-extracting the liquid for analyses. The SPLP extract is subsequently analyzed for the constituents of concern (e.g., OCPs or OPPs) and the results are compared to the surface water and/or groundwater cleanup target levels in Chapters 62-302, FAC and 62-777, FAC, respectively.
  - Atrazine was detected in the SPLP extract at concentrations exceeding the Chapter 62-777, FAC Groundwater Cleanup Target Level (GCTL) and Chapter 62-302, FAC Surface water Cleanup Target Level (SwCTL) in both samples (Comp-8 and Comp-15).
  - Dieldrin was not detected in either sample above the laboratory MDL, which was below the GCTL. However, the laboratory MDL for Dieldrin is 0.0011 µg/L which is above the SwCTL criteria of 0.00014 µg/L.

Metals Results

- Arsenic was detected in all of the composite samples at concentrations exceeding the SCTL-RDE criterion of 2.1 mg/kg, but below all SQAG-TEC criterion of 9.8 mg/kg. The measured arsenic concentrations ranged from 3.1 mg/kg to 6.8 mg/kg. The highest arsenic concentration (6.8 mg/kg) was detected in sample Comp-1.
- Barium was detected in of the composite samples at concentrations exceeding the SQAG-PEC criterion of 60 mg/kg. The measured barium concentrations ranged from 69 mg/kg to 118 mg/kg. The highest barium concentration (118 mg/kg) was detected in sample Comp-11 Split (the barium concentration in the parent sample was 98 mg/kg). All of the barium concentrations are below the SCTL criteria.
- Chromium was detected in all of the samples at concentrations exceeding the SCTL-LSW criterion of 4.2 mg/kg, but below all other applicable criteria. The measured chromium concentrations ranged from 5.6 mg/kg to 29 mg/kg.

- Copper was identified in all of the composite soil samples collected from the property. Copper concentrations in seven of the composite samples exceeded the USFWS Interim Screening Level (ISL) for protection of the Everglades Snail Kite (85 mg/kg). The measured copper concentrations in the samples ranged from 53 mg/kg to 110 mg/kg. The measured copper concentrations in all of the samples exceeded the SQAG-TEC of 32 mg/kg. None of the copper concentrations exceeded the SQAG-PEC or SCTL-RDE criteria of 150 mg/kg. The extent of copper impacted soils exceeding the USFWS ISL is shown on **Figure 4**.
- Cadmium and lead were identified in one or more of the composite soil samples collected on the property but at concentrations which are below the applicable SCTLs and SQAG-TEC criteria.
- Mercury was detected in all of the samples at concentrations exceeding the SCTL-LSW criterion of 0.01 mg/kg, but below all other regulatory criteria. Mercury concentrations ranged from 0.077 mg/kg to 0.14 mg/kg. The measured concentrations in the samples appear to be consistent with regional background conditions from atmospheric deposition.
- Selenium was detected in 27 of the 36 composite samples (including duplicate and split samples) at concentrations exceeding the SCTL-LSW criteria of 0.05 mg/kg. The measured selenium concentrations in the samples ranged from 1.5 mg/kg to 3.7 mg/kg. Selenium concentrations were below the laboratory MDL in all of the other samples; however the laboratory MDLs ranged from 0.47 mg/kg to 0.66 mg/kg which are above the SCTL-LSW criteria, in all cases except one (one sample had an MDL of 0.47 mg/kg the other eight samples had MDLs above the SCTL-LSW criteria of 0.5 mg/kg). No SQAGs have been established for selenium. An action level of 4.2 mg/kg was negotiated with USFWS for organic soils on the C9/C11 project, and it appears that a similar action level would be appropriate on the A-2 FEB. None of the detected selenium concentrations exceeded 4.2 mg/kg.
- Silver was detected in all three split samples at concentrations exceeding the SCTL-LSW criteria of 0.01 mg/kg. The measured silver concentrations in the three split samples were 0.61 mg/kg, 0.61 mg/kg, and 0.64 mg/kg. The silver concentrations in all of the original samples were below the laboratory MDL. Silver was below the laboratory MDL in all of the other samples; however the laboratory MDLs ranged from 0.26 mg/kg to 0.42 mg/kg which are above the SCTL-LSW criteria.
- Total organic carbon measurements ranged from 198,000 mg/kg to 503,000 mg/kg in the samples analyzed by the primary and secondary laboratories.

4.3 DATA VALIDATION

Validation of the laboratory data was performed using the FDEP ADaPT program to ensure that all required quality control targets were met. ADaPT data validation forms are provided with the laboratory reports in **Appendix A**. The data generally met the quality control requirements for both field and laboratory activities. Some of the data were qualified as noted in the laboratory report and in the summary tables, but none of the data were rejected due to quality control concerns.

- Comparison of the data for original and duplicate samples analyzed by the primary laboratory indicated good precision in measurement by the primary laboratory.
- Comparison of the data between the primary and secondary laboratory indicated good correlation between the laboratory results for the original and split samples.
- No target analytes were detected in the equipment blanks, indicating that laboratory and field decontamination procedures were effective.
- No target analytes were detected in the laboratory method blanks.
- A number of the primary samples had to be diluted for analysis of 4,4-DDT due to unknown matrix interference. The laboratory method detection limits for DDT ranged from about 0.9 ug/kg to 11 ug/kg, and exceeded the SQAG-TEC of 4.2 ug/kg, but were still below all regulatory criteria.
- The laboratory method detection limits for a number of chemicals exceeded the SCTL-LSW criteria. However, a review of the *FDEP Guidance for the Selection of Analytical Methods and for the Evaluation of Practical Quantitation Limits* indicates that the laboratory method detection limits are below the practical quantitation limits recommended in the FDEP guidance and generally represent the best commercially available detection limits for the methods.
- The laboratory method detection limits for dieldrin in the SPLP analysis leachate exceeds the FDEP Chapter 62-302, FAC surface water standard. However, the laboratory method detection limit is lower than the recommended practical quantitation limit in the FDEP guidance referenced above.

4.4 GEOSTATISTICAL EVALUATION

Since the density of sampling within the cultivated areas of the A-2 FEB was lower (10%) than composite sampling typically conducted under the ERA Protocol, the copper data was further evaluated to determine if it was adequate to make risk management decisions for the site.

As previously discussed, copper concentrations in the 30 composite soil samples ranged from 53 to 110 mg/kg, with an average concentration equal to 77.2 + 13.3 mg/kg and the 95% UCL copper concentration was equal to 83.1 mg/kg. In order to have confidence in the calculated 95% UCL, a sufficient number of samples must be collected to meet Type I and Type II error rate requirements for decision making. Type I error (alpha) is the probability of incorrectly predicting that the average copper concentrations on the site are less than the snail kite benchmark when they are actually higher than the benchmark. In the case of a 95% UCL, the Type I error rate is set at 5%. Type II error (beta) is the probability of predicting that the average copper concentrations are greater than the snail kite benchmark when they are actually less. .

The sample size calculations provided in USEPAs ProUCL tool (ProUCL v 4.1, 2012) use established USPEA guidance for sample size calculations to provide a minimum number of samples necessary to meet Type I and Type II error rates at a given standard deviation and tolerable error margin (delta). The delta value provides a 'grey area' which represents a margin of error attributable to laboratory precision, laboratory reporting accuracy, sampling error, etc.

The ProUCL calculator was used in this case by setting the alpha equal to 0.05 and the beta equal to 0.1. The standard deviation of the copper concentrations in soil was equal to 13.3 mg/kg and the data were normally distributed allowing for the use of parametric statistics. The delta was set equal to 8.5 mg/kg or 10% of the 85 mg/kg benchmark. Using those parameters, the ProUCL calculator indicates that a minimum of 23 samples are required to meet the minimum requirements of a 95% UCL estimate of the mean with a 10% Type II error rate using the data collected at the A-2 FEB. This indicates that an adequate number of samples were collected to calculate a reliable estimate of the 95% UCL of the soil copper concentration.

5. SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

5.1 SLERA METHODOLOGY

PSI contracted with Formation Environmental, LLC to prepare a screening level ecological risk assessment (SLERA) for the subject property. The SLERA is provided in **Appendix B**. The purpose of the SLERA was to evaluate potential risks to benthic invertebrates and higher trophic species, particularly aquatic wading birds, associated with exposure to the site soils, assuming that a water quality project is implemented and the land is inundated. The SLERA was conducted in accordance with the SFWMD-USFWS-FDEP ERA Protocol.

Once flooded, aquatic organisms such as benthic invertebrates may inhabit the site and could be exposed to residual chemicals. Flooding changes the potential for ecological exposure because many contaminants are more mobile and bioavailable in aqueous environments, and may bio-accumulate more readily in aquatic systems than in terrestrial systems. For the purposes of this analysis, the receptors of greatest concern are aquatic-feeding wildlife, especially Federal or State Trust resources that could be attracted to the newly flooded parcels if an aquatic prey base becomes established. Bioaccumulation of residual chemicals in aquatic prey species could lead to toxic exposure of Trust resources feeding at newly formed aquatic environments. Also considered is the potential for effects to benthic invertebrate communities that could lead to loss of ecosystem function within the newly created aquatic system.

To evaluate potential effects to benthic invertebrates, soil data were compared to the SQAG-TEC and SQAG-PEC values. Risk to aquatic-feeding wildlife was evaluated by estimating the potential exposure of avian receptors to chemicals through the ingestion of aquatic prey species that might accumulate chemicals from soils after they have been flooded. Exposure and risks were calculated for aquatic-feeding wildlife using a model developed for the District specifically for the purposes of this program (Goodrich 2002 and NewFields 2006). The model provides conservative (i.e., protective) exposure estimates for key species of wildlife that are common in central and southern Florida. The model was developed to incorporate potential bioaccumulation of organic and inorganic chemicals into an aquatic food web that could develop at a flooded agricultural site. The model has been approved by the USFWS for use by the District in making decisions regarding property acquisition.

The SLERA was conducted using consistently conservative assumptions about toxicity, bioavailability, and exposure patterns. The combination of conservative assumptions can result in substantial uncertainty and overestimation of risks of adverse ecological effects. In most cases, the District has elected to use SLERA results as a basis for corrective actions, seeking to err on the side of environmental protection. In other cases where very large areas are involved, the District has sought to reduce uncertainty in exposure assessments by performing additional tests outlined in the ERA Protocol.

5.2 SLERA RESULTS

Formation Environmental generated the following conclusions based on the SLERA analysis:

Benthic Invertebrates

- Maximum detected concentrations of copper and dieldrin were greater than the SQAG-TEC only. Risks to the benthic invertebrate community due to exposure to both are predicted to be low but cannot be conclusively dismissed. The 95% UCL of both copper and dieldrin exceeded the SQAG-TEC. The very high levels of organic carbon in the soils likely mitigate the risk to both constituents of potential concern (COPCs) due to decreased bioavailability. Similarly, the mean PEC-HQ was lower than 0.5, indicating that cumulative risk from exposure to copper and dieldrin is expected to be low.
- All detected concentrations of barium, as well as the 95% UCL, exceeded the SQAG-PEC. However, no risk is predicted from exposure to barium because all of the samples collected from the A-2 FEB are within the range of barium concentrations defined by FDEP (Carvalho and Schropp 2002) as clean areas and areas established as a statewide reference for healthy biological communities.
- Concentrations of atrazine, 2,4-D, metribuzin, and phorate were also detected in several samples across the A-2 FEB. While elevated concentrations of each of these herbicides and insecticides were observed, communication with Florida Crystals farm managers indicates that all are actively applied as part of their general farming practice. All of the detected chemicals have relatively short half-lives and are not expected to persist for long periods after farming on the A-2 FEB is ceased. Best management practices should be followed to allow for sufficient time for the COPCs to degrade prior to completion of the A-2 FEB.

Aquatic-Feeding Birds

- Selenium concentrations in A-2 FEB soil samples exceeded the USFWS screening benchmark for effects to aquatic-feeding wildlife at a number of locations. Risks were subsequently evaluated using the SLERA model which resulted in no HQs greater than 1.0 using maximum detections. Risks were also predicted using the TTF model from Presser and Luoma (2010) and the data from the C9/C11 selenium study to estimate bird egg selenium concentrations. At maximum sediment concentrations, bird egg selenium concentrations were not predicted to be greater than the 95% lower confidence limit of the recommended egg tissue effect threshold concentrations. Based on these results and the results of the C9/C11 selenium study completed by the District, no unacceptable risk to aquatic-feeding birds is predicted in the A-2 FEB.
- Copper concentrations exceeded the 85 mg/kg interim benchmark for protection of the Everglade snail kite in just over 25% of the composite samples. However, the 95% UCL copper concentration was less than the benchmark. Given the relationship between organic carbon content in sediments and the bioavailability

of copper, the observed low magnitude exceedances of the benchmark are not expected to result in unacceptable levels of risk to the Everglade snail kite. The District should consider periodic monitoring of copper concentrations in surface water, periphyton, and apple snails following construction to provide data pertinent to the management of risks to the Everglade snail kite.

- All other HQs calculated via the food-web model using maximum detected composite sample concentrations were less than 1 indicating risks from these COIs are de minimus.

Overall, no evidence of elevated agrochemical contamination within the soils was found that would cause concern related to the construction of the A-2 FEB based on risk to the future aquatic community or to USFWS trust species that may utilize the future habitat provided by its construction. Due to the observed copper concentrations greater than the 85 mg/kg benchmark, monitoring of copper in surface water and apple snails following construction is recommended.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

- Very few organic agrochemicals were detected in the site soil at concentrations exceeding ecological or human health risk screening criteria. The majority of the detected chemicals, including 2,4-D, atrazine, metribuzin, and phorate are being actively applied on the property and soil concentrations are likely to dissipate rather quickly once the agricultural use of the property is ceased, given these chemicals relatively low persistence in the soil.
- Dieldrin is the only persistent organic chemical that was detected, but it was only sporadically detected at concentrations exceeding the SQAG-TEC, but below the SQAG-PEC. The hazard quotients for dieldrin that were calculated in the SLERA for a number of aquatic-feeding birds were well below one; thus, potential impacts to Trust species from exposure to residual dieldrin are likely to be very low.
- Copper was the primary constituent of potential ecological concern that was detected in the site soils.
  - Copper was detected in approximately 27% of the composite samples at concentrations exceeding the USFWS ISL of 85 mg/kg. The detected copper concentrations ranged as high as 110 mg/kg and exhibited a normal data distribution with a mean concentration of 77.2 mg/kg and a 95% upper confidence limit (UCL) of 81.3 mg/kg. Spatially, the data present a random pattern, and no discernible areas of higher concentrations could be interpreted from the maps.
  - Based on the copper data from the 10% sampling coverage, it is estimated that on the order of 3,850 acres of the property may contain copper concentrations exceeding the USFWS ISL. However, most of the exceedances are likely to only marginally exceed the ISL, and would be within the 85-95 mg/kg range.
  - The USFWS ISL for copper was developed for protection of the endangered Everglades snail kite and the ISL was derived using a standard bioaccumulation model that is thought to be generally applicable for the sandy soils, containing only small amounts of organic carbon, associated with citrus groves where copper sulfate is liberally applied as a fungicide in south Florida. Organic carbon concentrations in sandy soils are typically less than 1% while the organic carbon content in the A-2 FEB soils ranges from about 20% to about 50%. Metals, including copper are known to bind tightly with organic matter in the soil, and would be less bioavailable in these organic soils than they would be in sandy soils. A review of available published studies relating bioavailability to organic content in the soil was performed as part of the SLERA. These previous studies suggest a strong correlation between increased organic content

and decreased bioavailability; however, no direct numeric correlation could be gained from these studies that would allow us to calculate an alternate ISL for these soils based on the increased carbon content. Qualitatively, copper concentrations that only marginally exceed the ISL of 85 mg/kg in these highly organic soils are not likely to represent a significantly increased risk to the Everglades snail kite. As low as a 10 – 20% reduction in bioavailability would be expected to reduce uptake into the apple snails to levels equal to or less than predicted by the 85 mg/kg benchmark over the large majority of the A-2 FEB footprint.

- The Everglades snail kite could be exposed to copper concentrations in its primary food source, the apple snail, which may accumulate copper in its tissue from direct contact with the soil, or through ingestion of periphyton. The model makes certain assumptions regarding the bioaccumulation of copper up through the food chain and the degree to which ingested copper would be adsorbed by the Everglades snail kite. Apple snail bioaccumulation, Everglades snail kite exposure, and copper bioavailability studies are currently being conducted by both USFWS and SFWMD to evaluate these critical assumptions in the model. These results are not yet available. Bioaccumulation studies currently being performed by SFWMD suggest that copper concentrations in the surface water are likely to peak shortly after initial filling of the A-2 FEB, but would decline rapidly following the completion of the FEB. Since apple snails are not likely to establish a population large enough to support the foraging requirements of one or more snail kites immediately upon filling of the FEB, the snails and therefore, the Everglades snail kite, are not likely to be exposed to the peak concentrations of copper. The initial study data combined with the consideration of copper bioavailability discussed in the previous bullet suggest that the impacts to the Everglades snail kite to copper concentrations only marginally exceeding the ISL are not likely to be significant.
- PSI does not believe that corrective action to address copper impacted soils is warranted based on:
  - the marginal exceedance of the ISL,
  - the fact that the 95% UCL copper concentration across the site is less than 85 mg/kg,
  - the low likelihood of impacts from exposure to these soils given the decreased bioavailability associated with these soils, and
  - the interim study results indicating that the model assumptions used to develop the ISL may be overly conservative,.
- Based on the presumption that no corrective action is warranted for marginally impacted soils, PSI does not believe that further soil sampling for copper is warranted. Given the normal distribution and low standard

deviation of the data set, additional sampling is not likely to result in increased power or increased confidence in the data set.

- Arsenic concentrations across the majority of the A-2 FEB footprint are likely to exceed the FDEP Soil Cleanup Target Level for Residential Direct Exposure, but the detected concentrations are all below the SQAG-TEC criterion. Arsenic concentrations are not likely to represent a human health or ecological risk, as long as the soil is managed on-site and is not disposed off-site at an uncontrolled site.
- A number of chemicals, including 2,4-D, atrazine, metribuzin, phorate, dieldrin, chromium, mercury, selenium, and silver were detected in one of more of the composite soil samples at concentrations exceeding the soil cleanup target levels for leaching to surface water (SCTL-LSW). However, it should be noted that the SCTL-LSW criteria are based on leaching of chemicals from the soil into a Class III surface water body. In this case, the soils will be in direct contact with surface water once the project is constructed; however, the overlying surface water body would be classified as a treatment cell, and not as a Class III surface water. Therefore, the Class III surface water criteria and the SCTL-LSW criteria do not apply to these soils.
- Class III surface water criteria must be met for waters that are discharged from the A-2 FEB and therefore, comparison of the chemical concentrations in the soil with the SCTL-LSW criteria may be beneficial in evaluating whether exceedances of the Class III surface water criteria are likely at the A-2 FEB discharge point. An evaluation of the chemical data indicates that exceedances of the Class III surface water at the discharge of the A-2 FEB are very unlikely due to the following factors:
  - A number of the chemicals such as 2,4-D, atrazine, metribuzin, and phorate are relatively short-lived in the environment and were recently applied during active crop management. These chemicals are not likely to be present in the soil at significant concentrations when the reservoir is constructed.
  - Dieldrin is biologically persistent, but was only detected sporadically in the A-2 FEB footprint. The effect of dilution from incoming surface water and water overlying clean areas of the FEB are likely to dilute any leaching of these chemicals within these limited areas.
  - Chromium, mercury, and selenium were consistently detected and silver was detected at a few locations at concentrations exceeding the SCTL-LSW criteria. However, these metals all sorb strongly to organic matter in the soil and are not likely to leach to a significant degree from the highly organic soils in the A-2 FEB. Default SCTL-LSW criteria are based on soils with a much lower organic content than the soils on the subject property.

<u>Overall, no evidence of elevated agrochemical contamination within the soils was found that would cause concern related to the construction of the A-2 FEB based on risk to the future aquatic community or to USFWS trust species that may utilize the future habitat provided by its construction.</u>

6.2 RECOMMENDATIONS

- Based on the exceedances of the USFWS ISL for copper in a number of the soil samples, PSI recommends that the District conduct a monitoring program at start-up of the FEB to verify copper concentrations in the surface water, periphyton ,and in any apple snails that may occupy the FEB in the early stages of habitat development. This monitoring may be discontinued once it is verified that copper concentrations in the surface water, periphyton, and apple snails are below acceptable risk thresholds for protection of the Everglades snail kite.
- Based on the exceedance of the SCTL-LSW for atrazine, 2,4-D, metribuzin, phorate, dieldrin, chromium, mercury, and selenium in a number of soil samples, one-time surface water sampling for these parameters is recommended during start-up of the FEB to verify that these chemicals are not leaching into the surface water.
- An agrochemical best management practices (BMP) plan is recommended to address the use of agrochemicals on the property in the interim use period prior to project construction, assuming that the property will continue to be used for agricultural purposes in the interim. The intent of the BMP plan is to ensure that further agrochemical application does not result in increased concentrations for the chemicals of concern that were identified in the Phase II ESA. Further application of copper-containing fertilizers will need to be particularly scrutinized. A ramp-down period for some of the readily degradable agrochemicals (e.g., atrazine) may be warranted to ensure that the concentrations of these chemicals are below ecological risk thresholds at the time of project construction.
- Based on the presence of arsenic in the site soils at concentrations exceeding the SCTL-residential criteria, these soils should not be transported off-site for uncontrolled disposal. A soil management plan should be developed for project construction to ensure proper handling and disposal of the soils.

7. WARRANTY

PSI warrants that the findings and conclusions reported herein were conducted in general accordance with good commercial and customary practice for conducting a Phase II Environmental Site Assessment. However, these findings and conclusions contain all of the limitations inherent in these methodologies.

The Phase II Environmental Site Assessment has been developed to provide the client with information regarding apparent indications of chemical impacts to the subject property. It is necessarily limited to the conditions observed and to the information available at the time of the work. The assessment and conclusions presented herein were based upon the subjective evaluation of limited data. They may not represent all conditions at the subject site as they reflect the information gathered from specific locations. PSI warrants that the findings and conclusions contained herein have been promulgated in accordance with generally accepted environmental investigation methodology and only for the site described in this report.

Due to the limited nature of the work, there is a possibility that there may exist conditions which could not be identified within the scope of the assessment or which were not apparent at the time of report preparation. It is also possible that the testing methods employed at the time of the report may later be superseded by other methods. The description, type, and composition of what are commonly referred to as "hazardous materials or conditions" can also change over time. PSI does not accept responsibility for changes in the state of the art, nor for changes in the scope of various lists of hazardous materials or conditions. PSI believes that the findings and conclusions provided in this report are reasonable. However, no other warranties are implied or expressed.

TABLES

TABLE 1: **SOIL ANALYTICAL DATA SUMMARY - COMPOSITE SAMPLES (detected constituents only)**
PROJECT NAME: A-2 Flow Equalization Basin
PSI PROJECT NO.: 05521114

			Chlorinated Herbicides (ug/kg)	OPPs (ug/kg)			OCPs (ug/kg)	Metals (mg/kg)										TOC (mg/kg)
Sample ID	Date Collected	Sample Interval (ft bls)	D, 2-4'	Atrazine	Metribuzin	Phorate	Dieldrin	Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Mercury	Selenium	Silver	Total Organic Carbon
		SCTL-RDE	770,000	4,300	54,000	18,000	80	2.1	120	82	210	150	400	3	440	410	***
		SCTL-LGW	700	60	2,200	300	2	SPLP	1600	7.6	38	***	SPLP	2.1	5.2	17	***
		SCTL-LSW	900	40	800	1	0.1	SPLP	***	***	4.2	***	***	0.01	0.5	0.01	***
		SQAG-PEC	***	***	***	***	62	33	60	5.0	110	150	130	1.1	***	2.2	***
		SQAG-TEC	***	0.30	***	***	1.9	9.8	20	1.0	43	85*	36	0.18	***	1.0	***
Comp-1 012313	1/23/2013	0-0.5	58 U	39 I	**41 I**	3.6 U	1.7 U	6.8	110	0.11 U	19	110	**7.8**	0.1	1.7 I	0.33 U	**320,000**
Comp-2 012513	1/25/2013	0-0.5	65 U	29 U	20 U	4.1 U	1.9 U	5.2	93	0.11 U	15	**59**	**6.7**	0.098	2.0 I	0.33 U	**383,000**
Comp-3 012313	1/23/2013	0-0.5	65 U	29 U	20 U	4.1 U	1.9 U	4.3	91	0.11 U	16	**82**	**5.4**	0.11	2.5	0.33 U	**440,000**
Comp-4 012413	1/24/2013	0-0.5	65 U	29 U	20 U	**9.6 I**	1.9 U	4.7	95	0.12 U	5.6	91	**5.9**	0.14	2.3 I	0.36 U	**354,000**
Comp-4 DUP 012413	1/24/2013	0-0.5	74 U	33 U	23 U	4.7 U	1.1 U	4.1	93	0.14 U	6.8	**80**	**5.7**	0.13	1.8 I	0.42 U	**259,000**
Comp-5 012513	1/25/2013	0-0.5	63 U	27 U	20 U	3.9 U	1.8 U	4.6	94	0.11 U	15	**53**	**5.5**	0.12	2.1 I	0.33 U	**423,000**
Comp-6 012513	1/25/2013	0-0.5	70 U	30 U	22 U	4.3 U	0.99 U	4.5	110	0.12 U	18	**75**	**6.1**	0.12	0.66 U	0.36 U	**440,000**
Comp-7 012313	1/23/2013	0-0.5	57 U	25 U	18 U	3.6 U	1.6 U	6.4	97	0.10 U	20	**75**	**6.3**	0.11	0.55 U	0.30 U	**389,000**
Comp-7 DUP 012313	1/23/2013	0-0.5	58 U	25 U	18 U	3.6 U	1.7 U	5.7	97	0.11 U	19	**74**	**7.1**	0.11	2.8	0.33 U	**329,000**
Comp-8 012313	1/23/2013	0-0.5	62 U	3,100	**240**	3.8 U	1.8 U	3.8	96	0.12 U	14	87	**6.3**	0.13	0.62 U	0.34 U	**358,000**
Comp-9 012213	1/22/2013	0-0.5	**200 I**	380	**280**	3.9 U	1.8 U	3.9	92	0.12 U	13	**67**	**5.3**	0.12	2.4 I	0.35 U	**430,000**
Comp-9 DUP 012213	1/22/2013	0-0.5	**170 I**	440	**280**	4.4 U	1.0 U	3.5	110	0.14 U	17	**65**	**5.8**	0.12	3	0.40 U	**419,000**
Comp-10 012313	1/23/2013	0-0.5	57 U	25 U	18 U	3.6 U	4.5 I	4.9	95	0.11 U	12	**68**	**5.9**	0.13	1.6 I	0.31 U	**364,000**
Comp-11 012413	1/24/2013	0-0.5	63 U	27 U	20 U	3.9 U	1.8 U	3.6	98	0.11 U	15	**79**	**5.6**	0.14	0.58 U	0.31 U	**450,000**
Comp-11 SPLIT	1/24/2013	0-0.5	70 U	30 U	NA	4.3 U	10.5 U	6.4	118	0.10 I	14.2	**83.5**	**6.2**	0.087	2.4	0.61 I	**461,000**
Comp-12 012513	1/25/2013	0-0.5	63 U	27 U	20 U	3.9 U	1.8 U	3.8	100	0.11 U	13	87	**6.8**	0.14	3.7	0.32 U	**470,000**
Comp-13 012213	1/22/2013	0-0.5	59 U	110 I	19 U	3.7 U	1.7 U	6.2	100	**0.15 I**	29	90	**6.7**	0.13	2.3	0.32 U	**400,000**
Comp-14 012213	1/22/2013	0-0.5	60 U	26 U	19 U	3.8 U	1.7 U	5.5	80	**0.18 I**	16	**68**	**6.6**	0.11	2.2 I	0.34 U	**374,000**
Comp-15 012213	1/22/2013	0-0.5	**290**	3,500	**730**	4.3 U	4.9 I	3.4	87	**0.12 I**	7.8	**75**	**7**	0.11	2.6	0.35 U	**477,000**
Comp-15 SPLIT	1/22/2013	0-0.5	880	1,600	NA	4.1 U	9.91 U	5.46	103	0.02 U	7.36	86.0	**7.36**	0.077	1.99	0.61 I	**461,000**
Comp-16 012313	1/23/2013	0-0.5	52 U	330	**58 I**	120 I	5.1 I	4	91	0.096 U	23	96	**6.1**	0.13	2.3	0.29 U	**388,000**
Comp-17 012313	1/23/2013	0-0.5	60 U	160 I	**600**	3.8 U	1.7 U	3.8	99	0.12 U	17	**85**	**6.4**	0.13	2.6	0.33 U	**409,000**
Comp-18 012513	1/25/2013	0-0.5	**940**	3,300	**1,100**	3.9 U	1.8 U	3.4	97	0.11 U	11	88	**4.7**	0.15	1.5 I	0.32 U	**450,000**
Comp-19 012413	1/24/2013	0-0.5	55 U	24 U	17 U	3.4 U	1.6 U	5.5	88	0.11 U	17	**59**	**6.5**	0.12	0.57 U	0.31 U	**198,000**
Comp-20 012413	1/24/2013	0-0.5	57 U	25 U	**140**	3.6 U	1.6 U	5	90	0.10 U	14	**70**	**6.3**	0.11	0.55 U	0.30 U	**361,000**
Comp-21 012213	1/22/2013	0-0.5	52 U	55 I	**200**	93 I	1.5 U	3.5	69	**0.17 I**	9.4	**79**	**8.4**	0.099	0.47 U	0.26 U	**308,000**
Comp-22 012313	1/23/2013	0-0.5	63 U	27 U	20 U	3.9 U	1.8 U	4.3	100	**0.16 I**	12	**83**	**6.2**	0.14	2.5	0.35 U	**448,000**
Comp-23 012413	1/24/2013	0-0.5	59 U	26 U	19 U	3.7 U	2.7 I	4.2	82	0.11 U	13	**59**	**5.4**	0.12	2.6	0.32 U	**384,000**
Comp-24 012413	1/24/2013	0-0.5	64 U	28 U	20 U	4.0 U	1.8 U	4.1	99	**0.14 I**	28	**82**	**6.6**	0.14	2.5	0.35 U	**464,000**
Comp-25 012513	1/25/2013	0-0.5	58 U	31 I	**120**	3.6 U	1.7 U	6.4	100	0.11 U	19	**67**	**5.6**	0.11	2.5	0.32 U	**392,000**
Comp-26 012413	1/24/2013	0-0.5	57 U	25 U	18 U	3.6 U	1.6 U	5.5	98	0.11 U	17	**78**	**6.4**	0.13	0.58 U	0.32 U	**355,000**
Comp-27 012213	1/22/2013	0-0.5	70 U	35 I	22 U	4.3 U	0.99 U	3.5	89	0.12 U	9.1	**74**	**5.9**	0.14	2.9	0.36 U	**503,000**
Comp-28 012313	1/23/2013	0-0.5	58 U	190	**1,700**	3.6 U	1.7 U	3.1	83	**0.14 I**	26	**69**	**5.8**	0.13	1.8 I	0.30 U	**415,000**
Comp-28 SPLIT	1/23/2013	0-0.5	60 U	130 I	NA	3.8 U	9.47 U	4.79	98.2	0.02 U	22.6	**78.9**	**6.23**	0.085	2.08	0.64 I	**433,000**
Comp-29 012413	1/24/2013	0-0.5	74 U	33 U	23 U	4.7 U	1.1 U	4.3	86	0.14 U	7.2	**60**	**5.2**	0.13	2.3 I	0.42 U	**485,000**
Comp-30 012513	1/25/2013	0-0.5	63 U	27 I	20 U	3.9 U	1.8 U	3.2	96	0.12 U	21	100.0	**6.9**	0.15	0.65 U	0.35 U	**424,000**

Notes:
U = Less than the method detection limit
I = The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
J= Estimated value
Bold type indicates that the compound was detected above the laboratory method detection limits. The font color indicates the highest of the listed regulatory limits that was exceeded. Black **Bold** indicates a detection above the laboratory Method Detection Limit (MDL) but below all regulatory criteria.
* = Interim cleanup target level for protection of Everglades Snail Kite
*** = No Standard

TABLE 2: Summary of SPLP Results
PROJECT NAME: A-2 Flow Equalization Basin
PSI PROJECT NO.: 05521114

			OPPs (ug/L)	OCPs (ug/L)
Sample ID	**Date Collected**	**Sample Interval (ft bls)**	**Atrazine**	**Dieldrin**
		GCTL	3	0.002
		SwCTL	1.9	0.00014
Comp-8 012313	1/23/2013	0-0.5	7.2	NA
Comp-10 012313	1/23/2013	0-0.5	NA	0.0011 U
Comp-15 012213	1/22/2013	0-0.5	14	0.0011 U

Notes:

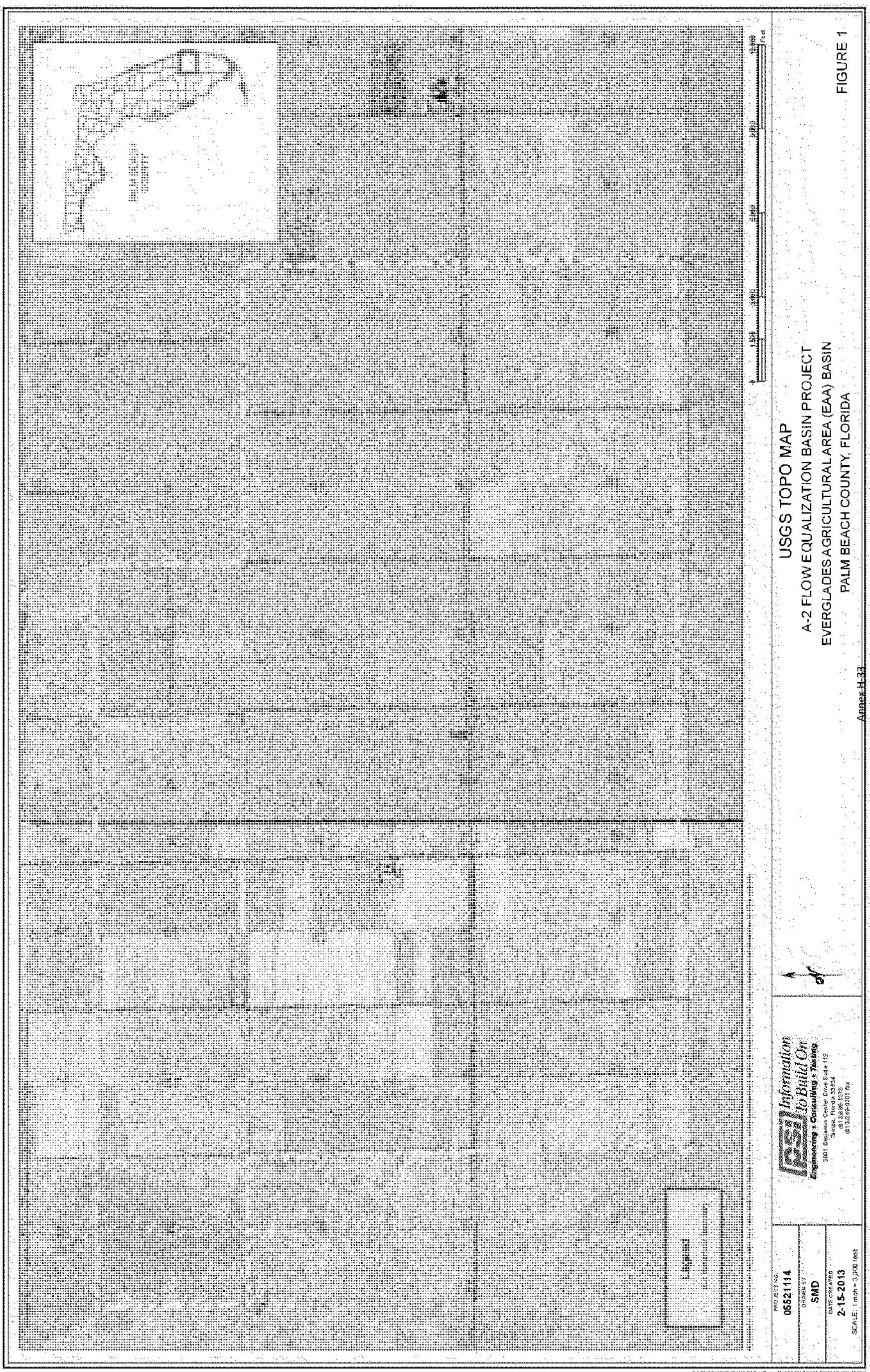
NA = Not Analyzed

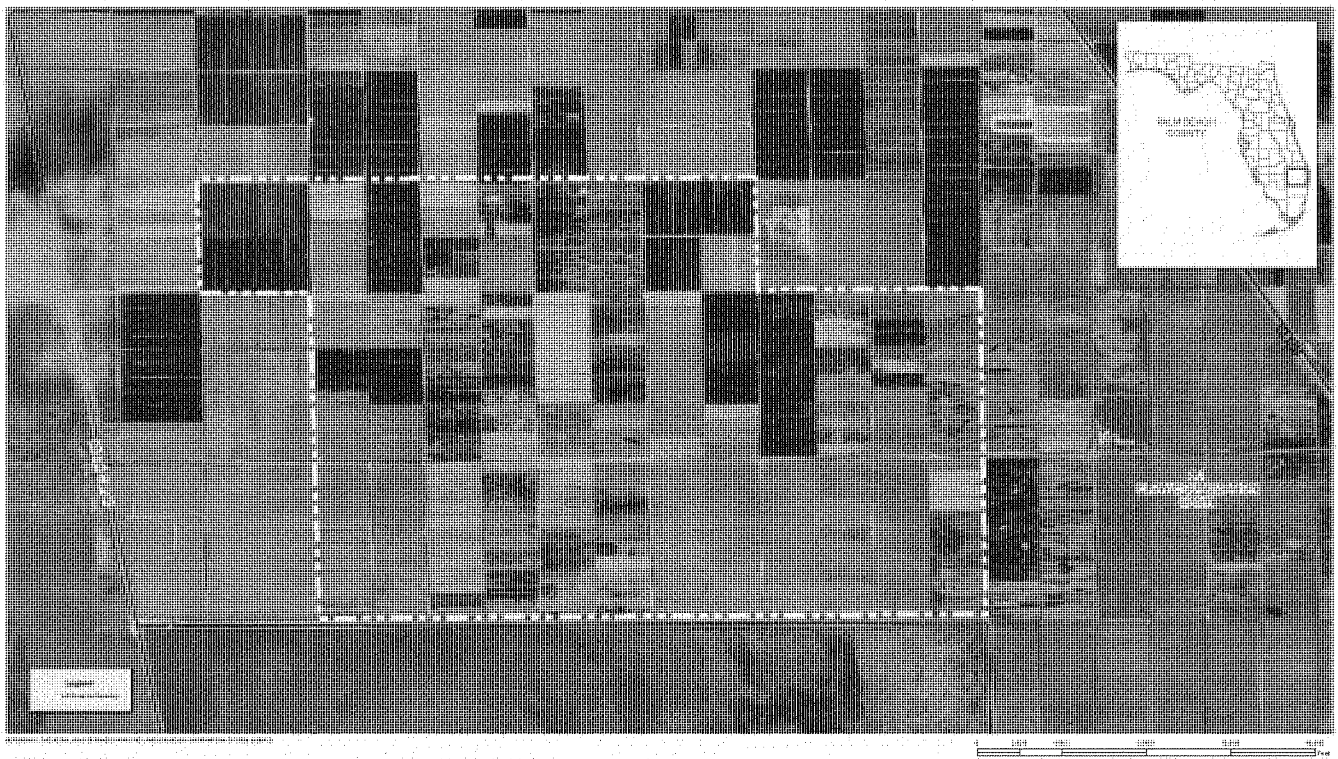
*** = No Standard

Bold indicates value exceeds the applicable GCTL or SwCTL. The font color indicates the highest regulatory limit that is exceeded.

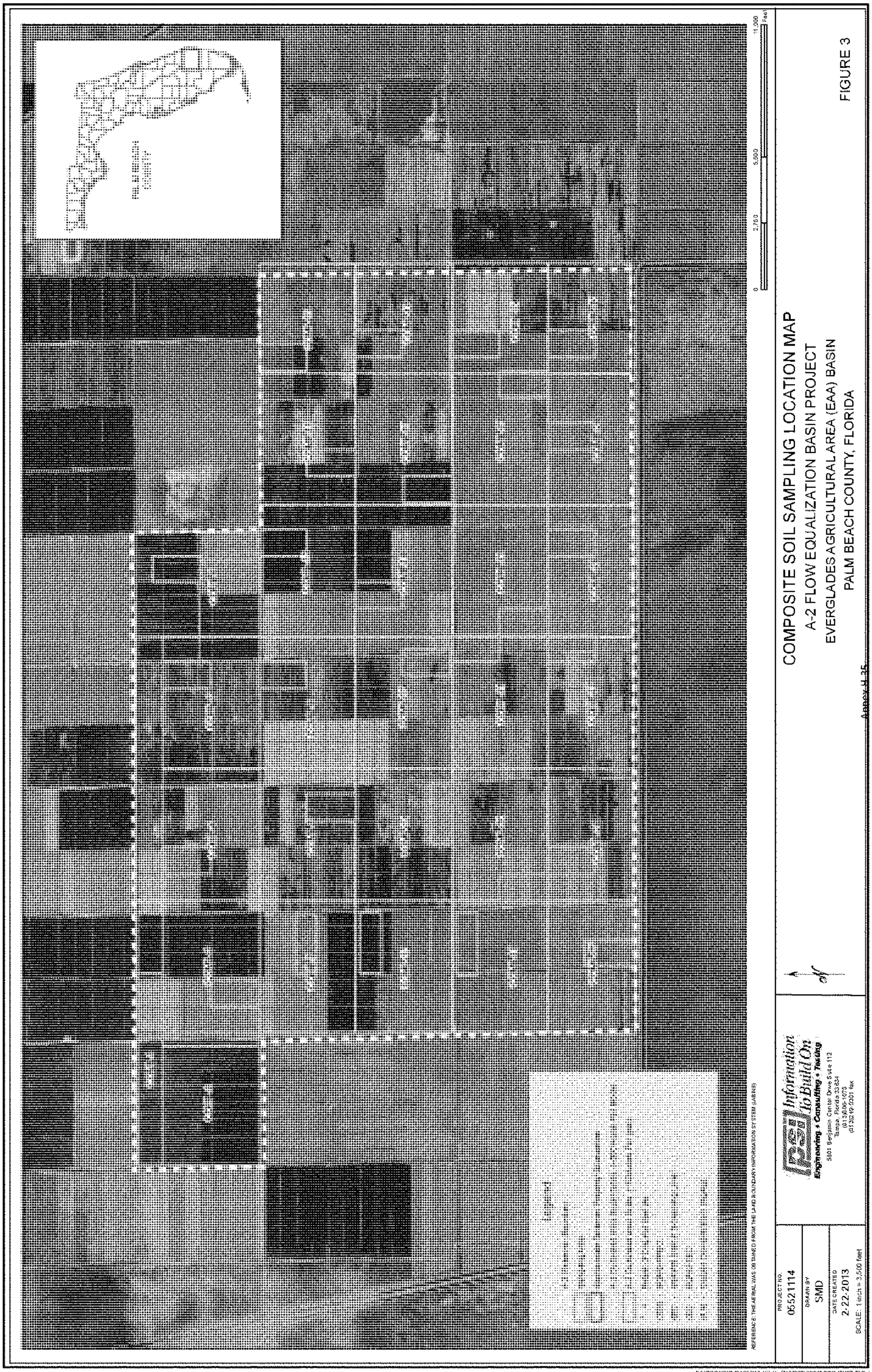
FIGURES

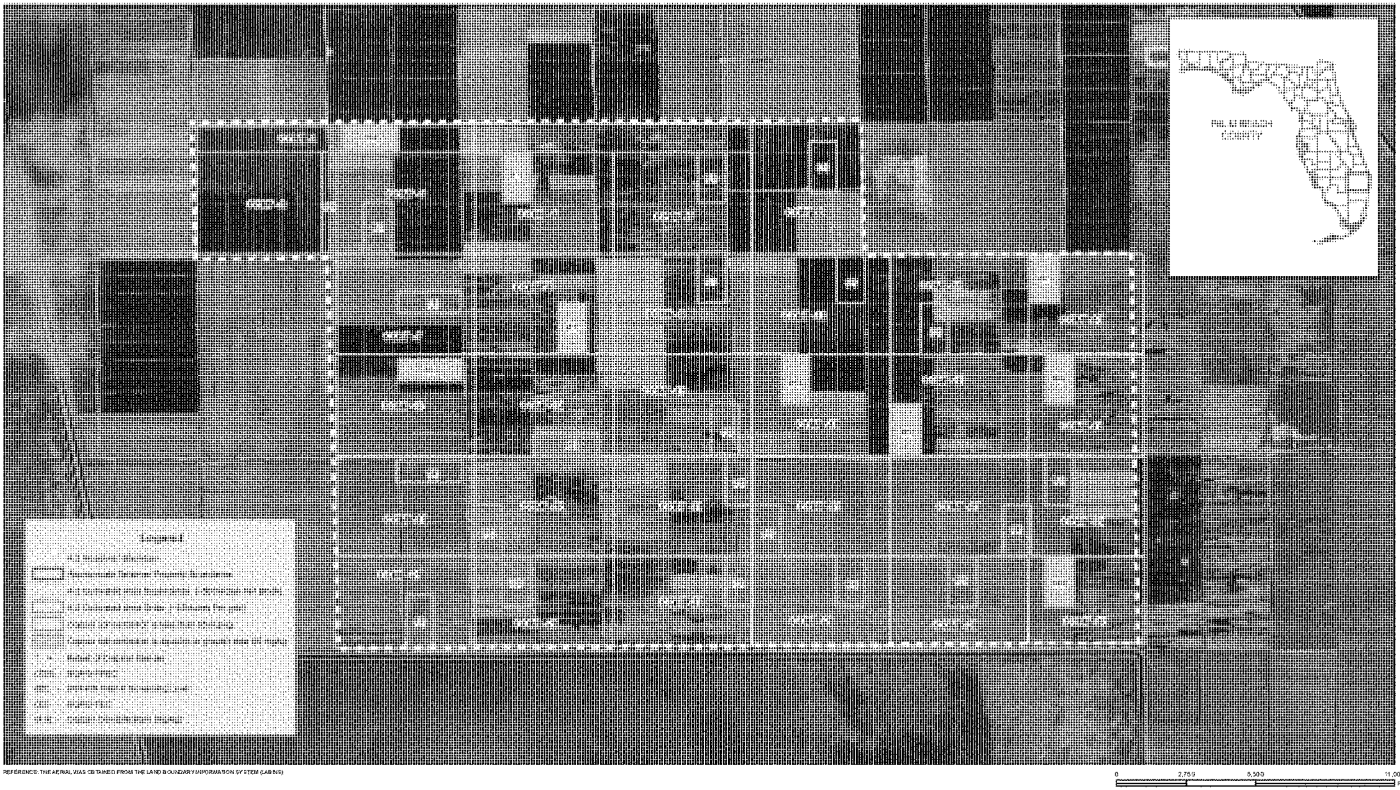
Annex H-32


USGS TOPO MAP
A-2 FLOW EQUALIZATION BASIN PROJECT
EVERGLADES AGRICULTURAL AREA (EAA) BASIN
PALM BEACH COUNTY, FLORIDA
FIGURE 1
Annex H-33
PROJECT NO.
05521114
DRAWN BY
SMD
DATE CREATED
2-15-2013
SCALE: 1 inch = 3,000 feet
Information to Build On
Engineering • Consulting • Testing



PROJECT NO. 05521114 DRAWN BY SMD DATE CREATED 2-15-2013 SCALE: 1 inch = 4,000 feet	PSI Information To Build On Engineering • Consulting • Testing 5801 Benjamin Center Drive Suite 112 Tampa, Florida 33634 (813)886-1075 (813)249-0301 fax	SITE VICINITY MAP A-2 FLOW EQUALIZATION BASIN PROJECT EVERGLADES AGRICULTURAL AREA (EAA) BASIN PALM BEACH COUNTY, FLORIDA	FIGURE 2


COMPOSITE SOIL SAMPLING LOCATION MAP
A-2 FLOW EQUALIZATION BASIN PROJECT
EVERGLADES AGRICULTURAL AREA (EAA) BASIN
PALM BEACH COUNTY, FLORIDA
FIGURE 3
0
2,750
5,500
11,000
Feet
PROJECT NO.
0552114
DRAWN BY
SMD
DATE CREATED
2-22-2013
SCALE: 1 inch = 3,500 feet
Information To Build On
Engineering • Consulting • Testing



PROJECT NO.
05521114
DRAWN BY
SMD
DATE CREATED
2-22-2013
SCALE: 1 inch = 3,500 feet

PSI Information To Build On
Engineering • Consulting • Testing
5801 Benjamin Center Drive Suite 112
Tampa, Florida 33634
(813)00-1075
(813)249-0201 fax

A-2 COPPER CONCENTRATION MAP
A-2 FLOW EQUALIZATION BASIN PROJECT
EVERGLADES AGRICULTURAL AREA (EAA) BASIN
PALM BEACH COUNTY, FLORIDA

FIGURE 4

Annex H-36

SUMMARY ENVIRONMENTAL REPORT

For the

CENTRAL EVERGLADES STUDY
A-2 RESERVOIR
PALM BEACH COUNTY, FLORIDA

Prepared for

SOUTH FLORIDA
WATER MANAGEMENT DISTRICT
ENVIRONMENTAL SCIENCE UNIT
MAINTENANCE MANAGEMENT SECTION
3301 GUN CLUB ROAD
WEST PALM BEACH, FLORIDA 33406

Prepared by

Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634
Telephone (813) 886-1075

PSI PROJECT NO. 0552812

August 21, 2012

August 21, 2012

South Florida Water Management District
Environmental Science Unit
Maintenance Management Section
3301 Gun Club Road
West Palm Beach, Florida 33406

Attn: Mr. Robert Kukleski

Re: A-2 Reservoir Summary Environmental Report
Central Everglades Study
Palm Beach County, Florida
PSI Project No.: 0552812

Dear Mr. Kukleski:

In accordance with our agreement, Professional Service Industries, Inc. (PSI) has completed the summary of previous environmental investigations for the above referenced project.

Thank you for choosing PSI as your consultant for this important project. If you have any questions, or if we can be of additional service, please call us at (813) 886-1075.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Steve Long, P.E., P.G.
Chief Engineer

SUMMARY ENVIRONMENTAL REPORT

For the

CENTRAL EVERGLADES STUDY
A-2 RESERVOIR
PALM BEACH COUNTY, FLORIDA

Prepared for

SOUTH FLORIDA
WATER MANAGEMENT DISTRICT
ENVIRONMENTAL SCIENCE UNIT
MAINTENANCE MANAGEMENT SECTION

Prepared by

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PSI PROJECT NO. 0552812

Stephen P. Long, PE, PG
Chief Engineer

August 21, 2012

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TABLES

APPENDICES

1 INTRODUCTION

1.1 Property Description

The proposed A-2 Reservoir project is located along the west side of US 27 South in unincorporated Palm Beach County and encompasses on the order of 14,408 acres. The project location is shown on **Figure 1-1**. The project lands consist of 8 separate parcels. The tract numbers, prior ownership, and acreage are shown in the table below.

A-2 Reservoir		
D7100-044	TALISMAN SUGAR CORPORATION	2
D7100-047	TALISMAN SUGAR CORPORATION	10
D7100-066	TALISMAN SUGAR CORPORATION	12
D7100-067	TALISMAN SUGAR CORPORATION	1
D7100-104	TALISMAN SUGAR CORPORATION	14,371.53
D7100-139	TALISMAN SUGAR CORPORATION	1
D7100-141	WEINLEIN, JOAN	10
D7200-005	TALISMAN SUGAR CORPORATION	1
A-2 Total		14,408.53

Most of the project area has been historically cultivated in sugar cane, with occasional rotational crops of rice or corn. The property is being leased to New Hope Sugar Corporation for sugar cane cultivation. A Site Plan is provided as **Figure 1-2**.

The primary parcel (Tract D7100-104) was acquired from Talisman Sugar Company in 1999 by the District. Several of the smaller parcels listed above were also owned and operated by Talisman Sugar Corporation, but these parcels were deferred from transfer during the original transaction until environmental concerns on these small areas could be addressed. The Weinlan parcel (Tract D7100-141) was leased to Talisman Sugar at the time of the 1999 acquisition and was evaluated with the remainder of Tract D7100-104. It is acknowledged that the assessment methods and protocols that were utilized at the time of the original acquisition are not entirely consistent with the current protocols for environmental risk assessment that were jointly developed by United States Fish and Wildlife (USFWS), the Florida Department of Environmental Protection (FDEP) and the South Florida Water Management District (SFWMD).

1.2 Authorization

This Summary Report was prepared in substantive compliance with PSI Proposal No. 552-58094 dated November 28, 2011, which was authorized by SFWMD Contract and Work Order No. 4600002399-WO#02.

1.3 Purpose/Objectives

The District requires a summary report for the A-2 Reservoir project, which compiles the results of the previous investigations performed on the properties within the project footprint. The primary purposes of the report are:

- Compile and summarize the results of previous environmental studies within the project area;
- Document and map known point source and non-point source areas of impact which might present increased ecological or human health risk upon construction of the project.

1.4 Proposed Construction

The proposed project will consist of the construction of a large reservoir for water storage. The design has not yet been initiated so details on the use of each parcel are not yet available. However, for the purposes of this document, PSI has assumed worst-case conditions that the entirety of the property will be inundated. If portions of the property are ultimately not flooded, the ecological risks discussed herein for those areas would be overstated.

2. REGULATORY FRAMEWORK

2.1 Regulatory Oversight

The FDEP, FWS, and SFWMD jointly developed a protocol, entitled "*Protocol for Assessment, Remediation, and Post-Remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects* for conducting environmental assessments on agricultural lands proposed for use in water resources projects. This protocol has commonly been referred to as the Ecological Risk Assessment (ERA) Protocol. The ERA Protocol includes separate evaluation of potential point source areas (e.g., underground storage tanks, pesticide mix/load areas, etc.) and residual chemical impacts across agricultural areas associated with routine application of agrochemicals as a normal farming practice. The ERA Protocol is intended to be a dynamic document which is revised as improvements in science or regulatory framework change. The ERA Protocol was initially drafted in 2000 and the most recent revisions are reflected in the August 2008 version of the document.

As previously noted, some of the assessment work conducted on parcels within the project footprint was conducted prior to the initial version of the ERA Protocol or using earlier drafts of the document. Prior to the 2000 ERA Protocol most of the assessments focused solely on evaluation of risks associated with point source areas, and little investigation work was performed to evaluate potential non-point source risks associated with residual chemical concentrations in soil associated with routine application of agrochemicals across widespread cultivated areas.

All of the work conducted by the SFWMD for the Project was performed under the direct supervision of both FDEP (Bureau of Waste Cleanup) and the USFWS and completed in accordance with the ERA Protocol in place at the time of the assessment. Additionally, FDEP applied the following point source contamination specific rules, including:

- Chapter 62-770, FAC (Petroleum Contamination Site Cleanup Criteria)
- Chapter 62-780, F.A.C. (Contaminated Sites Rule)
- Chapter 62-777, FAC (Contaminant Cleanup Levels), F.A.C.

The ERA Protocol acknowledges that the lands are being acquired for conversion to storm water treatment areas, engineered wetlands, reservoirs, and other aquatic features. Both human health concerns and ecological risks are evaluated concurrently as part of the protocol. Human health risks evaluation was performed by comparing contaminant concentrations in all media (e.g., soil, groundwater, surface water, sediment) to human health-based cleanup target levels (CTLs) promulgated by FDEP in Chapter 62-777, F.A.C. Ecological risks were concurrently evaluated by comparing chemical concentrations to the Sediment Quality Assessment Guidelines (SQAGs) developed by FDEP for inland waters and the copper and selenium ecological restoration target established by the USFWS.

While the ERA Protocol evaluates both human health and ecological risks, in most cases the contaminant concentration thresholds for ecological risks are significantly lower than human health risk thresholds for the current and proposed future land use. For example, the USFWS ecological restoration target for copper is 85 mg/kg compared with the CTL for commercial /industrial land use which is 89,000 mg/kg. In many cases, the need for corrective action was solely driven by the need to minimize ecological risks for the aquatic environment being created by the project. This fact is critical because USACE Regulation ER 1165-2-132 prohibits recommending projects or features implementation that would "... result in treating or otherwise abating pollution problems caused by other parties where those parties have, or are likely to have, a legal responsibility for remediation or other compliance responsibility". Contaminant concentrations in the soils within the project boundary are low enough that the landowner would not be subject to any enforcement by FDEP or Environmental Protection Agency (EPA) as long as the property continues in agricultural use.

It should be noted that site characterization and corrective actions on the Talisman parcels were performed by the property owner, rather than directly by SFWMD. Talisman performed the detailed site assessment and corrective action tasks on all "exclusion areas" which were identified based on the SFWMD Phase II ESA (Dames and Moore, 1998). Talisman's work was conducted under the oversight of both SFWMD and FDEP. However, since the assessment/corrective action work was conducted solely on point source areas, USFWS was not involved in the oversight of this work. EPA Region IV did provide concurrence on the Dames and Moore 1998 Phase II ESA. The end point for all of these exclusion areas was issuance of a No Further Action letter or Site Rehabilitation Completion Order (SRCO) from FDEP. It was previously noted that some of the SRCOs on specific point sources on the Talisman parcels are based upon recording of a deed restriction to prevent residential and other sensitive uses on these parcels.

The format and process for regulatory agency approval and concurrence of the assessment and corrective actions conducted on the site varies between point sources and non-point source issues. FDEP is the lead agency for assessment and corrective action for point sources where contaminant concentrations are high enough to exceed the CTLs for the current and future land use as outlined in Chapter 62-777, F.A.C. In these cases, FDEP issues a No Further Action Letter or Site Rehabilitation Completion Order (SRCO) upon completion of the assessment and/or corrective action process.

For non-point source areas and point source areas where contaminant concentrations exceed ecological thresholds but are below the FDEP CTLs, FDEP rules do not apply. In these situations, FDEP provides review and approval through memoranda or letter responses provided by their Bureau of Waste Cleanup. Although USFWS does not have jurisdiction over point sources with contaminant concentrations exceeding the FDEP CTLs (except to the extent Trust Species are affected), they have generally provided comment on an informal basis with regard to these issues. USFWS has generally concentrated on non-point source issues with the potential to affect Trust Species.

As a final point, neither the FDEP nor FWS review process for the assessment and corrective action work requires public comment. However, both of these agencies were involved in the permitting process for the abandoned EAA Reservoir Project, reviewing the project documents and providing the necessary permit approvals. The permit approvals were subject to public notice and all related environmental cleanup documents and approvals were included in the administrative record.

2.2 ARARs

As part of the assessment process on each parcel, chemical concentrations in all media were compared to applicable or relevant and appropriate requirements (ARARs), depending upon future proposed usage of each tract. It is acknowledged that numeric cleanup criteria have changed over time, and may not have been identical for each parcel that was assessed.

Additionally, in 1999, the FDEP shifted the cleanup target levels for soil and groundwater from individual cleanup rules (e.g., Chapter 62-770, FAC – Petroleum Cleanup Rule, Chapter 62-785, FAC – Brownfields Rule, etc.) into a separate rule, Chapter 62-777, FAC - Contaminant Cleanup Target Levels, which included the numeric cleanup criteria that applied universally to all of the cleanup rules.

For this report, chemical concentrations have been compared to current ARARs. It is acknowledged that some of the Site Rehabilitation Completion Orders (SRCOs) issued by FDEP on parcels or individual point source locations within the project footprint were based on the cleanup target levels in place at the time the SRCOs were issued, and these cleanup target levels may have been higher or lower than the current criteria. For example, all of the point sources on the Talisman property were remediated based on a commercial soil cleanup target level (SCTL) for arsenic of 3.7 mg/kg; however, the current SCTL for arsenic is 12 mg/kg.

The current ARARs for each media are summarized below.

2.2.1 Soil

The following human-health based criteria are established by the FDEP in Chapter 62-777 of the Florida Administrative Code (FAC). Chapter 62-777, FAC includes soil cleanup target levels (SCTLs) for both direct exposure and leaching to groundwater/surface water. Both the direct contact and leaching criteria must be considered to determine the need for corrective action.

- ***Residential*** – The Soil Cleanup Target Level for direct exposure in a residential setting (SCTL-RDE) is the default standard for site screening purposes in Florida, and assumes potential contact with soils on a regular basis by adults and children.

- ***Industrial/Commercial*** – The Soil Cleanup Target Level for direct exposure in a non-residential setting (SCTL-IDE) assumes extended contact with soils on a daily basis by adult workers at commercial/industrial sites, or on agricultural properties where farming practices result in frequent site contact. Use of this standard requires that a deed restriction be recorded against the property. It should be noted that a number of point source locations on the Talisman properties were closed with deed restrictions and these parcels are specifically identified throughout the report. Copies of the deed restrictions for any restricted closure areas are also included in the report appendix.

- ***Leaching to Groundwater*** – The Soil Cleanup Target Levels for leaching to groundwater (SCTL-LGW) represent default criteria for site screening purposes in Florida, and are based on soil concentrations which are considered likely to result in an exceedance of the groundwater quality standard for a particular chemical. In cases where the default SCTL-LGW criterion is exceeded, FDEP cleanup rules allow the responsible party to conduct follow up testing by the Synthetic Precipitation Leaching Procedure (SPLP) to evaluate the leaching potential. The results of the SPLP test are compared to the Chapter 62-777, FAC Groundwater Cleanup Target Levels (GCTL) discussed below. If the SPLP results are below the applicable GCTL, the soils are not considered to present a leaching concern and only the direct contact SCTL needs to be considered.

  Several heavy metals (e.g., arsenic) do not have numeric SCTL-LGW criteria and instead FDEP requires testing by the SPLP method and comparison to the GCTLs.

- ***Leaching to Surface Water*** – The Soil Cleanup Target Levels for leaching to surface water (SCTL-LSW) are applicable where impacted soils may be in contact with a surface water body. Soils within proposed upland areas or outside the area to be inundated by the project do not need to consider the SCTL-LSW criteria. FDEP also allows the responsible party to test any soil samples exceeding the default SCTL-LSW criteria by the SPLP method and the results are compared to the Surface Water Cleanup Target Levels, discussed below.

2.2.2 Sediment Ecological Risk Criteria

The FDEP has previously indicated that soils within proposed wetland or water storage areas should be regulated as sediments, as these soils will ultimately become inundated. For sediments, the Sediment Quality Assessment Guidelines (SQAGs) as defined in *Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4*, (MacDonald, 2000) have generally been applied for screening purposes. The SQAGs are not a human health-based criteria, but are instead relevant only to the evaluation of ecological risk. The referenced guideline outlines two potential standards which were developed specifically with respect to benthic macro invertebrate species, which represent the bottom of the food chain, as follows:

- ***No Observed Adverse Effects Level*** – The threshold effects concentration (SQAG-TEC) is the more conservative value and is utilized as a screening tool in evaluating sediments. Contaminant concentrations below the SQAG-TEC generally do not warrant further investigation.
- ***Lowest Observed Adverse Effects Level*** – The probable effects concentration (SQAG-PEC) represents the level above which adverse effects are likely to occur. Contaminant concentrations exceeding the SQAG-PEC generally require corrective action, except when exceedences are very limited in areal extent (e.g., point sources).

It should be noted that the SQAGs are predictive of potential adverse effects to benthic invertebrates and may not adequately predict ecological risks to higher trophic level species. USFWS has generally tolerated some predicted risks to benthic invertebrates as long as the perceived risks are not predicted to affect the health of the overall ecosystem that will develop upon project construction. On previous projects, USFWS has agreed that some exceedences of the SQAG-TEC criteria are acceptable, as long as the 95% upper confidence level (UCL) estimate of the mean analyte concentrations across the site do not exceed the SQAG-TEC. USFWS has generally required corrective actions where the chemical concentrations exceed the SQAG-PEC criteria over more than an extremely limited area.

It should also be noted that SQAGs may not be established for all analytes of interest. USFWS protocols for ecological risk assessment (USFWS, March 2008) recommend consideration of Ecological Screening Values (ESV) established by EPA Region IV in *Ecological Screening Values or Surface Water, Sediment, and Soil* (WSRC, November 1998) when Florida SQAGs are not available.

Finally, it should also be noted that SQAGs are not regulatory benchmarks and do not carry the force of law like SCTLs. They are screening benchmarks that may be used in making risk management decisions.

2.2.3 Sediment – Interim Screening Levels for Ecological Risk

USFWS has established specific screening levels for certain chemicals based on specific risks. Screening levels for copper and selenium are discussed below.

For copper, the USFWS utilizes an interim screening value of 85 mg/kg for protection of the endangered Snail Kite, in addition to comparison with the SQAG-TEC.

No SQAG values have been established for selenium. However, selenium has historically been screened for potential ecological effects under the protocol using 2 mg/kg as a benchmark. The potential for effects to aquatic-feeding wildlife and/or benthic invertebrates and fish at this benchmark is uncertain.

2.2.4 Sediment – Site Specific Ecological Risk Based Concentrations

As previously stated, the SQAGs are intended to be protective of benthic invertebrates, but are not necessarily reflective of risks to higher trophic level species, included migratory bird species and wading birds, which are protected as Federal Trust Species. Where contaminant concentrations exceed the SQAGs or where potentially bioaccumulative chemicals are detected, the ERA Protocol typically requires preparation of a Screening Level Ecological Risk Assessment (SLERA) in order to develop site specific ecological Risk-Based Screening Concentrations (RBCs).

To evaluate potential effects to benthic invertebrates, soil data were compared to the SQAG-TEC and SQAG-PEC values. Risk to aquatic-feeding wildlife are typically evaluated by estimating the potential exposure of avian receptors to chemicals through the ingestion of aquatic prey species that might accumulate chemicals from soils after they have been flooded. Exposure and risks are calculated for aquatic-feeding wildlife using a model developed for the District specifically for the purposes of this program (Goodrich 2002 and NewFields 2006).

2.2.5 Groundwater

Groundwater analyte concentrations were compared to the Groundwater Cleanup Target Levels (GCTLs) found in Chapter 62-777, FAC.

2.2.6 Surface water

Surface water analyte concentrations were compared to the Surface Water Cleanup Target Levels (SwCTLs) found in Chapters 62-302 and 62-777, FAC.

2.2.7 Applicable Criteria

All of the above criteria have been considered in evaluating the analytical results obtained during the assessment activities described herein. Since some portions of the site may not become inundated, it is appropriate to compare analyte concentrations in the soil to the human health-based SCTLs established in Chapter 62-777, FAC. Therefore, soil data was compared to both the SCTLs for residential direct exposure (SCTL-RDE) and to the SCTLs for leaching to groundwater (SCTL-LGW) and leaching to surface water (SCTL–LSW).

It is likely that most of the site will be inundated; at least for a portion of each year, and that important ecological receptors will utilize the property. Therefore, it is also necessary to compare the site data to the SQAGs and the Site-Specific Ecological RBCs generated from the SLERAs. For most analytes of interest (arsenic being the notable exception), the SQAG-TEC criteria are more stringent than the SCTL-RDE criteria. Therefore, in most cases, a cleanup to SQAG-TEC criteria is also protective of human health. It should also be noted that the SQAGs are not standards or deterministic values (i.e., an exceedance does not indicate absolutely that adverse affects will occur); the SQAGs are merely screening values. Data exceeding the SQAG values generally indicate the need for further study. Conversely, chemical concentrations which do not exceed the SQAGs are generally screened out from any further consideration with respect to ecological risk.

The SCTLs for leaching to surface water (SCTL-LSW) have also been considered for soils which are, or may become inundated.

2.2.8 USACE HTRW

Because the project may be completely or partially constructed under the direction of USACE, Engineering Regulation (ER) 1165-2-132 – Hazardous Toxic and Radioactive Wastes (HTRW) was considered to be applicable to project construction. ER 1165-2-132.prohibits USACE Districts from executing construction projects with known HTRW and assigns 100% of the cost and responsibility associated with remediation to the local sponsor.

HTRW is defined to include any material listed as a "hazardous substance" under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq (CERCLA). (See 42 U.S.C. 9601(14)). Hazardous substances regulated under CERCLA include "hazardous wastes" under Sec. 3001 of the Resource Conservation and Recovery Act, 42 U.S.C. 6921 et seq; "hazardous substances" identified under Section 311 of the Clean Air Act, 33 U.S.C. 1321, "toxic pollutants" designated under Section 307 of the Clean Water Act, 33 U.S.C. 1317, "hazardous air pollutants" designated under Section 112 of the Clean Air Act, 42 U.S.C. 7412; and "imminently hazardous chemical substances or mixtures" on which EPA has taken action under Section 7 of the Toxic Substance Control Act, 15 U.S.C. 2606; these do not include petroleum or natural gas unless already included in the above categories. (See 42 U.S.C. 9601(14).)

The concentration at which the presence of a hazardous substance in the soil or groundwater would render that media as HTRW is not specifically defined in ER 1165-2-132. On a previous project (Indian River Lagoon South – C-44 Component), USACE acknowledged that the presence of hazardous substances at concentrations below all regulatory criteria did not constitute HTRW.

Therefore, for the purposes of this document PSI has considered HTRW soils to be any soils at point source locations exhibiting concentrations of target analytes exceeding any of the following criteria:

- FDEP Soil Cleanup Target Levels
- SQAG-PEC criteria
- USFWS Interim Screening Criteria for Copper (85 mg/kg)
- USFWS Interim Screening Criteria for Selenium (2 mg/kg)

PSI has considered HTRW groundwater to include any groundwater associated with a point source release exhibiting concentrations of target analytes exceeding the FDEP Chapter 62-

777, FAC Groundwater Cleanup Target Levels or Federal Maximum Concentration Levels (MCLs) for drinking water.

It should be noted that it is the District's position that the residual agrochemicals that are not associated with a spill, but are associated with purposeful application of these chemicals. These agrochemicals are not CERCLA regulated substances, and therefore are not subject to the USACE HTRW policy because:

1. Historical evidence shows long-term agricultural production on the site,
2. The chemicals found on site are active ingredients found in commercially available products registered under the 1947 Federal Insecticide, Fungicide and Rodenticide Act (FIFRA),
3. The concentrations of these chemicals found on site are within a range reflecting long-term application of chemicals on the cultivated lands in a customary manner, and
4. The site specific research has revealed no evidence of illegal activities causing the presence of these chemicals on site,

Therefore, it is reasonable to surmise that these chemicals were legally applied as part of farming activities for their intended purpose and that they were not the result of a spill or waste management action.

2.2.9 Hazardous Waste Criteria

While none of the media within the project footprint are considered to be hazardous wastes under the Resource Conservation and Recovery Act (RCRA), the hazardous waste rules under 40 CFR 260-265, and Chapter 62-730, FAC were considered applicable and were considered in our evaluation of the data.

As discussed below, none of the residual agricultural chemicals on the project site exhibit any of the hazardous waste characteristics even though none of the residual agricultural chemicals on site are considered a solid waste (chemicals were lawfully applied for their intended purpose and not discarded). For soil or groundwater to be considered a RCRA hazardous waste, it would first need to be classified as a solid waste.

Per Subpart C (40 CFR 261.20 et seq.) the four (4) RCRA characteristics of hazardous waste are: ignitability, corrosivity, reactivity, and toxicity. Ignitable wastes readily catch fire, sustain combustion, and when ignited, burn so vigorously and persistently that it creates a hazard. Corrosive wastes are a liquid and are acidic or alkaline wastes that readily corrode or dissolve flesh, metal, or other materials. Reactive wastes are unstable, readily explode or undergo violent reactions.

The fourth characteristic is toxicity. Toxic wastes leach toxic compounds or elements into underlying soils or groundwater supplies. For a toxic constituent in 40 CFR 261, Subpart C, demonstration of the RCRA toxicity characteristics can be determined by utilizing the Toxicity Characteristics Leachate Procedure (TCLP) test or by analyzing for total constituent concentration and applying the "Rule of 20" to infer whether the RCRA Toxicity Characteristics regulatory limits would be exceeded. The "Rule of 20" allows a toxicity determination to be made by comparing the total concentration analysis (dry weight) to the TCLP regulatory concentration (wet weight). The rule is used by multiplying the RCRA TCLP limit (mg/l) by 20 and then comparing this value to the measured total constituent concentration (mg/kg). If the measured total constituent concentration value is less than the TCLP concentration multiplied by 20, the material cannot be a RCRA characteristic waste based on toxicity as determined by analytical procedures. Additionally, if the constituent is not listed in Table 1 of Subpart C, the material is not a RCRA characteristic waste based on toxicity.

Based on the "Rule of 20" none of the soil or groundwater containing residual agricultural chemicals on the project site are classified as a RCRA toxic hazardous waste. Therefore, the remaining residual agricultural chemical soils on site are not hazardous waste under RCRA.

None of the soils or groundwater within the project boundary exhibit any of the hazardous waste characteristics. The concentrations of the remaining residual agricultural chemicals are not sufficient to render the soil or groundwater toxic, corrosive, ignitable or reactive. Therefore, testing for these characteristics is not necessary.

3. SUMMARY OF PREVIOUS REPORTS

All of the properties within the A-2 Reservoir project area have been previously investigated through a series of environmental investigations. The primary parcel (Tract D7100-104) was initially investigated as a part of the Talisman Ranch, which was acquired by SFWMD in 1999. It should be noted that the Talisman reports include a far greater area than is contained within the current reservoir footprint. Only those portions of the Talisman Ranch within the current A-2 Reservoir project footprint are discussed below.

At the time of the initial investigation, several point source areas of concern were identified, and these areas were deferred from the transfer in 1999. These areas were surveyed and legal descriptions were created. SFWMD has assigned tract numbers D7100-044, D7100-047, D7100-066, D7100-139, and D7200-005 to these deferred parcels. Each of these areas was separately investigated and remediated and closure obtained from FDEP. These parcels were transferred to SFWMD in 2009. It should also be noted that the 10-acre Weinlan property, Tract D7100-141 was also included within the Talisman investigations as this parcel is completely surrounded by the Talisman Ranch, and was being leased by Talisman at the time that the initial investigations were completed. The deferred parcel locations are shown on **Figure 3-1.**

3.1 Former Talisman South Ranch

The Talisman South Ranch property consists of approximately 20,525 acres that has been used for the cultivation of sugar cane since the mid-1960s. Prior to that it was undeveloped wetlands. The property was continually operated by Talisman from the 1960's until 1999 when the property was acquired by SFWMD. Subsequent to the SFWMD acquisition the section of the property within the A-2 Reservoir footprint has been operated under a lease agreement by New Hope Sugar Corporation from 1999 to present. Tract # D7100-104 lies within portions of Sections 4, 5, and 6, Township 45 South Range 37 East, a portion of Section 13, Township 46 South, Range 35 East, Sections 15 – 36, Township 46 South, Range 36 East, Sections 5 – 9, 16 – 22, 26 – 30, and portions of Sections 4, 10, 14, 23 – 25, 31- 36, Township 46 South, Range 37 East, and a portion of Section 31, Township 46 South, Range 38 East.

A summary of assessment and corrective actions performed on the Former Talisman South Ranch is provided in **Table 1**. A summary of previous environmental reports prepared for the subject property is provided in **Table 2**, and each of these reports is further described in the following sections.

3.1.1 Summary of Phase I/II ESA

<u>Environmental Concerns Summary Report, 1996, (Dames & Moore)</u>

Dames & Moore conducted a preliminary site assessment of the Talisman Sugar Corporation farm (Tract D7100-104) and sugar mill (Tract D7100-029) in 1996. The sugar mill parcel is outside the current project footprint and is not discussed herein. Additionally, only the western portion of Tract D7100-104 is within the project footprint and only this section of the parcel is discussed herein.

PSI was unable to obtain a copy of this report; however, the report was summarized in the Phase II Environmental Site Assessment described below, which was also prepared by Dames and Moore. The scope of work for the Environmental Concerns Summary Report was similar in nature to a Phase I Environmental Site Assessment (ESA) and included site reconnaissance, interviews with the property owner and government officials, review of governmental databases for regulated facilities and spill sites, and a review of available historical resources. The Phase I ESA identified the following areas of concern on Tract D7100-104, which are within the A-2 Reservoir Footprint:

- A solid waste disposal area within a former borrow pit
- Seven point source areas within a former labor camp
- Three diesel powered pump stations
- An electric pump station
- A pesticide mix/load area

The areas of concern are summarized in **Table 1**. Dames and Moore identified each area of concern with a unique identification number, which included the farm name code, followed by a numeric id number. For example, the Talisman Farm labor camp was designated as T-3, and smaller areas of concern within the labor camp were designated as T-3.1-Pesticide Mix-Load Area, T-3.2-Burn Area, etc.

These areas of concern, shown on were all investigated during the Phase II ESA discussed below.

<u>Volume 1 – Acquisition Properties Phase II Environmental Site Assessment Talisman Sugar Corporation Properties, Palm Beach and Hendry Counties, for South Florida Water Management District, November 9, 1998, (Dames & Moore).</u> **(See Appendix A-1)**

Dames & Moore (D&M) conducted a Phase II Environmental Site Assessment (ESA) in 1998 at the Talisman Farm. This assessment included the entirety of Tracts D7100-104 and D7100-029 (sugar mill), as well as multiple tracts that are outside the project footprint. Only results from investigation conducted within Tract D7100-104 are discussed herein.

D&M conducted an extensive Phase II investigation to evaluate all of the areas of concern listed in **Table 1**. These areas included:

- T-2 Borrow Pit Landfill
- T-3 Labor Camp
  - T-3.1 Pesticide mix/load area
  - T-3.2 Aircraft Refueling Area/Runway
  - T-3.3 Burn Pit
  - T-3.4 Drum Storage Area
  - T-3.5 Aircraft Maintenance Building
  - T-3.6 Water Treatment Plant
  - T-3.7 Miscellaneous Area
- T-6 Electric Pump Station
- T-7 Diesel Pump Station
- T-8 Diesel Pump Station
- T-21 Pesticide mix/load area
- T-24 Diesel Pump Station

The Phase II ESA included the collection of soil and groundwater samples from each of the areas of concern. Test trenching was also completed in a number of areas where suspect buried debris was identified. D&M conducted a comprehensive evaluation of current and historical agrochemical use on the property in order to determine the list of chemicals of potential concern. The analytical testing methods varied between locations, depending upon the specific concern. For example, analysis for total petroleum hydrocarbons (TPH) was conducted for pump stations, but more extensive analysis, including RCRA metals, copper, chlorinated pesticides and herbicides, triazine herbicides, and organophosphorus pesticides were conducted at pesticide mix load areas, equipment staging areas, and burn pits. The analyses did not include selenium, as this metal was not yet identified as a potential concern in 1998.

Based on the Phase II investigation, D&M eliminated T-3.5, T-3.6, T-3.7, and T-24 as concerns. The remaining areas where impacts were detected are discussed below.

D&M conducted an electromagnetic survey and test trenching to determine the extent and type of waste disposal in this area. The extent of the former borrow pit was defined, and D&M determined that the pit had been backfilled with agricultural wastes (e.g., bagasse) and agricultural equipment parts. Some oil containing equipment, hydraulic hoses, etc. were identified in the test trenches. Five soil samples and twelve groundwater samples were collected from the solid waste borrow pit area. The soil analytical results reported detectable concentrations of TRPH while the groundwater analytical results detected m&p cresol and phenol above the Groundwater Cleanup Target Levels (GCTLs). D&M recommended further assessment of the groundwater and removal of the solid waste from the pit.

Eighteen soil samples and sixteen groundwater samples were collected from the Talisman labor camp. The soil analytical results indicated elevated levels of TRPH at the burn pit and drum storage area. Elevated levels of atrazine were detected in groundwater samples collected from the pesticide storage / mix & load area and the airplane refueling area / runway. The groundwater analytical results also indicated concentrations of PAHs above the GCTLs. Further investigations were recommended at the pesticide storage / mix & load area and refueling area / runway, burn pit, and the drum storage area.

D&M obtained one soil sample and installed two groundwater monitoring wells at T-21 Pesticide Mix/Load Area. The soil and groundwater results indicated the presence of arsenic at concentrations above the applicable regulatory standards. The arsenic concentration detected in Soil Sample, T-21SC-1 was reported at 100 mg/kg. Monitoring Well T-21-MW-45 had a reported arsenic concentration of 448 micrograms per liter (μg/L), while T-21-MW-52 had a reported arsenic concentration level of 122 μg/L. Both analytical results are above regulatory guidelines. Further site assessment was recommended to delineate the impacted soil and groundwater.

D&M conducted visual observations at T-7 and excavated one test trench on the southwest side of the pump station. The test trench log indicated the presence of stained soils, but no Organic Vapor Analyzer (OVA) measurements were recorded. No laboratory testing of soil or groundwater was performed at this pump station and it was included as an Exclusion Area based on visual evidence only.

D&M conducted visual observation and exploratory trenching around the pump station at T-8. D&M excavated two test trenches along the east and west sides of the AST; no staining or evidence of environmental concerns were noted in the trench log. D&M did not conduct laboratory analysis of soil or groundwater at this location; however, T-8 was included as an Exclusion Area.

Soil analytical results revealed elevated concentrations of chlorinated pesticides at concentrations exceeding the SQAG-TEC criteria at electric pump station T-6. No groundwater samples were collected from this location. Further site assessment was recommended to determine the extent of pesticide impacts in soil.

Six areas of concern (T-2, T-3, T-6, T-7, T-8, and T-21) were identified as "Exclusion Areas" with known impacts in the D&M Phase II ESA. These exclusion areas are shown on **Figure 3-1**. D&M defined a buffer area around each area of concern, and legal descriptions were created for these areas. The Exclusion Areas were deferred during the land transfer from Talisman to SFWMD until such time as Talisman obtained SRCOs on these Exclusion Areas from FDEP. Talisman was required to assess and remediate these areas to the lower of the SCTL criteria or the SQAG-TEC criteria, whichever was lower. The assessment and remediation activities performed on these Exclusion Areas is described below in Section 3.1.2. Talisman did obtain SRCO's for all of these Exclusion Areas and they were eventually transferred to SFWMD.

Site Inspections/Environmental Assessment Deferred Parcels – Former Talisman Property, Palm Beach County, Florida, dated July 17, 2007 (URS Corporation). **(See Appendix A-2)**

The deferred parcels were conveyed to the District as part of the purchase and exchange agreement between the District and U.S. Sugar Corporation. URS reviewed regulatory files to confirm that the deferred parcels had received regulatory closures from the State and conducted site inspections of each parcel. URS concluded that each parcel had received either a No Further Action or a Site Rehabilitation Completion Order and that no obvious impacts had occurred at the parcels since 1999.

Final Site Inspections/Environmental Assessment Deferred Parcels – Former Talisman Ranch Report, Palm Beach County, Florida, January 21, 2009 (URS Corporation). **(See Appendix A-3)**

Final inspections were conducted of the deferred parcels that were conveyed to the District as part of the purchase and exchange agreement between the District and U.S. Sugar Corporation. URS conducted site inspections of each parcel and concluded that no obvious impacts had occurred at the deferred parcels since 1999.

Everglades Agricultural Area Basin Reservoir – Phase I Environmental Assessment Summary Document, March 18, 2003 (URS Corporation). **(See Appendix A-4)**

URS summarized all of the historical assessments and corrective actions on the Talisman Sugar Corporation Farm conducted as of 2002. This summary report was developed as part of the EAA Basin Reservoir – Phase I for the Project Delivery Team (PDT). One comment was received from the PDT and subsequently addressed.

3.1.2 Summary of Corrective Actions

A Corrective Actions Location Map is included as **Figure 3-2**. A summary of the corrective actions performed is included in **Table 1**. More detailed information regarding the corrective actions performed on this tract is summarized below:

Site Rehabilitation Completion Report – Talisman Sugar Corporation T-2 (Borrow Pit), February 2002 (PSI) **(See Appendix A-5)**

The Talisman Borrow Pit was a former rock quarry that was filled with vegetative matter, debris, tires, and equipment from farm and sugar mill operations. The former Borrow Pit is located within the former Talisman South Ranch property. More specifically it is located six miles west of US Highway 27 and approximately 16 miles south of the City of South Bay. The pit lies within Section 28, Township 46 South, Range 36 East, as referenced on the USGS "Everglades NW, Florida" Topographic Map. The location of the former Borrow Pit is shown of **Figure 3-2**. A summary table of the range of detected concentrations, after any corrective actions, is provided in **Table 3**.

During PSI's initial assessment of the Borrow Pit, twelve soil samples were collected from the Pit and a test pit was excavated on the southern portion of the Pit. Low levels of TPH and various PAHs were detected in all of the samples. Several metals were also detected in the soil samples, but were below their respective regulatory criteria. Metal debris was encountered in the test pit and was hauled off-site.

PSI conducted a source removal to remove the metal debris and petroleum contaminated soil from the pit. Based on an agreement with FDEP, the bagasse was allowed to remain in the pit. Prior to excavation activities, PSI constructed haul roads, soil and debris staging areas, an infiltration pond, a water treatment system, and excavated a de-watering trench. During the excavation of the Pit, debris was separated from the soil using various forms of heavy equipment. The miscellaneous debris was hauled off-site to a land fill or recycling center. The remaining soil was transported to a soil stockpile staging area. Clean soil, which was defined as all contaminants of potential concern (COPCs) were below the soil cleanup target levels for leaching to groundwater (SCTL-LGW) criteria, was set aside to be used as backfill upon completion of the excavation. The SCTL-LGW criteria was used as the determining factor for clean vs. dirty soil, due to the fact that the excavation area was going to be covered with at least 2 ft. of clean fill.

As a result of the excavation activities, approximately 1,009 tons of steel, 473 tons of tires, 3,895 tons of construction and demolition (C&D) debris, and 3,735 tons of soil which did not meet the clean soil criteria was transported off-site to a disposal facility. In addition to the excavation activities, PSI installed a groundwater treatment system. Due to the inability of the system to filter out lead from the groundwater, the treatment system operation was abandoned after several trials.

Once excavation activities were complete, PSI removed the equipment staging areas, the impoundment berm, decommissioned the soil stockpile staging area and backfilled the Borrow Pit. As previously mentioned, almost all of the soil removed from the borrow pit was transported off-site for disposal. Only a small amount of soil met clean soil standards which allowed for use as backfill. This small amount of soil was returned to the southeast corner of the former borrow bit and covered with at least 2 ft. of clean, overburden soils. After completion of the backfilling and grading, two small ponds remained in the south and northwest portions of the Pit.

Surface water samples were collected from varying depths from the two remaining ponds. The samples were analyzed for TPH and total lead, as those were the only analytes detected in the soil or groundwater. Several sampling events occurred from June 2000 to October 2001, and the final results indicated the water in both ponds was below the groundwater and surface water standard for lead.

Lead was identified as the only COPC in the groundwater and surface water at the site. The removal of significant quantities of metal waste and lead-impacted soil has effectively removed the source of this contamination. The most recent surface water sampling results indicate that lead concentrations in the surface water in both the north and south ponds are below the Chapter 62-777, FAC groundwater and surface water criteria for lead.

PSI recommended that FDEP issue a Site Rehabilitation Completion Order (SRCO) with a non-residential use deed restriction for this exclusion area. As part of the deed restriction, the engineered cover over the site must remain in place. The FDEP issued an SCRO with conditions on July 21, 2006. A copy of the SRCO is included in **Appendix B-1**.

Site Rehabilitation Completion Report – Talisman Sugar Corporation T-3 (Labor Camp), March 2003 (PSI) **(See Appendix A-6)**

The former Labor Camp is located within the former Talisman South Ranch property. More specifically it is located approximately seven (7) miles west of US Highway 27 and approximately 16 miles south of the City of South Bay. The camp lies within Section 20, Township 46 South, Range 36 East, as referenced on the USGS "East of Little Cypress, Florida" Topographic Map. The location of the former Labor Camp is shown of **Figure 3-2**. A summary table of the range of detected concentrations, after any corrective actions, is provided in **Table 4**.

The T-3 exclusion area encompasses 10 acres and formerly operated as residential housing for farm workers (aka a labor camp). The labor camp ceased operation in about 1971 and the property was then utilized by a crop-dusting operation until 1999. The exclusion area includes four former concrete buildings used as residential quarters, an aircraft landing strip, and a pesticide mixing/loading area for loading agrichemicals into aircraft. All of the buildings were demolished down to the slab by PSI. Fueling and minor maintenance of single engine aircraft was also performed at the site. Four ASTs were also located within the exclusion area. Other areas of interest on the site included a wastewater treatment plant for domestic wastes associated with the former labor camp and a concrete burn pit for burning of empty agrichemical containers. All of the site features are shown on Figure 2 of the SRCR for the T-3 Labor Camp found in **Appendix A-6**.

All of the structures on the property were demolished in 2000. The fuel ASTs were removed and PSI submitted a Storage Tank Closure Report, dated April 9, 2001, which is discussed separately below. All of the drums and containers were removed from the buildings and disposed off-site under manifest. The concrete sump and trench drain in the pesticide mix/load area were cleaned and demolished. The trailers used for agrichemical storage were demolished or sold for use elsewhere. The concrete buildings were demolished down to the slab and the concrete rubble was crushed and used off-site for road base. Currently the concrete slabs and foundations are the only structures remaining in place.

The Dames and Moore Phase I/II identified seven (7) areas of potential concern. These areas are shown on Figure 2 of the SRCR and listed below:

- Runway Area
- Re-Fueling Area
- Pesticide Mix/Load Area
- Burn Pit Area

- Drum Storage Area
- Aircraft Maintenance Area
- Wastewater Treatment Plant

Dames and Moore conducted Phase II activities at each of these locations. The scope of work varied between each location, but generally consisted of exploratory test pits, soil sampling, and groundwater sampling. Based on the results of these investigations, PSI established the following list of COPC for the former Labor Camp:

- Organophosphorus pesticides (including atrazine)
- Organochlorine pesticides
- RCRA Metals (including arsenic, cadmium, and lead)
- VOCs (Re-Fueling Area only)
- Dioxins and furans (Burn Pit only)

Based on the results from the Dames and Moore investigation only five (5) areas (mix/load, burn pit, drum storage, aircraft maintenance, and wastewater treatment plant) required additional soil investigation and only two (2) areas (re-fueling, and mix/load) required additional groundwater investigation. The additional investigation generally consisted of additional soil samples to delineate soil impacts and the installation of an additional monitoring well to delineate groundwater impacts.

Based on the site characterization data collected by both PSI and D&M, PSI determined that remediation of five areas would be required. These areas are listed below and shown on Figure 5 of the SRCR for the T-3 Labor Camp found in **Appendix A-6**.

Area #1: Pesticide and metals impacted soils in the pesticide mix/load area centered around soil sample location SS-18;

Area #2: Atrazine-impacted soils in the pesticide mix/load area centered around SS-17;

Area #3: Atrazine-impacted soils in the pesticide mix/load area centered around D&M sample T-3.2SC-7.

Area #4: Pesticide and metals impacted soils in the drum storage area (Building D) centered around SS-5 and SS-27; and,

Area #5: Lower concentration pesticide and metals impacted soils around the north and east sides of Building C extending east of SB-4.

The extent of excavation for each of these areas is shown on Figures 5 and 6 of the SRCR for the T-3 Labor Camp found in **Appendix A-6**. Soils were excavated using a trackhoe and temporarily stockpiled on plastic sheeting adjacent to the excavation area pending laboratory analysis and disposal facility acceptance. The excavation and post-excavation confirmation soil sampling strategy for each of these areas varied according to the amount of site characterization data available. A total of 1038.5 tons of pesticide and metal impacted soils were excavated and disposed off-site at WMI-Okeechobee. An additional 1,890 cubic yards of impacted soil was excavated and transported to the Talisman Sugar Mill Ash Pit for disposal. Upon completion of the excavations, PSI collected confirmation soil samples from the sidewalls and base of each excavation. The confirmation soil sampling results indicated that no soils exceeding either the SQAG-TEC or applicable SCTL criteria for any COPC remained on site, except for a single soil sample in Area #1 which contained an atrazine concentration (93 μg/kg), which slightly exceeded the SCTL-LGW criteria of 60 μg/kg. However, PSI did not believe this single detection warranted further excavation given the high organic content of the soils and the fact that the concentration only slightly exceeded the SCTL-LGW criterion in the upper 1 foot of soil column. Atrazine concentrations were shown in the site characterization phase to attenuate rapidly with depth.

The D&M Phase II ESA identified only three monitoring wells on the site which were impacted by petroleum hydrocarbon constituents and/or atrazine. The impacts were defined by the remaining wells installed by D&M and PSI, in which no COPC were detected. PSI conducted several rounds of monitoring at the affected wells and found that both the atrazine and the petroleum constituent concentrations attenuated rapidly over time. The petroleum constituents attenuated to below the GCTLs without the need for any remediation. The atrazine concentrations were significantly reduced, but a source removal was required to further reduce the concentrations to below the GCTL at MW-51. Upon completion of the excavation around MW-51, PSI installed and sampled a replacement well MW-51R and the results indicated that the source removal was sufficient to remediate the atrazine concentrations in the groundwater to below the GCTL.

Based on this information, PSI recommended that FDEP issue a Site Rehabilitation Completion Order (SRCO) with a non-residential use deed restriction for this exclusion area. The FDEP issued an SCRO with conditions on July 21, 2006. A copy of the SRCO is included in **Appendix B-2**.

Tank Closure Report – Talisman Sugar Corporation – Talisman Labor Camp (Abel's Flying Service), April 2001 (PSI) **(See Appendix A-7)**

This report was prepared to document tank closure activities associated with two 4,000-gallon steel aviation gasoline (AV-Gas) aboveground storage tanks (ASTs) located within the former Labor Camp described above. The ASTs were mounted on concrete saddles within secondary containment and located in the northeast quadrant of the Labor Camp.

The ASTs and containment basin were inspected and were deemed to be in good condition with no holes, cracks or leaks. PSI excavated two test trenches adjacent to each side of the secondary containment basin. Six soil samples were collected from the sides of the test trenches for field screening using an OVA and no readings were above 10 ppm. PSI collected two confirmation soil samples for laboratory analysis for PAHs and VOAs.

A groundwater monitoring well was previously installed as part of the site wide assessment performed by D&M in 1998. The well was installed approximately 18 feet southeast of the ASTs containment basin and was deemed suitable for the tank closure assessment. The well was sampled in 1999 for OPPs, VOAs, and TPH.

PSI concluded that no contaminated soil was detected within the excavation around the secondary containment basin either visually or by the OVA. Confirmation laboratory analyses indicated no concentrations above detection limits. Groundwater samples were collected from the well located 18 feet southeast of the containment basin and indicated no analytes were detected above GCTLs. Based on this data PSI recommended the FDEP grant No Further Action status for the tank. FDEP accepted the closure report in a letter dated May 23, 2001; a copy of the FDEP letter is provided in **Appendix B-3.**

<u>Limited Contamination Assessment Report/No Further Action Request – Talisman Sugar Corporation – Talisman Sugar Farm – T-6 (Electric Pump Station), August 1999 (PSI)</u> **(See Appendix A-8)**

This Electric Pump Station (T-6) was part of the former Talisman Sugar Corporation property. The site lies within Section 25, Township 46 South, Range 36 East, as referenced on the United States Geological Survey (USGS) "South of Okeelanta", Florida" 7.5 minute quadrangle map. A Site Location Map is included as **Figure 3-2**. This site consists of an electric pump station that includes two electric pumps, two breaker boxes on a concrete slab, a valve platform, valve pipes, and various drainage pipes. A Site Map is included as Figure 2 of the LCAR/NFA Request for the T-6 Pump Station found in **Appendix A-8**. The property was utilized by Talisman as an electric pump station to maintain the water level in the adjacent canal. The pump station is located on fill material which bridges the canal and serves as a canal crossing for vehicles and equipment.

While D&M did not note any potential environmental concerns at this pump station, they did collect a soil sample from the T-6 area for the intended purpose of obtaining background levels for the Talisman Sugar Farm. The sample was analyzed for RCRA Metals, OCPs, OPPs, and chlorinated herbicides. DDE, DDT, and dieldrin were detected at concentrations exceeding the SQAG-TEC criteria. Arsenic was also detected at a concentration slightly exceeding the SCTL-RDE criteria. However, since the site is scheduled for flooding and residential use of the property will not be permitted, PSI determined that the Soil Cleanup Goal for direct residential exposure is not an Applicable or Relevant and Appropriate Requirement (ARAR) for this site. Therefore, arsenic was not further considered as a COC at this site. PSI did not conduct any testing for arsenic at T-6.

In February and May 199, PSI performed a soil investigation at this site consisting of collecting 20 soil samples from various locations and depths. The soil samples were analyzed for organochlorine pesticides by USEPA Method 8081. The initial analytical results were below the laboratory detection limits for all of the constituents included in USEPA Method 8081. However, the laboratory detection limits were above the SQAG-TEC criteria for a number of the COC. A second set of soil samples was collected from approximately the same locations as the original data points. All of the EPA Method 8081 analytes were below the laboratory detection limits. Although the laboratory detection limits were above the SQAG-TEC criteria for a few of the COC, the detection limits represent the best available technology.

Based on the site characterization soil analytical results, it appears that no soils exceeding the SQAG-TEC and/or SCTL-IDE or SCTL-LGW criteria are present at this site. No groundwater sampling was conducted at the site by either D&M or PSI. However, groundwater sampling did not appear warranted at this site given the absence of COC in soil at concentrations exceeding the SCTL-LGW criteria.

PSI believed that the information contained within the report was sufficient to conclude that no further action is required for the subject site. Therefore, on behalf of Talisman, PSI recommended that the FDEP issue a "No Further Action" letter for the subject site. The FDEP issued a No Further Action for this site on December 21, 1999; a copy of the letter is included in **Appendix B-4**.

<u>Limited Contamination Assessment Report/No Further Action Request – Talisman Sugar Corporation – Talisman Farm – T-7 (Pump Station), September 1999 (PSI)</u> **(See Appendix A-9)**

This Pump Station (T-7) was part of the Talisman Sugar Corporation property. This site lies within Section 27, Township 46 South, Range 36 East, as referenced on the United States Geological Survey (USGS) "Everglades 1 NW", Florida" 7.5 minute quadrangle map. A Site Location Map is included as **Figure 3-2**.

This site consists of an agricultural pump station which is used to maintain water levels in an adjacent irrigation canal. The pump station was identified by Talisman personnel as Pump Station PS-4. The pump station includes a 500-gallon capacity diesel fuel AST inside a concrete containment basin, a diesel-powered pump engine, and a vertical shaft turbine pump. The storage capacity of the AST at this pump station is less than 550 gallons and is therefore not regulated under Chapter 62-761, FAC. The pump station is located by the side of the canal and is fully enclosed (AST and motor) in a concrete containment basin with a roof. Fuel is transferred from the tank to the motor via above-ground, one inch diameter steel-mesh rubber coated diesel supply and return lines. An on-demand vacuum system is used to transfer fuel to the pump engine. There was no obvious staining around the outside of the containment basin. However, there were small stains located inside the containment area. Figure 2 of the LCAR/NFA Request for the T-7 Pump Station found in **Appendix A-9** illustrates the site layout.

In April 1999, PSI personnel conducted preliminary site characterization activities at T-7. PSI did not note any evidence of soil staining or petroleum odors during our site investigation. Fourteen surficial soil samples were collected from around the pump station for OVA-FID screening. No OVA-FID readings in excess of 10 ppm were recorded. Therefore, PSI selected four surficial soil samples for laboratory analysis by laboratory method FL-PRO for TPH and EPA Method 8100 for PAHs. No PAHs were detected in these soil samples and the highest measured TPH concentration was 15 mg/kg. This TPH concentration is well below the SCTL-residential direct exposure I and SCTL-leachability criteria. No SQAG-TEC criteria has been established for TPH. Additionally, PAHs were not detected above the LMDLs (5 ug/kg) in the second set of soil samples collected on July 1, 1999.

Based on the soil screening and analytical results, it appears that no soils exceeding the SQAG-TEC criteria or SCTL criteria are present. Based on the lack of COCs in the soil at T-7, PSI did not believe that installation of a monitoring well for the purpose of groundwater sampling was warranted at this location.

PSI recommended that the FDEP issue a "No Further Action" letter for the subject site. The FDEP issued a No Further Action for this site on December 21, 1999; a copy of the letter is included in **Appendix B-5**.

Site Rehabilitation Completion Report – Talisman Sugar Corporation – Talisman Farm – T-8 (Pump Station), September 1999 (PSI) **(See Appendix A-10)**

This Pump Station (T-8) was part of the Talisman Sugar Corporation property. This site lies within Section 27, Township 46 South, Range 36 East, as referenced on the United States Geological Survey (USGS) "South of Okeelanta, Florida" 7.5 minute quadrangle map. A Site Location Map is included as **Figure 3-2**.

This site consists of an agricultural pump station which is used to maintain water levels in an adjacent irrigation canal. The pump station was identified by Talisman personnel as Pump Station PS-5. The pump station includes an approximately 500-gallon capacity, AST inside a steel containment basin, a diesel-powered pump engine, and a vertical shaft turbine pump. The storage capacity of the AST at this pump station is less than 550 gallons and is therefore not regulated under Chapter 62-761, FAC. The AST and its steel containment structure are located on a concrete slab with the pump engine and turbine pump. Flexible 1" diameter steel-mesh rubber coated diesel supply and return lines run above-grade between the AST and pump engine. An on-demand vacuum system is used to transfer fuel to the pump engine. The containment basin also has a metal corrugated roof structure. The pump engine for the station rests on a concrete slab, which extends over the northeast edge of the canal. The concrete slab was covered by a metal corrugated roof structure, but is not surrounded by a berm to prevent run-off. Figure 2 of the SRCR for the T-8 Pump Station found in **Appendix A-10** illustrates the site layout.

PSI conducted site characterization soil sampling around the concrete pad containing the AST containment and the pump engine. Soil samples collected from all sides of the pump station indicated no OVA-FID readings in excess of 5 PPM and no surficial staining or petroleum odors were noted by PSI. However, laboratory analysis of soil samples collected from a depth of 0-2 feet BLS on all sides of the pump station indicated the presence of several PAH compounds at concentrations exceeding the SQAG-TEL criteria, but significantly below the SCTL-leachability criteria. As stated in the SRA, the SQAG-TEL criteria apply only to the upper 6 inches of soil column within the proposed reservoir area.

In order to remove soils containing PAH concentrations exceeding the SQAG-TEL criteria within the upper six inches of soil column, PSI conducted excavation around the north, east, and west sides of the pump station to a depth of at least 6 inches BLS. A total of 6.36 tons of petroleum impacted soil was removed. Upon completion of the excavation, four soil confirmation samples were collected. The laboratory results did not indicate the presence of any PAH compounds at concentrations exceeding the SQAG-TEL criteria. Based on the lack of soils containing TPH or PAH concentrations exceeding the SCTL-leachability criteria, PSI did not believe investigation of the groundwater was warranted at this location.

PSI recommended that the FDEP issue a SRCO for the subject site. The FDEP issued a SRCO for this site on December 21, 1999; a copy of the SRCO is included in **Appendix B-6**.

Site Rehabilitation Completion Report – Talisman Sugar Corporation – Talisman Farm – T-21 (Pesticide Mix/Load Area), May 2002 (PSI) **(See Appendix A-11)**

This Pesticide Mix/Load area (T-21) was part of the Talisman Sugar Corporation property. This site lies within Section 17, Township 46 South, Range 36 East, as referenced on the United States Geological Survey (USGS) "East of Little Cypress Swamp" 7.5 minute quadrangle map. A Site Location Map is included as **Figure 3-2**. A summary table of the range of detected concentrations, after any corrective actions, is provided in **Table 5**.

This site consists of a pesticide mixing and loading area also utilized for storing and staging of farm equipment. The site is developed with a small corrugated metal shed, approximately 30 feet by 12 feet, with an overhang. The interior of the storage shed was concrete floored. The shed appeared to have been utilized for storing pesticides in the dry granular form. However, it is possible that liquid pesticides may have been stored there as well. A Site Map is included as Figure 2 of the SRCR for the T-21 Pesticide Mix / Load Area in **Appendix A-11**. The property was utilized by Talisman for mixing and loading of pesticides in addition to storing farm equipment. It was also used as a collection point for sugar cane during harvest activities. No significant staining was noted during this fieldwork; however, pesticide odors were detected. The pesticides appeared to have been used in ground application. No water wells, restroom facilities, septic systems or fueling facilities were located on-site.

Potential constituents of concern (COC) at the subject site which were identified in the D&M Phase II ESA, included arsenic in soil and groundwater. At the request of the FDEP, groundwater analytical testing was performed for dioxins.

PSI collected 49 surface soil samples (0-2 feet bls) and nine deep soil samples (two to four feet bls) on a grid basis across the site. The highest arsenic concentration detected was 48.0 mg/kg. Four separate arsenic impacted areas were defined encompassing a total of approximately 13,500 square feet. Soils within these areas were excavated to a depth of six inches below original grade and transported to Magnum Environmental Services, Inc. for thermal treatment and incorporation into asphalt products. A total of 686.25 tons of arsenic-impacted soil was excavated on May 3 through 7, 1999 for treatment by Magnum.

Following excavation activities, 24 confirmation soil samples (T-21SS-50 – T-21SS-73) were collected from the base of the excavation on a grid basis. Based upon the results, concentrations of arsenic above the SCTL-LGW screening criteria of 10 mg/kg were detected in five of the samples. These samples were analyzed by EPA Method 1312/6010 for SPLP arsenic. The results indicated that an SPLP arsenic concentration exceeding the GCTL was detected in one of the samples (T-21-SS-52).

Based on the SPLP arsenic concentration detected in confirmation sample T-21SS-52, PSI excavated an additional 6.35 tons of soil from around this location on July 1, 1999. The excavation was continued vertically to a depth of about 2 feet bls. After completion of the excavation, three additional confirmation soil samples (T-21SS-74 – T-21SS-76) were collected from the base of the excavation for arsenic analysis. The measured arsenic concentrations in these samples were below all regulatory criteria. Following this excavation, the area was backfilled to grade.

PSI also installed five additional monitoring wells and collected groundwater samples for analyses for arsenic. Groundwater samples were also collected from D&M wells T-21-MW-45 and T-21-MW-52 on two separate dates for analysis for arsenic. In addition, groundwater samples from D&M well T-21-MW-45 were analyzed for dioxins/furans, TPH, PAHs and VOAs. The results indicated that arsenic concentrations above GCTLs were detected in T-21MW-45, T-21MW-52, and T-21-MW-3. The highest arsenic concentration detected was 120 μg/L in the groundwater sample collected from T-21-MW-52. All other parameters were either below detection limits or below applicable GCTLs.

Based upon the groundwater analytical results, PSI installed and operated a groundwater pump and treat remediation system in order to reduce the arsenic concentrations in the groundwater. The treatment system consisted of two recovery wells, tray stripper aeration and filtering with granular aluminum oxide. Following treatment, the water was sprayed over the northwestern portion of the site via low flow sprinkler heads mounted on five-feet tall poles. The treatment system was operated for a period of about 3 months and was shut down when arsenic concentrations in the influent were consistently below the GCTL for four consecutive sampling events.

Following system operation, groundwater samples were collected on multiple occasions from previously impacted monitoring wells and analyzed for arsenic. Results of the last sampling event indicate that the groundwater meets the GCTL for arsenic concentrations.

PSI requested a SRCO with non-residential deed restrictions for this site; The FDEP issued a SRCO for this site on July 21, 2006; a copy of the SRCO is included in **Appendix B-7**.

Site Rehabilitation Completion Report – Talisman Sugar Corporation – Talisman Farm – T-24 (Pump Station), October 1999 (PSI) **(See Appendix A-12)**

Pump Station T-24 was part of the Talisman Sugar Corporation property. This site lies within Section 26, Township 46 South, Range 36 East, as referenced on the United States Geological Survey (USGS) "South of Okeelanta, Florida" 7.5 minute quadrangle map. A Site Location Map is included as **Figure 3-2**. A summary table of the range of detected concentrations, after any corrective actions, is provided in **Table 6**.

This site consists of an agricultural pump station which is used to maintain water levels in an adjacent irrigation canal. The pump station was identified by Talisman personnel as Pump Station IPS-3. The pump station includes a 3,000-gallon capacity diesel fuel AST inside a concrete containment basin, a diesel-powered pump engine, and a vertical shaft turbine pump. The storage capacity of the AST at this pump station is greater than 550 gallons and is therefore regulated under Chapter 62-761 FAC. The AST is registered under facility I.D. # 8623252. The pump station is situated on a fill material dike or plug which bridges the main east-west canal on the lower Talisman Farm. The dike is approximately 25 feet wide and includes the pump station and a gravel canal crossing access road. The AST is located on an approximate 8 inch thick concrete slab surrounded with a 2.5 feet high masonry block wall and is covered with a corrugated metal roof. The pump engine is located on an approximate eight (8) inch thick concrete pad. Figure 2 of the SRCR for the T-24 Pump Station found in **Appendix A-12** illustrates the site layout.

During the Phase II ESA investigation activities, D&M conducted visual reconnaissance and soil sampling at T-24. No evidence of soil staining was noted, but one soil sample was collected for laboratory analysis for TPH, which was not detected in the soil sample. Therefore, T-24 was not identified as an Exclusion Area in the Phase II ESA. However, a follow-up investigation performed by D&M and SFWMD in March, 1999 identified stained soil around the west side of the pump station due to a recent discharge. No soil samples were collected during this investigation.

Based upon visual observation and OVA-FID screening, a small amount of soil (0.68 tons) was excavated and removed from the site. A total of eight confirmatory soil samples were collected following excavation activities. The highest reported TPH concentration was 290 mg/kg. While, no SQAG-TEC has been established for TPH, the reported TPH concentration is well below the SCTL-LGW and SCTL-RDE criteria. PAH concentrations within the upper 6 inches of soil (the depth defined as "sediment") were below laboratory detection limits. PAH concentrations in the soil below 6 inches BLS are below the SCTL-LGW and SCTL-RDE criteria. The SQAG-TEC criteria does not apply to the soils below 6 inches bls.

Based upon the limited impact to the soil at the site no groundwater samples were collected. It does not appear that the referenced petroleum release could have affected groundwater at the subject site.

PSI recommended that the FDEP issue a SRCO for the subject site. The FDEP issued a SRCO for this site on December 24, 1999; a copy of the SRCO is included in **Appendix B-8**.

3.2 Summary of Restrictive Covenants

Restrictive covenants or deed restrictions exist on several of the parcels within the footprint of Talisman South Ranch (D7100-104), as shown on **Figure 3-3.** Tract D7100-066 (Former Borrow Pit – T-3), Tract D7100-047 (Talisman Labor Camp - T-2), and Tract D7100-044 (Pesticide Mix/Load Area – T-21) are all protected by deed restrictions preventing use of the property for residential or other sensitive purposes. Additionally the deed restrictions all include prohibitions on use of groundwater within the restricted areas. The deed restriction for the labor camp also includes provisions preventing excavation or disturbance of a clean soil cap that was placed over portions of the borrow pit.

Copies of all of the deed restrictions are provided in **Appendix C**.

3.3 Summary of Remaining HTRW Areas

The known HTRW soil areas remaining within the project footprint are located within the T-2 (D7100-047), T-3 (D7100-066) and T-21 (D7100-044) exclusion areas. These areas consist of point source areas where cleanup was completed and a conditional SRCO was issued, but contaminant concentrations remain at concentrations exceeding the SCTL-RDE criteria. Arsenic is the predominant COPC which is present at concentrations exceeding the SCTLs in these areas.

4. GEOLOGY/HYDROGEOLOGY

4.1 Regional Geology

The region is overlain by layers of Peat known locally as "muck". Muck is an organically rich soil that forms when the rate of accumulation of organic matter exceeds the rate of decay. The accumulation rate can vary, but can be as much as 10 centimeters per 100 years. Much of the muck has been subjected to subaerial exposure since the dewatering of large areas of marshland through water drainage canals. This exposure has had the effect of causing the muck volume to steadily decrease through biochemical oxidation, compaction, erosion, and fire. It is estimated that the muck soil in these dewatered areas diminishes by as much as 1 inch per year.

Underlying the muck is the Fort Thompson Formation, which is locally referred to as the "cap rock" and is primarily dense, fossiliferous limestone. The Fort Thompson Formation is considered to be Pleistocene in age.

The Caloosahatchee Formation underlies the Fort Thompson Formation. The Caloosahatchee Formation is a marl that is composed of a sequence of sandy limestone lenses that are interbedded with layers of calcareous clays and sands. The Caloosahatchee Formation appears to straddle the Pliocene/Pleistocene boundary.

Underlying the Caloosahatchee Formation, the Tamiami Formation is a complex Pliocene age unit of sand, clay, and reef facies, all of which contain at least small amounts of phosphate. The Tamiami Formation occurs over much of southern Florida and is unconformably overlain by the Caloosahatchee and Fort Thompson Formations, which consist of highly fossiliferous carbonates and siliclastic sediments.

Underlying the Tamiami Formation is the Miocene-age Hawthorn Group, which is composed of a variety of sediments including carbonates, quartz sands, clay, and phosphate. The Hawthorn Group has been subdivided into two formations; the Peace River Formation forming the upper Hawthorn siliclastic section and the Arcadia Formation, which forms the lower Hawthorn carbonate section.

The Hawthorn Group is underlain by a 3000-feet thick carbonate sequence consisting of Oligocene and Eocene aged sediments. The Suwannee Limestone, the Ocala Limestone, and the Avon Park Formation comprise the Oligocene sediments. The Eocene sediments are made up of the Oldsmar Formation.

4.2 Regional Hydrologeology

The underlying hydrogeologic formations of the area may best be categorized as two aquifers separated by an impermeable confining zone.

The shallow, nonartesian aquifer system extends to a depth of approximately 150 feet BLS and is recognized as the northernmost extension of the Biscayne Aquifer. It consists primarily of the Fort Thompson, Caloosahatchee, and Tamiami Formations. The base of the shallow aquifer is marked by the top of the Hawthorn Group, which is the intermediate confining unit for the underlying Floridan aquifer.

The deep, artesian aquifer is known as the Floridan Aquifer and is the most productive aquifer in the area, with permeable zones as deep as 1,200 feet BLS. The Floridan Aquifer consists of the lower units of the Hawthorn Group, the Suwannee Limestone, the Ocala Group, and the Avon Park Limestone.

Groundwater levels throughout the area vary from one to six feet BLS. Groundwater flow in the surficial aquifer is generally to the south-southeast; however, flow direction is strongly influenced by the system of canals and pumping stations present throughout the area. When the canals are pumped and water levels in the canals are lowered, shallow groundwater tends to flow toward the canals.

4.3 Site Specific Geology

Based on the lithology encountered during installation of monitoring wells and excavation of impacted soils, the soil profile across the project area varies between locations. In general, the near-surface geology consists of a 3-5 foot layer of organic muck soils, overlying a dense sandy limestone (cap rock) of 1-2 feet in thickness. The cap rock is underlain by a light tan limestone unit which extends to a depth of at least 13 feet bls. The near surface geology has been altered significantly in areas that have been developed, such as the Talisman Sugar Mill. In most of the developed areas, the muck layer has been removed and replaced with crushed limerock. Within the cooling canal system, infiltration ponds and waste lake areas at the Talisman Sugar Mill, the muck layer was partially removed to create the berms to contain the water. In these areas a thin muck layer is present overlying the cap rock. The deeper canals across the property were created by blasting away the cap rock and excavating the underlying limestone to the desired depth.

4.4 Site Specific Hydrogeology

Groundwater is encountered across the project area at depths ranging from about 1-6 feet BLS, depending upon the surface elevation. The project area is sub-divided and surrounded by a series of drainage canals, which control the water level within the area to prevent flooding. The groundwater flow direction was not calculated. However, it is likely that groundwater flow in the vicinity of the subject site is largely controlled by the water level in the adjacent canals. During periods of pumping (when the water level in the canals is mechanically lowered), groundwater flow is likely toward the canals.

5. GOVERNMENTAL DATABASE REVIEW

PSI reviewed an environmental database report, provided by Environmental Data Resources, Inc. (EDR) to determine whether any open regulatory enforcement cases (e.g., leaking tanks, spills, etc.) were present on the subject property. The EDR report can be found in **Appendix D**. Some of the sites listed in the EDR report are discussed in previous sections of this report (e.g., Talisman Sugar Corporation – Abel's Flying Service); therefore they are not mentioned in this section. All of the other sites listed in the EDR are outside the boundary of the A-2 Reservoir and will also not be discussed in further detail as they do not represent an environmental concern to the future construction of the reservoir.

No sites were listed in the EDR Report within the A-2 Reservoir boundary that have not been previously addressed.

6. OVERVIEW OF ASSESSMENT AND REMEDIATION

The A-2 Reservoir project area is made up of 8 individual tracts of land comprising approximately 14,408 acres, located within the south portion of the Everglades Agricultural Area (EAA). The EAA has a long history of farming dating back to the early 1960's for most of the project area. Most of the property has been in use primarily for the cultivation of sugar cane, and occasional rotational crops such as corn and rice. Phase I-II ESAs have been performed on all of the tracts according to the protocols that were in place that the time that each of the parcels were acquired. Additional investigations have been performed to define the extent of contaminants within point source areas, and corrective actions have been performed to address point sources where necessary. No significant sampling of the cultivated area has been performed to date.

6.1 Point Source Areas

The Phase I ESAs performed on the project parcels identified the presence of seven separate potential source areas, including pump stations, pesticide mix load areas, storage tanks, a former borrow pit, a crop-dusting operation and landing strip. **Table 1** summarizes the disposition of all of the point source areas on the subject property. Based on PSI's review of the reports, all of these point sources have been investigated and corrective actions have been performed as necessary to remediate these areas to the required levels for project construction. In a few areas, deed restrictions were utilized to allow levels exceeding the SCTL-RDE to remain in place. All of the assessment and remediation work for the point sources was conducted under oversight from FDEP and the Department has granted unconditional or conditional SRCOs for all of the point sources.

There are no known point sources on the subject property that remain open with FDEP. PSI also researched governmental records for open enforcement cases, and there are no open cases with FDEP within the project area.

6.2 Regional Evaluation of Cultivated Areas

Since much of the assessment of the project area was performed before the development of the ERA Protocol, the level of assessment of cultivated areas is not consistent with current requirements. No significant sampling of cultivated areas was performed within the A-2 Reservoir Footprint.

6.3 Outstanding Corrective Actions

The following corrective actions have been proposed but not completed:

- None

6.4 Outstanding Regulatory Issues

Since no cultivated area sampling has been performed on the A-2 Reservoir footprint, the USFWS and FDEP have not provided any input on potential residual agrochemicals in cultivated areas.

7. REFERENCES

1. Protocol for Assessment, Remediation and Post-Remediation Monitoring for Environmental Contaminants for Everglades Restoration Projects, 13 March 2008, SFWMD, FWS, and FDEP

2. Phase I and Phase II Environmental Risk Assessment for the Stormwater Treatment Areas Tract Nos. 100-009, 100-020, and 103-108, Palm Beach County, Florida 1995 and 1996 Ayres Associates

3. Phase I – Phase II Environmental Site Assessment, Florida Crystals Corporation, Palm Beach County, March 30, 1999, Dames & Moore

4. Everglades Agricultural Area Basin Reservoir – Phase I Environmental Assessment Summary Document, March 18, 2003, URS Corporation

5. Volume 1 – Acquisition Properties, Phase II Environmental Site Assessment, Talisman Sugar Corporation Properties, Palm Beach and Hendry Counties, for South Florida Water Management District, November 9, 1998, Dames & Moore

6. Site Inspections/Environmental Assessment Deferred Parcels – Former Talisman Property, Palm Beach County, Florida, July 17, 2007, URS Corporation

7. Final Site Inspections/Environmental Assessment 8 Deferred Parcels – Former Talisman Ranch Report, Palm Beach County, Florida, January 21, 2009, URS Corporation

8. Site Rehabilitation Completion Report, Talisman Sugar Corporation T-2 (Borrow Pit), Palm Beach County, Florida, 4 February 2002, PSI

   a. 7-21-06 DEP issued CSRCO

9. Site Rehabilitation Completion Report, Talisman Sugar Corporation T-3 (Labor Camp), Palm Beach County, Florida, 25 March 2003, PSI

   a. 7-21-06 DEP issued CSRCO

10. Tank Closure Report, Talisman Sugar Corporation, Talisman Labor Camp (Abel's Flying Service), Palm Beach County, Florida, 9 April 2001, PSI

11. Limited Contamination Assessment Report / No Further Action Request, Talisman Sugar Corporation, Talisman Sugar Farm, T-6 (Electric Pump Station), Palm Beach County, Florida, 27 August 1999, PSI

    a. 5-30-99 PSI Response to Comments

    b. 12-21-99 DEP issued SRCO

12. Limited Contamination Assessment Report / No Further Action Request, Talisman Sugar Corporation, Talisman Farm – T-7 (Pump Station), Palm Beach County, Florida, 28 September 1999, PSI

    a. 12-21-99 DEP issued SRCO

13. Site Rehabilitation Completion Report, Talisman Sugar Corporation, Talisman Farm – T-8 (Pump Station), Palm Beach County, Florida, 28 September 1999, PSI

    a. 12-21-99 DEP issued SRCO

14. Site Rehabilitation Completion Report, Talisman Sugar Corporation, Talisman Farm – T-21 (Pesticide Mix/Load Area), Palm Beach County, Florida, 20 May 2002, PSI

    a. 7-21-06 DEP issued CSRCO

15. Site Rehabilitation Completion Report, Talisman Sugar Corporation, Talisman Farm – T-24 (Pump Station), Palm Beach County, 15 Florida, October 1999, PSI

    a. 12-29-99 DEP issued SRCO

8. WARRANTY

PSI warrants that the findings and conclusions reported herein were conducted in general accordance with good commercial and customary practice for conducting a Phase II Environmental Site Assessment. However, these findings and conclusions contain all of the limitations inherent in these methodologies.

This summary report has been developed to provide the client with information regarding apparent indications of chemical impacts to the subject property. It is necessarily limited to the conditions observed and to the information available at the time of the work. The assessment and conclusions presented herein were based upon the subjective evaluation of limited data. They may not represent all conditions at the subject site as they reflect the information gathered from specific locations. PSI warrants that the findings and conclusions contained herein have been promulgated in accordance with generally accepted environmental investigation methodology and only for the site described in this report.

Due to the limited nature of the work, there is a possibility that there may exist conditions which could not be identified within the scope of the assessment or which were not apparent at the time of report preparation. It is also possible that the testing methods employed at the time of the report may later be superseded by other methods. The description, type, and composition of what are commonly referred to as "hazardous materials or conditions" can also change over time. PSI does not accept responsibility for changes in the state of the art, nor for changes in the scope of various lists of hazardous materials or conditions. PSI believes that the findings and conclusions provided in this report are reasonable. However, no other warranties are implied or expressed.

TABLES

Table 1 Summary of Assessment and Corrective Actions
A-2 Reservoir Project
Palm Beach County, Florida

Tract Nos.	Previous Name(s)	Acreage	Reports	Phase I Summary	Phase II Summary	Corrective Action Summary	Regulatory Concurrence	HTRW	Restrictive Covenant	Exit Assessment Results	Recent Spills
D7100-104, D7100-044, D7100-047, D7100-066, D7100-067, D7100-139, D7100-141, D7200-005	Talisman South Ranch	14,408	See Table 2 for list of Reports performed on these parcels	Point source RECs identified at eight (8) areas within these parcels, listed below:	Soil and / or groundwater exceedances were identified, in the following areas:	Corrective Action Activities included the following:				The labor camp, borrow pit, pesticide mix and load area, and four pump stations were visually inspected in 2007 and 2009. No stained soils, stressed vegetation or other environmental impacts were observed. No soil or groundwater samples were collected.	No
				Borrow Pit (T-2)	Arsenic and petroleum hydrocarbons detected above SCTLs; phenols and m,p & o xylenes detected above GCTLs	Excavated 3,005 tons of steel, 475 tons of tires, 3,895 tons of C & D debris, 1,793 tons of soil. Also installed GW treatment system (operation was abandoned due to inability to filter out lead)	CSRCO, 7-21-06	Soil above SCTL	Non-residential Deed Restriction		
				Labor Camp (T-3)	Arsenic and petroleum hydrocarbons detected above SCTLs at burn pit area and drum storage area within labor camp. Petroleum hydrocarbons / solvents and arsenic detected in GW above GCTLs at pesticide mix / load area and refueling area / runway within labor camp.	Excavated approximately 5,590 tons of soil from 8 areas within labor camp. Petroleum impacts in GW naturally attenuated below GCTLs. Source removal reduced arsenic GW concentrations below GCTL.	CSRCO, 7-21-06	Soil above SCTL	Non-residential Deed Restriction		
				Pump Station (T-6)	OCPs detected above SQAGs	Sediment samples collected around pump station; no OCPs detected above SQAGs or SCTLs	SRCO, 12-21-99	No	No		
				Pump Station (T-7)	No soil or groundwater samples collected; visual evidence of soil staining	14 surficial soil samples collected around pump station; no exceedances above SQAGs or SCTLs	SRCO, 12-21-99	No	No		
				Pump Station (T-8)	No soil or groundwater samples collected; No visual evidence of soil staining; Still included as Exclusion Area	Excavated approximately 0.25 tons of petroleum impacted soil	SRCO, 12-21-99	No	No		
				Pump Station (T-24)	No soil or groundwater samples collected; No visual evidence of soil staining; Still included as Exclusion Area	Excavated approximately 0.69 tons of soil	SRCO, 12-29-99	No	No		
				Pesticide Mix/Load Area (T-23)	Arsenic detected above SCTL and GCTL	Excavated approximately 612 tons of arsenic impacted soil. Installed GW pump and treat system, operated for 3 mths.; effectively lowered the arsenic concentrations below the GCTL	CSRCO, 7-21-06	Soil above SCTL	Non-residential Deed Restriction		

Table 2. Summary of Environmental Reports
A-2 Reservoir
Palm Beach County, FL

Consultant	Report Type	Report Title	Report Date	Tract Nos.	Previous Name(s)
URS/Dames & Moore	Phase I / II	Talisman Sugar Corp. - Vol. 1 - Acquisition Properties	November-98	100-104*	Talisman South Ranch
PSI	SRCR	Talisman Sugar Corp. - T-2 Borrow Pit	February-02	100-104*	Talisman South Ranch
PSI	Tank Closure Report	Talisman Sugar Corp. - Labor Camp (Abel's Flying Service	April-01	100-104*	Talisman South Ranch
PSI	SRCR	Talisman Sugar Corp. - T-3 (Labor Camp	March-03	100-104*	Talisman South Ranch
PSI	LCAR / NFA Request	Talisman Sugar Corp. - T-6 (Electric Pump Station)	August-99	100-104*	Talisman South Ranch
PSI	LCAR / NFA Request	Talisman Sugar Corp. - T-7 (Pump Station)	September-99	100-104*	Talisman South Ranch
PSI	SRCR	Talisman Sugar Corp. - T-8 (Pump Station)	September-99	100-104*	Talisman South Ranch
PSI	SRCR	Talisman Sugar Corp. - T-24 (Pump Station)	October-99	100-104*	Talisman South Ranch
PSI	SRCR	Talisman Sugar Corp. - T-21 Pesticide Mix/Load Area	May-02	100-104*	Talisman South Ranch
URS	Site Inspections/Environmental Assessment	Deferred Parcels - Former Talisman Property	July-07	100-104*	Talisman South Ranch
URS	Final Site Inspections/Environmental Assessment	Eight Deferred Parcels - Former Talisman Ranch Property	January-09	100-104*	Talisman South Ranch
URS	Environmental Assessment Summary Document	Everglades Agricultural Area Basin Reservoir Project	March-03	--	Talisman South Ranch

SRCR = Site Rehabilitation Completion Report
LCAR = Limited Contamination Assessment Report
* = Tract Nos. 100-149, 100-044, 100-047, 100-066, 100-067, 100-139, 100-141, 200-005, 100-143

Table 3. Range of Concentrations Measured vs. Regulatory Requirements
T-2 Exclusion Area (Former Borrow Pit)
Former Talisman South Ranch
Tract No. D7100-068
A-2 Reservoir
Palm Beach County, FL

					State Regulatory Limits (mg/Kg)			
Parameter	CAS #'s[1]	CERCLA[2] Regulated (Y/N)	Range[3] Observed (mg/Kg)	EPA Regulatory Limits[4] (mg/Kg)	SCTL-CDE[5]	SCTL-RDE[6]	SQAG-PEC[7]	SQAG-TEC[8]
Arsenic	7440-38-2	Y	<0.5 - 5.3	1.6	12	2.1	33	9.8
Barium	7440-39-3	Y	24 - 37	190,000	130,000	120	60	20
Cadmium	7440-43-9	Y	0.83 - 6.2	800	1,700	82	5.0	1.0
Chromium	7440-47-3	Y	1.1 - 24.0	NG	470	210	110	43
Lead	7439-92-1	Y	1.3 - 93	800	1,400	400	130	36
Mercury	7439-97-6	Y	0.011 - 0.034	43	17	3	1.1	0.18
Benzo(a)anthracene	56-55-3	Y	0.028 - 0.042	2.1	#	#	1.1	0.11
Benzo(ghi)perylene	191-24-2	Y	0.032 - 0.050	NG	52,000	2,500	NG	NG
Chrysene	218-01-9	Y	0.032 -0.064	210	#	#	1.3	0.17
Dibenzofuran	132-64-9	Y	0.033 - 0.097	1,000	6,300	320	NG	NG
Fluoranthene	206-44-0	Y	0.055 - 1.250	22,000	59,000	3,200	2.2	0.42
Naphthalene	91-20-3	Y	0.065 - 3.0	18	300	55	0.56	0.18
Phenanthrene	85-01-8	Y	0.066 - 1.6	NG	36,000	2,200	1.2	0.2
Pyrene	129-00-0	Y	0.050 - 1.160	17,000	45,000	2,400	1.5	0.2
TPH	NO CAS	N	43.0 - 305	NG	2,700	460	NG	NG

Notes:
mg/Kg - milligrams per Kilogram
NG - No guideline
- Site concentrations for carcinogenic polycyclic aromatic hydrocarbons must be converted to Benzo(a)pyrene equivalents before comparison with the appropriate direct exposure SCTL for Benzo(a)pyrene using the approach described in the February 2005 "Final Technical Report: Development of Cleanup Target Levels (CTLs) for Chapter 62-777, F.A.C."
[1]CAS Registry Number (CAS#'s) - unique numeric identifier which designates one substance and has no chemical significance
[2]40 Code of Federal Regulations (CFR) 302.4, Designation of Hazardous Substances - Comprehensive Environmental Response, Compensation, Liability Act
[3]Range of chemical concentrations observed in all the samples collected within the T-2 Exclusion Area (Former Borrow Pit)
[4]USEPA - Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites - Industrial Soil
[5]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, Direct Exposure - Commercial / Industrial
[6]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, Direct Exposure - Residential
[7]Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4 (MacDonald, 2000), Sediment Quality Assessment Guidelines-Probable Effects Concentration
[8]Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4 (MacDonald, 2000), Sediment Quality Assessment Guidelines-Threshold Effects Concentration

Table 4. Range of Concentrations Measured vs. Regulatory Requirements
T-3 Exclusion Area (Former Labor Camp)
Former Talisman South Ranch
Tract No. D7100-047
A-2 Reservoir
Palm Beach County, FL

					State Regulatory Limits (mg/Kg)			
Parameter	CAS #'s[1]	CERCLA[2] Regulated (Y/N)	Range[3] Observed (mg/Kg)	EPA Regulatory Limits[4] (mg/Kg)	SCTL-CDE[5]	SCTL-RDE[6]	SQAG-PEC[7]	SQAG-TEC[8]
Arsenic	7440-38-2	Y	0.95 - 18.5	1.6	12	2.1	33	9.8
Barium	7440-39-3	Y	13.9 - 66.9	190,000	130,000	120	60	20
Chromium	7440-47-3	Y	1.5 - 22.3	NG	470	210	110	43
Lead	7439-92-1	Y	0.76 - 82.0	800	1,400	400	130	36
Mercury	7439-97-6	Y	<0.010 - 0.032	43	17	3	1.1	0.18
Selenium	7782-49-2	Y	<0.030 - 1.2	5,100	11,000	440	N/A	N/A
4,4-DDE	72-55-9	Y	<0.00025 - 0.0021	5.1	15	2.9	0.031	0.0032
Atrazine	1912-24-9	Y	<0.017 - 0.093	7.5	19	4	NG	0.0003
Dieldrin	60-57-1	Y	<0.00036 - 0.0016	0.11	0.3	0.06	0.062	0.0019
Endrin	72-20-8	Y	<0.00050 - 0.017	180	510	25	0.210	0.0022
Endrin Aldehyde	7421-93-4	Y	<0.00037 - 0.00220	NG	NG	NG	NG	NG

Notes:
mg/Kg - milligrams per Kilogram
NG - No guideline
[1]CAS Registry Number (CAS#'s) - unique numeric identifier which designates one substance and has no chemical significance
[2]40 Code of Federal Regulations (CFR) 302.4, Designation of Hazardous Substances - Comprehensive Environmental Response, Compensation, Liability Act
[3]Range of chemical concentrations observed in all the samples collected within the T-3 Exclusion Area (Former Labor Camp)
[4]USEPA - Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites - Industrial Soil
[5]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, Direct Exposure - Commercial / Industrial
[6]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, Direct Exposure - Residential
[7]Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4 (MacDonald, 2000), Sediment Quality Assessment Guidelines-Probable Effects Concentration
[8]Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4 (MacDonald, 2000), Sediment Quality Assessment Guidelines-Threshold Effects Concentration

Table 5. **Range of Concentrations Measured vs. Regulatory Requirements**
T-21 Exclusion Area (Mix/Load Area)
Former Talisman South Ranch
Tract No. D7100-044
A-2 Reservoir
Palm Beach County, FL

					State Regulatory Limits (mg/Kg)			
Parameter	CAS #'s[1]	CERCLA[2] Regulated (Y/N)	Range[3] Observed (mg/Kg)	EPA Regulatory Limits[4] (mg/Kg)	SCTL-CDE[5]	SCTL-RDE[6]	SQAG-PEC[7]	SQAG-TEC[8]
Arsenic	7440-38-2	Y	<0.5 - 7.0	1.6	12	2.1	33	9.8

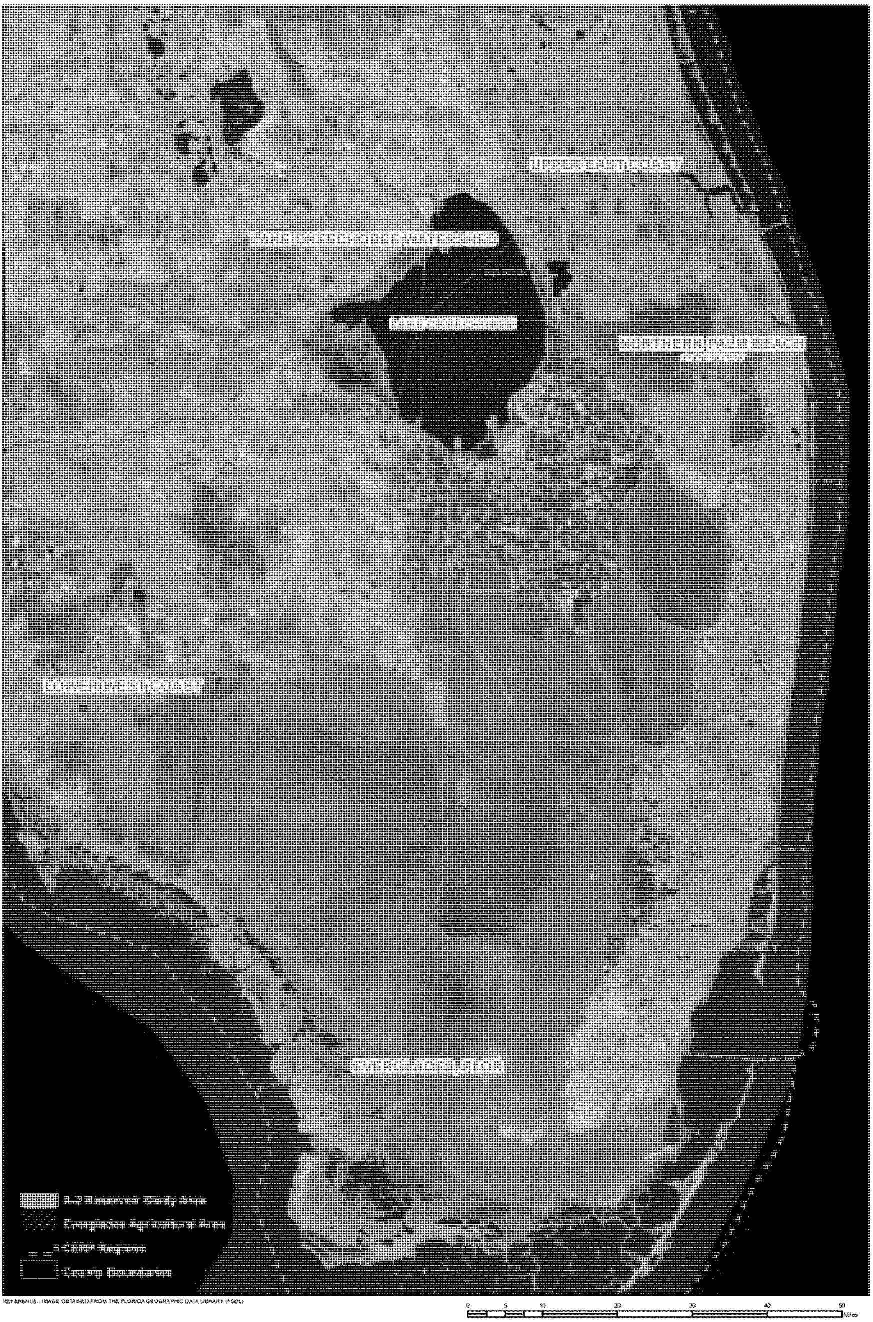
Notes:
mg/Kg - milligrams per Kilogram
NG - No guideline
[1]CAS Registry Number (CAS#'s) - unique numeric identifier which designates one substance and has no chemical significance
[2]40 Code of Federal Regulations (CFR) 302.4, Designation of Hazardous Substances - Comprehensive Environmental Response, Compensation, Liability Act
[3]Range of chemical concentrations observed in all the samples collected within the T-21 Exclusion Area (Mix/Load Area)
[4]USEPA - Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites - Industrial Soil
[5]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, Direct Exposure - Commercial / Industrial
[6]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, Direct Exposure - Residential
[7]Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4 (MacDonald, 2000), Sediment Quality Assessment Guidelines-Probable Effects Concentration
[8]Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4 (MacDonald, 2000), Sediment Quality Assessment Guidelines-Threshold Effects Concentration

Table 6. Range of Concentrations Measured vs. Regulatory Requirements
T-24 Exclusion Area (Pump Station)
Former Talisman South Ranch
Tract No. 100-104
A-2 Reservoir
Palm Beach County, FL

					State Regulatory Limits (mg/Kg)			
Parameter	CAS #'s[1]	CERCLA[2] Regulated (Y/N)	Range[3] Observed (mg/Kg)	EPA Regulatory Limits[4] (mg/Kg)	SCTL-CDE[5]	SCTL-RDE[6]	SQAG-PEC[7]	SQAG-TEC[8]
Acenaphthene	83-32-9	Y	<0.0050 - 0.155	33,000	20,000	2,400	0.089	0.0067
Acenaphthylene	208-96-8	Y	<0.0050 - 0.048	NG	20,000	1,800	0.130	0.0059
Benzo(a)anthracene	56-55-3	Y	<0.0050 - 1.650	2.1	#	#	1.1	0.11
Benzo(a)pyrene	50-32-8	Y	<0.0050 - 0.250	0.21	0.7	0.1	1.5	0.15
Benzo(ghi)perylene	191-24-2	Y	<0.0050 - 1.430	NG	52,000	2,500	NG	NG
Chrysene	218-01-9	Y	<0.0050 - 1.480	210	#	#	1.3	0.17
Fluoranthene	206-44-0	Y	<0.0050 - 0.086	22,000	59,000	3,200	2.2	0.42
Fluorene	86-73-7	Y	<0.0050 - 0.320	22,000	33,000	2,600	0.54	0.077
Indeno(123-cd)pyrene	193-39-5	Y	<0.0050 - 0.830	2.1	#	#	NG	NG
Phenanthrene	85-01-8	Y	<0.0050 - 0.185	NG	36,000	2,200	1.2	0.2
TPH	NO CAS	N	<15.3 - 290	NG	2,700	460	NG	NG

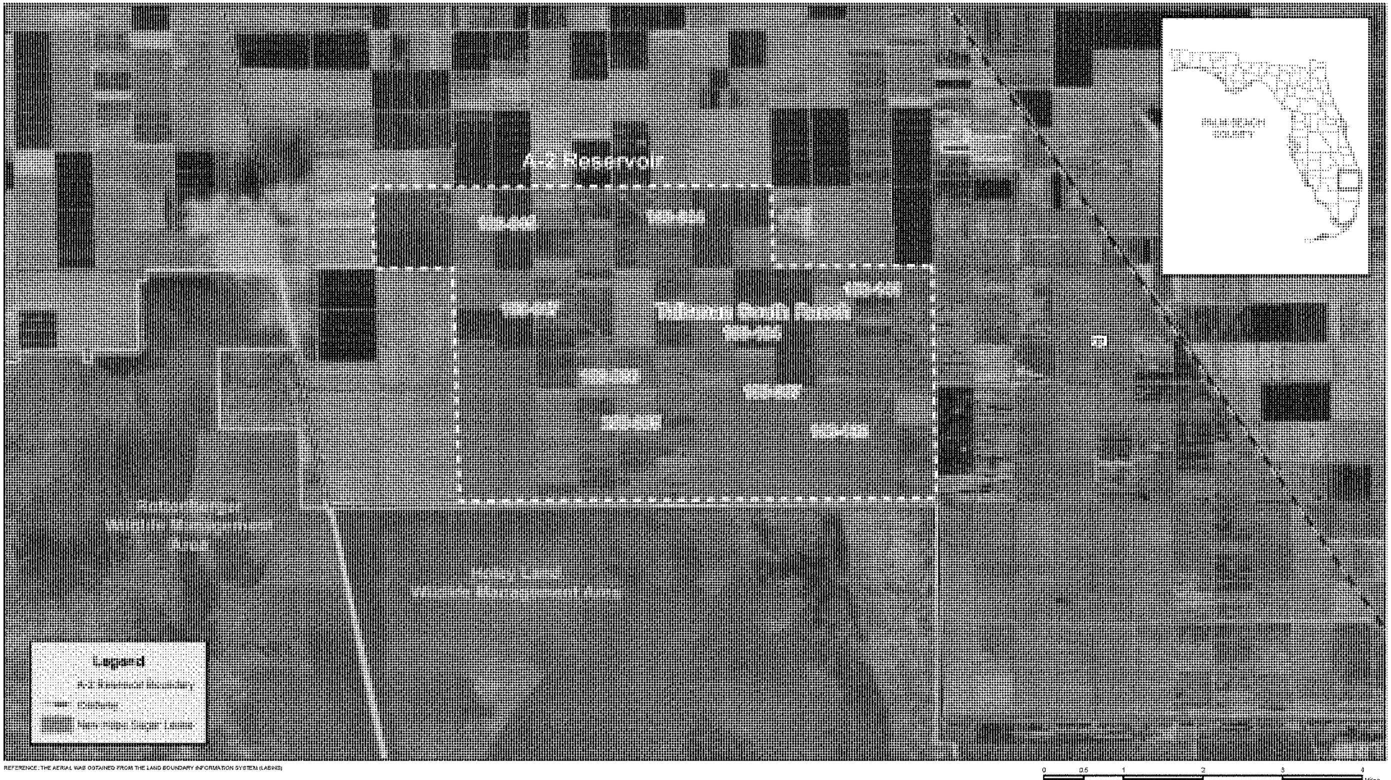
Notes:
mg/Kg - milligrams per Kilogram
NG - No guidline
- Site concentrations for carcinogenic polycyclic aromatic hydrocarbons must be converted to Benzo(a)pyrene equivalents before comparison with the appropriate direct exposure SCTL for Benzo(a)pyrene using the approach described in the February 2005 'Final Technical Report: Development of Cleanup Target Levels (CTLs) for Chapter 62-777, F.A.C.'
[1]CAS Registry Number (CAS#'s) - unique numeric identifier which designates one substance and has no chemical significance
[2]40 Code of Federal Regulations (CFR) 302.4, Designation of Hazardous Substances - Comprehensive Environmental Response, Compensation, Liability Act
[3]Range of chemical concentrations observed in all the samples collected within the T-24 Exclusion Area (Pump Station)
[4]USEPA - Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites - Industrial Soil
[5]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, Direct Exposure - Commercial / Industrial
[6]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, Direct Exposure - Residential
[7]Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4 (MacDonald, 2000), Sediment Quality Assessment Guidelines-Probable Effects Concentration
[8]Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4 (MacDonald, 2000), Sediment Quality Assessment Guidelines-Threshold Effects Concentration

FIGURES

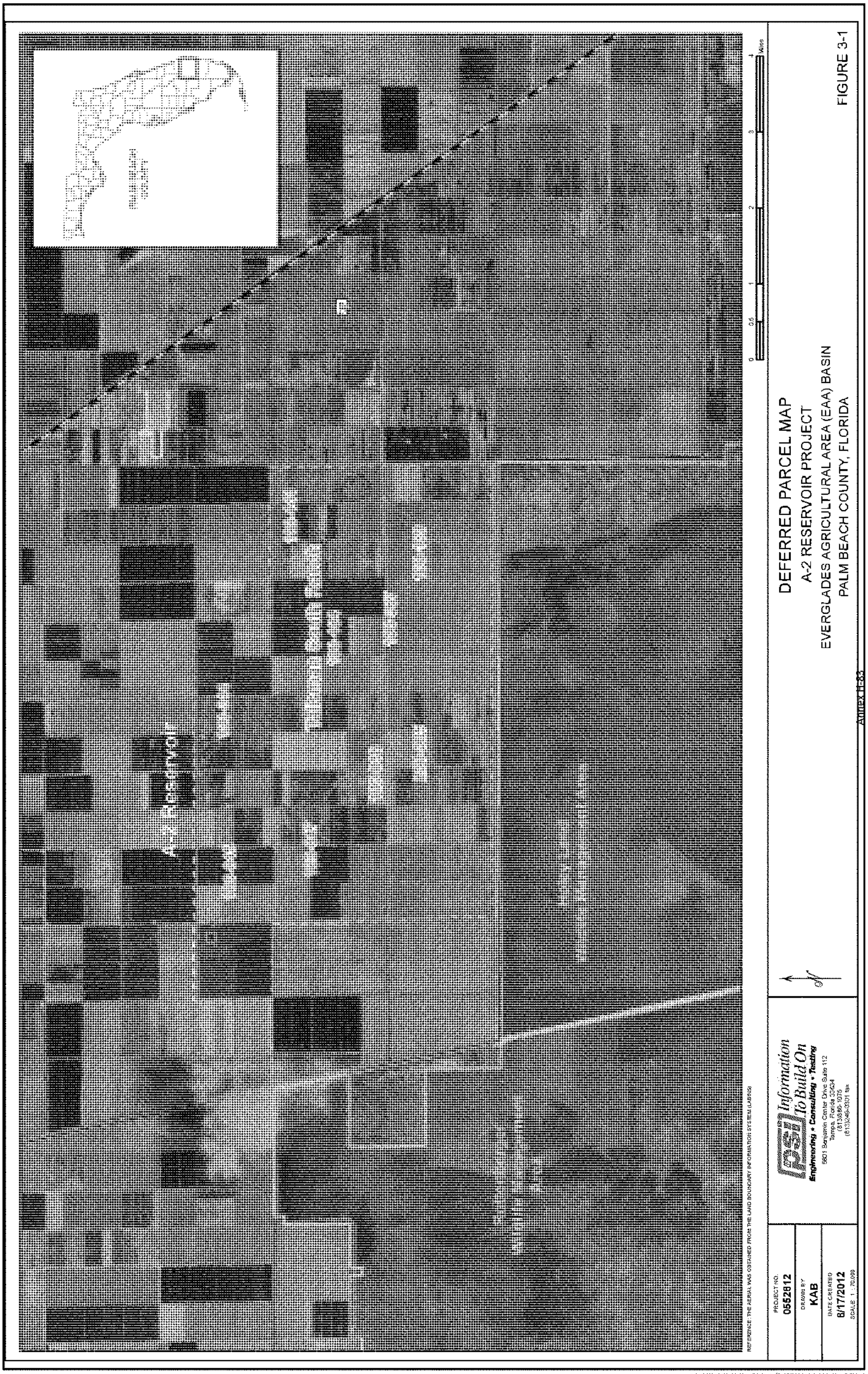


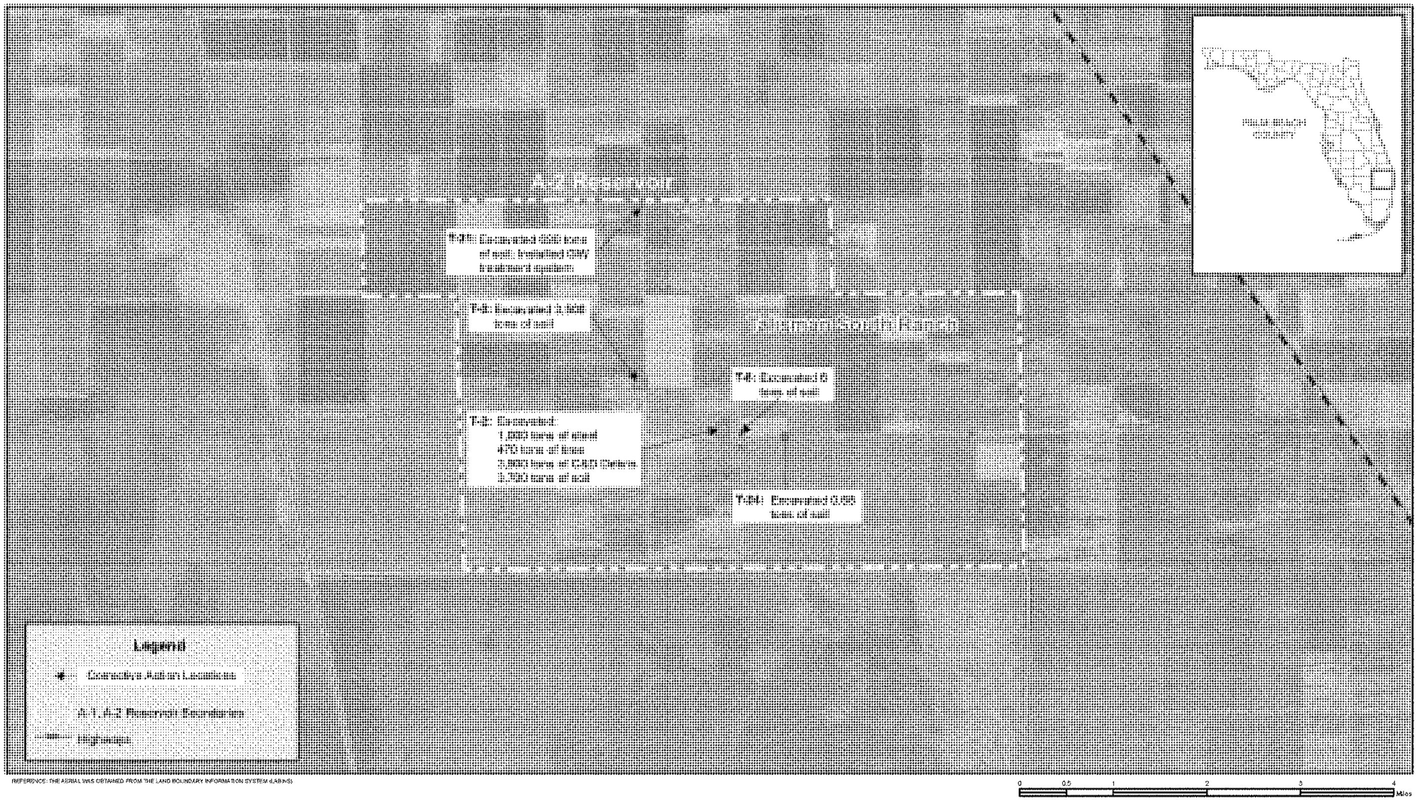
REFERENCE: IMAGE OBTAINED FROM THE FLORIDA GEOGRAPHIC DATA LIBRARY (FGDL)

PROJECT NO. 0552812	PSI Information To Build On Engineering • Consulting • Testing 5801 Benjamin Center Drive Suite 112 Tampa, Florida 33634 (813)886-1075 (813)249-0201 fax	SITE LOCATION MAP A-2 RESERVOIR PROJECT EVERGLADES AGRICULTURAL AREA (EAA) BASIN PALM BEACH COUNTY, FLORIDA
DRAWN BY: KAB		
DATE CREATED: 02-28-2012 SCALE: 1 : 750,000		FIGURE 1-1



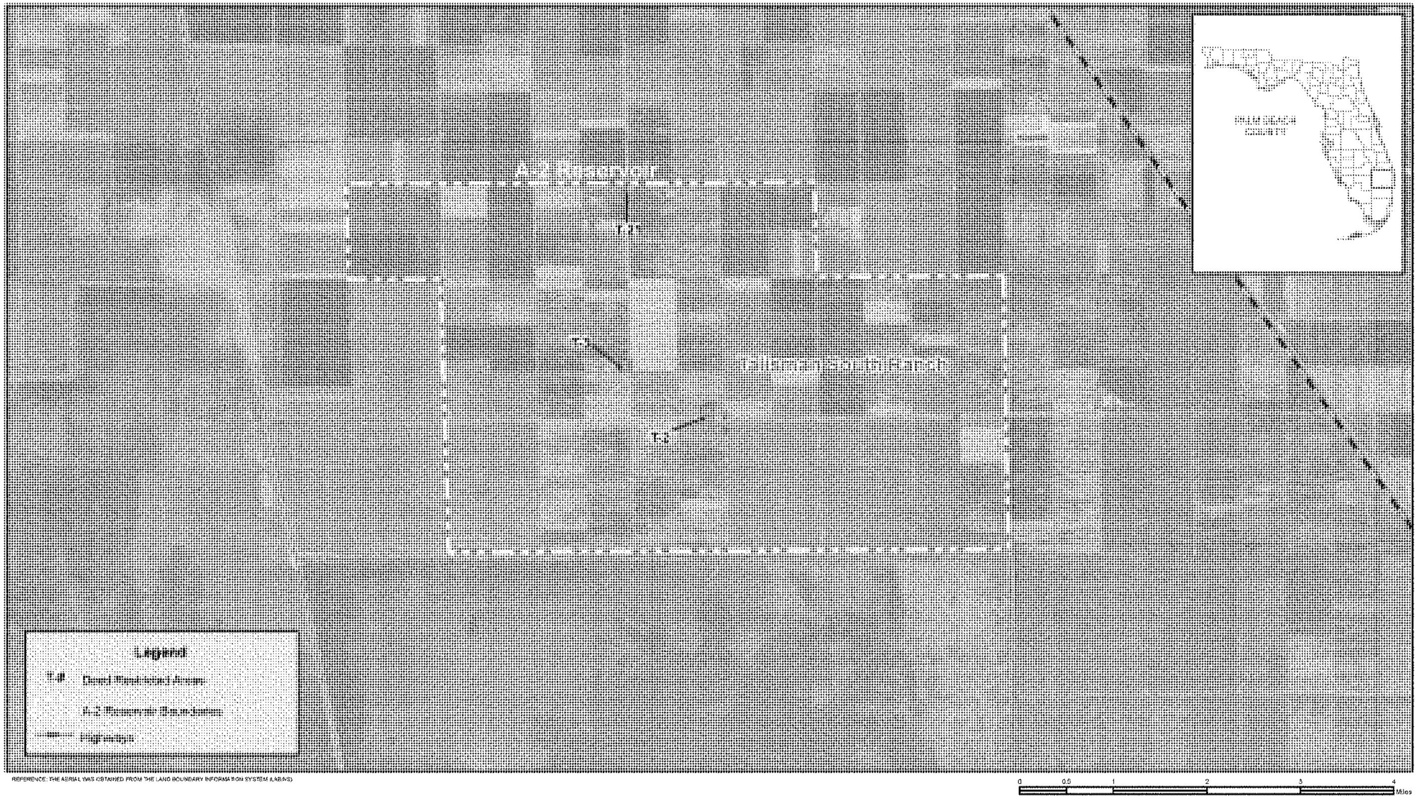
PROJECT NO. 0552812 DRAWN BY KAB DATE CREATED 8/17/2012 SCALE: 1 : 70,000	PSI Information To Build On Engineering • Consulting • Testing 5801 Benjamin Center Drive Suite 112 Tampa, Florida 33634 (813)886-1075 (813)249-0301 fax	SITE PLAN - AERIAL PHOTOGRAPH A-2 RESERVOIR PROJECT EVERGLADES AGRICULTURAL AREA (EAA) BASIN PALM BEACH COUNTY, FLORIDA FIGURE 1-2


DEFERRED PARCEL MAP
A-2 RESERVOIR PROJECT
EVERGLADES AGRICULTURAL AREA (EAA) BASIN
PALM BEACH COUNTY, FLORIDA
FIGURE 3-1
Annex H-83
0 0.5 1 2 3 4 Miles
REFERENCE: THE AERIAL WAS OBTAINED FROM THE LAND BOUNDARY INFORMATION SYSTEM (LABINS)
PROJECT NO.
0552812
DRAWN BY
KAB
DATE CREATED
8/17/2012
SCALE 1 : 70,000
Information To Build On
Engineering • Consulting • Testing
5601 Benjamin Center Drive Suite 112
Tampa, Florida 33634
(813)886-1075
(813)249-3301 fax
A-2 Reservoir



REFERENCE: THE AERIAL WAS OBTAINED FROM THE LAND BOUNDARY INFORMATION SYSTEM (LABINS)

PROJECT NO. 0552812	PSI Information To Build On — Engineering • Consulting • Testing — 5601 Benjamin Center Drive Suite 112, Tampa, Florida 33634, (813)886-1075, (813)249-0301 fax	CORRECTIVE ACTIONS LOCATION MAP A-2 RESERVOIR PROJECT EVERGLADES AGRICULTURAL AREA (EAA) BASIN PALM BEACH COUNTY, FLORIDA
DRAWN BY KAB		
DATE CREATED 02-28-2012 SCALE: 1 : 60,000		FIGURE 3-2



REFERENCE: THE AERIAL WAS OBTAINED FROM THE LAND BOUNDARY INFORMATION SYSTEM (LABINS)

PROJECT NO.
0552812
DRAWN BY
KAB
DATE CREATED
02-28-2012
SCALE: 1 : 60,000

psi Information To Build On
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Tampa, Florida 33634
(813)886-1075
(813)249-0301 fax

DEED RESTRICTIONS MAP

A-2 RESERVOIR PROJECT
EVERGLADES AGRICULTURAL AREA (EAA) BASIN
PALM BEACH COUNTY, FLORIDA

FIGURE 3-3

Information To Build On
Engineering • Consulting • Testing

May 3, 2013

South Florida Water Management District
3301 Gun Club Road
West Palm Beach, Florida 33406

Attn: Mr. Robert Kukleski
Lead Environmental Engineer

Re: Phase II Environmental Site Assessment (ESA) – Addendum #1
A-2 Flow Equalization Basin (FEB) Project
Palm Beach County, Florida
Work Order #13

Dear Mr. Kukleski:

Professional Service Industries, Inc. (PSI) is pleased to submit this addendum to the Phase II Environmental Site Assessment (ESA) for the A-2 Flow Equalization Basin (FEB) dated March 25, 2013. This addendum is intended to address comments/requests for clarification that were received from the United States Army Corps of Engineers (USACE). PSI received comments from USACE via e-mail from Mark Shafer on April 2, 2013 and from Lisa Gued on April 11, 2013. We have provided each of the USACE comments below, followed by PSI's response:

Mark Shafer Comments

Provide documentation of:
a. FWS review of A2 sampling results.
b. Documentation of FDEP review of A2 Sampling results.
c. Letter from SFWMD to USACE requesting application of Sep 2011 AG-Chem policy to this project.

PSI Response: Concurrence letters from USFWS and FDEP are provided in **Attachment A** herein. SFWMD will separately provide a letter to USACE requesting application of the September 2011 USACE Ag-Chem Policy to this project.

In addition to USFWS review, this report must be reviewed by FDEP to satisfy USACE Ag-Chem policy.

PSI Response: FDEP has reviewed the Phase II ESA for the A-2 FEB and provided a concurrence letter, which is included in **Attachment A**.

Page 1. In reviewing the A2 Phase II report of March 25th, 2012, it references on page 1 the draft Summary Env. Report for the A-2 FEB, dated September 17, 2012. I have a copy of that report and it does not include much of the information that was originally included in the August 21st, 2012 version. I believe that the WMD solution to USACE concerns about the Sep 17 version was to revert back to the August 21st, 2012 version. I will be referencing the August 21st 2012 version in the CEPP PIR. To do this, page 1 of the March 25 report should be changed to reference the August 21st Summary report and the August 21st report should be provided with a signature from Steve Long.

PSI Response: A signed copy of the August 21, 2012 version of the Summary Environmental Report (SER) is included in **Attachment B**. Please note that PSI provided draft versions of the report on August 21, 2012 and September 17, 2012; however, we had not received previous instruction from SFWMD to finalize the report. Based on your comment and discussion with the District, the August 21 version of the report will be considered as the final version.

Page 6. Section 3.1. Should provide statement that USFWS and USACE reviewed the sampling scope of work and approved the sampling plan. Provide copy of USFWS review letter in appendix.

PSI Response: USFWS and FDEP were both provided with the scope of work and sampling plan. We received concurrence on the proposed plan from USFWS in a letter dated January 8, 2013. A copy of the USFWS concurrence is provided in **Attachment C**. We did not receive any written response from FDEP on the proposed sampling plan, but did receive a concurrence letter from FDEP on the Phase II ESA.

Page 4.1.1 Soil, 4th bullet. Second sentence says SCTL-LSW is appropriate. Third sentence essentially says SCTL-LSW not relevant. Please confirm with FDEP that FEB would not be a class III water though since the FEB eventually discharges to Class III water body don't know of relevance. Also, a discussion that FEB will discharge to STA34 or STA2B before being discharged to a Class III water.

PSI Response: Based on further discussions with SFWMD management, the District does not intend to pursue classification of the FEB as a treatment works as they have done for previous STA projects. The District intends to permit the FEB as a Class III surface water body; however, the FEB will discharge into either STA-3/4 or STA-2B, which are both classified as treatment works. In any case, it appears that the SCTL-LWS is an applicable and relevant and appropriate screening standard for the A-2 FEB project.

Page 12. Metals Results. Chromium exceeded the SCTL-LSW in all samples. Add discussion of why was this analyte not tested using SPLP protocol.

PSI Response: Chromium did exceed the SCTL-LSW of 4.2 milligrams per kilogram (mg/kg) in all of the composite soil samples, with concentrations ranging from 5.6 mg/kg to 28 mg/kg. The detected chromium concentrations appear to be representative of background soil conditions within the EAA and do not exceed any other ecological or human health screening criteria. Given the high organic content of the soils, PSI does not expect the chromium to leach into surface water to a significant degree. However, based on your comment, PSI subsequently analyzed two samples containing the highest chromium concentrations by the SPLP method to evaluate the potential for leaching. These results are tabulated and discussed on page 4 of this addendum. The SPLP analysis indicates only limited potential for leaching of chromium to surface water, and we do not believe that chromium would exceed the Class III surface water standards in the water impounded within the A-2 FEB due to extensive dilution and other factors. In any case, PSI recommended sampling of the surface water for chromium at start-up as a precaution. This recommendation was accepted by both USFWS and FDEP in lieu of further pre-construction studies.

Page 21. Arsenic: Concentrations do exceed the residential exposure criteria. The FEB may be open to the public for recreation. Some discussion of risks associated with public access should be provided in text. Perhaps a reference to other sites where FDEP has developed a "recreational" exposure criteria (Lake Okeechobee Scenic Trail for instance.)

PSI Response: Arsenic concentrations exceeded the Soil Cleanup Target Level for Residential Direct Exposure (SCTL-RDE) in all of the composite soil samples, and ranged from 3.1 mg/kg to 6.8 mg/kg. The mean arsenic concentration is 4.6 mg/kg. PSI utilized EPA ProUCL to calculate the 95% upper confidence limit (UCL) for the data set. The software package recommends a 95% UCL value of 4.895 mg/kg. A copy of the 95% UCL calculation sheet is provided in **Attachment D**.

While the FDEP does not have a promulgated SCTL for arsenic in a recreational setting, the Department has utilized 5.5 mg/kg as an appropriate SCTL for a number of other recreational projects across the state, including active parks with a significantly higher public exposure frequency than is likely for the FEB. Human health risks for arsenic exposure are primarily driven by ingestion of arsenic in the soil, and children are the most sensitive receptors. For the FEB, any direct contact with arsenic contaminated soils is likely to occur only on the bermed surfaces, where the muck soils may be used for surface dressing. Contact frequency for the general public or workers is likely to be minimal, in comparison to the frequency of use assumed by FDEP in the active park scenario which was used to develop the alternate SCTL for recreational use. PSI believes this alternate recreational SCTL is appropriate for this project and that no protections are necessary for protection of the public related to exposure to arsenic impacted soils in the FEB project.

Page 21. Chromium. Not sure that it is relevant that the planned FEB will or will not be classified as a Class III water body. The FEB will discharge to the STAs and eventually a class III water body. By the way, this paragraph on the SCTL-LSW exceedances is in direct contrast to the discussion that begins in the next paragraph that follows which begins "Class III surface water criteria".

PSI Response: The classification of the FEB as a Class III water body is relevant because since the Class III surface water standards will apply to the water body, then the SCTL-LSW criteria also apply to the soils within the A-2 FEB footprint. This discussion is now not relevant because the District has elected to permit the A-2 FEB as a Class III surface water.

Page 21. Bullet on Chromium, mercury, and selenium were.... Actual testing of these analytes using the SPLP test procedure would have been useful so you could say for sure if these "leach to a significant degree". This lack of testing should be further justified or corrected by additional testing.

PSI Response: Since the chromium, mercury and selenium concentrations in the soil appeared to be consistent with background conditions in the EAA, and the leaching potential of the highly organic soils was not considered to be high, PSI did not initially elect to perform SPLP analysis on any of the soil samples. However, pursuant to your request we analyzed two samples representing the highest range of these three metals by the SPLP method to evaluate leaching potential. The SPLP results are provided in **Attachment E** and are tabulated below.

Sample ID	Date Collected	Chromium	Mercury	Selenium
SPLP Leachate/163830 (Comp-7)	4/5/2013	3.5 U	0.062 U	2.3 U
SPLP Leachate/163832 (Comp-12)	4/5/2013	18	0.062 U	2.3 U

The results indicate limited potential for leaching of any of these three metals. It is acknowledged that the chromium concentration detected in Comp-12 slightly exceeds the Class III surface water standard of 11 ug/L and that while mercury was not detected in the samples, the method detection limits for mercury are higher than the Class III surface water standard. However, the SPLP results do not account for the extensive dilution that will occur in the FEB as fresh water enters the system. The results indicate that the underlying soils are not likely to leach to the overlying surface water to a degree that would cause an exceedence of the Class III surface water criteria. In any case, PSI has recommended surface water sampling for these metals at start-up to verify this conclusion. Both FDEP and USFWS have accepted the start-up sampling in lieu of conducting further pre-construction studies.

Page 22. Arsenic: The recommendation should indicate whether the results for Arsenic should warrant measures taken in the soil management plan to reduce possible human exposure due to potential for arsenic on levee soils. (Blending or capping with low-arsenic soils, for instance.)

PSI Response: Because the 95% UCL arsenic concentrations in the site soil are below the alternate SCTL for recreational use that has been used by FDEP on similar projects, PSI does not believe that any additional protective measures, such as blending or capping of arsenic impacted soils is warranted to reduce possible exposure to arsenic in the soil.

Lisa Gued Comments on Phase II ESA

Page 2: 1st bullet: How were ND values incorporated in the statistical analyses?

PSI Response: One-half of the detection limit was used to represent non-detect values in the data set.

Page 2: 1st bullet: A table listing the mean and the standard deviation of detected compounds would be useful.

PSI Response: A table showing the mean concentrations and standard deviations for detected compounds that exceeded screening criteria is provided in **Attachment F**.

Page 7: 2nd paragraph: Which chemicals were recently applied?

PSI Response: PSI was informed that Atrazine, 2, 4, D, Dimetric, Calisto, Thimet, and Asolan were in use on the property and had been recently applied. We did not obtain a specific field by field application schedule for these chemicals. Through coordination with Florida Crystals Corporation, we did ensure that we did not sample any fields where chemicals had been applied within the last two weeks.

Page 8: 2nd bullet: Split samples were not accomplished with OP pesticides and herbicides because the primary split laboratory subcontracted these analyses to Sunlabs. Sunlabs was the primary laboratory.

PSI Response: Primary and split samples for organophosphorous pesticides and herbicides were inadvertently run by the same laboratory on this project. The A-2 FEB was the first project where Sun Labs served as a primary laboratory. We were aware that the secondary laboratory, ALS had previously subcontracted these analyses to SunLabs and we would have been better served to select a different secondary laboratory and this issue will be corrected for the next project. The split samples do serve a function in evaluating the precision of the primary laboratory, as the split samples were analyzed on a different day and in a different batch than the original samples. Split samples were analyzed for OCPs and metals by separate laboratories.

Page 10: 3rd paragraph: FWS protocols recommend consideration of ESV established by EPA Region IV when Florida SQAGs are not available. Were these values considered in this assessment?

PSI Response: This statement is correct; however, in this case no ESVs were published for any of the chemicals which were detected that do not have SQAGs. Atrazine, 2,4-D, metribuzin, phorate and selenium do not have either SQAGs or ESVs.

Pages 11-13: In the discussion of the results, the mean and the standard deviation should be reported.

PSI Response: Mean chemical concentrations and standard deviations are reported in the table provided in **Attachment F.**

Pages 11-13: For compounds where the detection limit was higher than the criteria, this should be reported.

PSI Response: A data table showing all target analytes, the method detection limits and all of the regulatory criteria is provided in **Attachment G**.

Page 11: Last paragraph. The MDL that the laboratory reported is approximately 100 times the SQAG-TEC for atrazine.

PSI Response: PSI acknowledges that the MDLs reported for atrazine, which generally ranged from 24-30 ug/kg, are higher than the SQAG-TEC, but are below all other regulatory criteria. The method detection limits reported by SunLabs are consistent with those reported for other labs that are listed on the District's approved list for this contract and meet the MDLs outlined in the SFWMD standard ADaPT library. For example, E-Labs (Pace) reported an MDL for atrazine using EPA Method 8141 of 33 ug/kg and Jupiter Environmental Laboratories reported an MDL of 25 ug/kg using EPA method 8141.

Page 12: 2nd paragraph: The text fails to state that the holding times for SPLP analyses per method EPA 1312 were exceeded. This makes the data questionable.

PSI Response: PSI agrees that the holding times for atrazine and dieldrin were exceeded for the SPLP analyses; however, we do not agree with the assertion that the data is questionable due to the exceedence of hold times. We typically run SPLP analyses as a follow-up when analytes are detected in the composite soil samples at concentrations exceeding the leaching to groundwater or leaching to surface water criteria. By necessity, these samples are not analyzed until the initial results are reported and we determine the specific analytes of concern and the samples with the highest range of these chemicals. It would be cost prohibitive to run all of the samples for SPLP analyses for all analytes or to run all of the composite samples on a rush basis in order to be able to run the SPLP analyses within hold times. Additionally, it would be prohibitive to the schedule and budget to return to the field to re-collect samples for SPLP analysis. In the past, both FDEP and USFWS have accepted that the SPLP results would be slightly beyond hold time for organic analytes and we do not believe that the analysis of these samples a few days beyond the hold time would significantly impact the results.

Page 13: 4.3 Data validation: ADaPT data validation forms were not provided with the laboratory reports in Appendix A.

PSI Response: The ADaPT data validation forms are provided herein in **Attachment H**.

Page 13: 4^{th} paragraph: Does USFWS concur with the value used of 4.2 mg/kg selenium?

PSI Response: Yes.

Page 14: 4^{th} bullet: A spot check of the data indicate that this statement is inaccurate. The method blank run 1/30/13 by CAS has barium, cadmium, copper, mercury in it.

PSI Response: The statement should read that no target analytes were detected in the laboratory method blanks which caused the sample data to be qualified. PSI acknowledges that estimated concentrations ("I" qualified) of barium, cadmium, copper, and mercury were detected in the method blank for the secondary laboratory. The sample data were not qualified as the samples contained concentrations of these metals in excess of 10 times the blank contamination.

Page 14: Bullets 6&7: There are a wide variety of MDLs being reported by commercial laboratories. Were the labs told which criteria the data was going to be compared to? Were different labs contacted?

PSI Response: PSI is aware that individual laboratories may have different method detection limits for any given chemical. The District has established a list of subcontract laboratories that are acceptable for use under the Ecological Risk Assessment contract. Each of these laboratories has been provided with a standard ADAPT library stating the required method detection limits and quality control requirements for each analyte/method/media. The method detection limit requirements listed in the ADAPT library were developed by HSW Engineers based on performance capabilities, regulatory guidance concentrations, and the FDEP Practical Quantitation Limits Guidance.

Page 14: It should be noted that the laboratory did not achieve the SQAGs TEC concentrations for any of the organophosphate pesticides (OPP), the triazine herbicides (including atrazine) or toxaphene. The SOW that this assessment was supposed to follow named EPA 8140 as the method for OPP. The chain of custody from the field requested EPA 8141 + atrazine for the split samples; the chain of custody between ALS and their subcontractor, Sunlabs was changed to EPA 8270. The chain of custody from the field produced to Sunlabs (the primary laboratory) requested EPA 8141. The data was reported out from EPA 8270 which did not conform to the scope. Typically, EPA 8140 provides lower detection limits than EPA 8270 due to use of a more selective detector.

PSI Response: EPA Method 8140 was not specified in the SOW and is no longer included in SW-846. None of the laboratories that are in use by the District are certified by the Florida Department of Health for this method. EPA Method 8141 was specified in the proposal SOW; however, after preparation of the SOW we began experiencing difficulty with the primary laboratory (Jupiter Environmental Laboratory) that we had proposed to use on the project, and we elected to utilize SunLabs as the primary laboratory. SunLabs does not utilize EPA Method 8141, but instead runs the analysis for OPPs by EPA method 8270. We believe that EPA method 8270 is preferable to EPA method 8141 because it offers mass spec confirmation of identified compounds. PSI has reviewed the MDLs for these compounds using the 8270 method vs. the MDLs reported by the other District-approved laboratories running EPA method 8141 and we found that the MDLs using EPA method 8270 are generally equivalent or better than those identified by the laboratories running EPA 8141. PSI did approve the use of EPA 8270 for OPP analysis, and the method should have been reflected on the chain of custody.

PSI acknowledges that the MDLs for diazinon, azinphos atrazine, simazine, and toxaphene exceed the SQAG TECs. It should be noted that the SQAG-TECs were calculated by an extrapolation of available toxicity data without reference to whether these calculated values were technically achievable by commercial laboratories using available equipment and methods. However, the MDLs reported by SunLabs using EPA 8270 are generally consistent or lower than those reported by other District laboratories using EPA Method 8141. Additionally, practical quantitation limits (PQLs) for a number of these compounds are included in the FDEP Guidance for the Selection of Analytical Methods and Evaluation of Practical Quantitation Limits (FDEP 2004) and the MDLs reported by SunLabs were lower than the FDEP PQLs in most instances. A comparison of the SQAG-TEC criteria, FDEP recommended PQLs, and the SunLabs average MDLs is presented below.

Analyte	SQAG-TEC (ug/kg)	Adapt Library MDL (ug/kg)	FDEP PQL (ug/kg)	SunLabs MDL (ug/kg)
Azinphos, ethyl	0.018	25	No goal	44
azinphos, methyl	0.062	50	7	29
chlorpyriphos	No standard	50	20	40
cuomaphos	No standard	30	40	38
diazinon	0.38	30	50	31
dimethoate	No standard	50	70	20
ethion	No standard	30	7	29
ethoprop	No standard	30	20	22
EPN	No standard	30	40	24
fensulfothion	No standard	30	50	27
fonofos	No standard	30	20	22
methyl parathion	No standard	100	20	16
mevinphos	No standard	30	30	22
naled	No standard	50	300	27
parathion	No standard	100	50	18
phorate	No standard	30	7	4.4
terbufos	No standard	30	7	4.4

Analyte	SQAG-TEC (ug/kg)	Adapt Library MDL (ug/kg)	FDEP PQL (ug/kg)	SunLabs MDL (ug/kg)
atrazine	0.3	No goal	10	25
simazine	0.34	No goal	20	24
toxaphene	0.1	30	100	57

Page 17: 1st bullet: Please confirm that the 95% UCL of dieldrin exceeds the SQAG-TEC.

PSI Response: The calculated 95% UCL for dieldrin is 2.15 ug/kg, which does slightly exceed the SQAG-TEC of 1.9 ug/kg.

Page 17: 2nd bullet: Does the FWS concur with no risk for barium?

PSI Response: Yes.

Page 17: 2nd bullet: The range of barium concentration defined by FDEP (Carvalho and Schropp, 2002) in the Florida DEPs Interpretive Tool for Assessment of Metal Enrichment in Florida Freshwater Sediment warns of the limitation that "the majority of the freshwater sediment systems used to build the sediment metals database from which this tool was developed came from central peninsular and north Florida. Therefore, this tool should be used to evaluate sediments from the same region". It goes on to say in the Recommendations: "... the interpretive tool should be used with a cautionary note outside of central peninsular and north Florida."

PSI Response: Comment noted. The Interpretive Tool was not used per se for the assessment. Rather, the concentrations of barium observed in the reference locations used in the Interpretive Tool were used to indicate that the barium concentrations observed at A-2 were not likely to be toxic to benthic invertebrates.

Table 1: SPLP should have a footnote.

PSI Response: This comment does not appear to be complete. Please indicate what the footnote should document.

Tables: A complete table listing the criteria and the found value and or detection limit would be useful to see at a glance the detection limit vs the criteria.

PSI Response: We do not typically provide tables showing all analytes, as USFWS and FDEP have indicated a preference to see only detected analytes. The method detection limits for all analytes are shown in the laboratory reports, which were included in Appendix A of the Phase II ESA. At your request, we have provided a table showing all analytes, the detection limits and the applicable regulatory criteria in **Attachment G**.

<u>Lisa Gued Comments re: Appendix B Screening Level Ecological Risk Assessment</u>

Page 3: 4th paragraph I have been unable to locate the full dataset.

PSI Response: The full dataset (i.e., all of the laboratory reports) was included on a CD ROM in Appendix A of the Phase II ESA Report.

Page 3: 5th paragraph: Which samples are discrete?

PSI Response: Only composite samples were collected for this assessment.

Page 4: 3.1.1 Does USFWS concur with this?

PSI Response: Yes.

Page 4: 3.1.1 The range of barium concentration defined by FDEP (Carvalho and Schropp, 2002) in the Florida DEPs Interpretive Tool for Assessment of Metal Enrichment in Florida Freshwater Sediment warns of the limitation that "the majority of the freshwater sediment systems used to build the sediment metals database from which this tool was developed came from central peninsular and north Florida. Therefore, this tool should be used to evaluate sediments from the same region". It goes on to say in the Recommendations: "... the interpretive tool should be used with a cautionary note outside of central peninsular and north Florida."

PSI Response: Comment noted. The Interpretive Tool was not used per se for the assessment. Rather, the concentrations of barium observed in the reference locations used in the Interpretive Tool were used to indicate that the barium concentrations observed at A-2 were not likely to be toxic to benthic invertebrates.

Page 5: 1st paragraph: Does the USFWS concur with the barium concentrations are not likely to cause effects?

PSI Response: Yes.

Page 5: 4th paragraph: Does the USFWS concur with the lack of PEC exceedance in any sample and the unique properties of muck soils with the A-2 cultivated area suggest that the potential for toxic effects would be lower than predicted by SQAGs?

PSI Response: Yes.

Page 5: 4th paragraph: Define unique properties.

PSI Response: The unique properties of muck soils are associated with the exceptionally high organic carbon content of the soils (20 – 50%) which is expected to reduce the bioavailability of copper once flooded versus soils containing lower amounts of organic material.

Page 6: 3.1.3: The information is in conflict with the ESA assertion on page 13. The recommended value for selenium should be inserted in to the detected table 1 and footnoted.

PSI Response: The USFWS has recommended a screening benchmark equal to 2 mg/kg for use in SFWMD SLERAs. The value is not experimentally derived and is not equivalent to a SQAG, so it is not appropriate for inclusion on Table 1. The 4.2 mg/kg value cited in the Phase II ESA is not a screening benchmark recommended by USFWS, but is rather an experimentally derived benchmark that may be applicable for use in South Florida in certain situations where selenium is present at concentrations greater than the 2.0 mg/kg screening benchmark in highly organic soils such as those found at this Site.

Page 6: 3.1.4 I am unable to identify a Figure 2 in the hard copy report.

PSI Response: Figure 2 was included in the SLERA; however, we have included a copy for your use in **Attachment I**.

Page 6: Does USFWS concur with the recalculation of the 0.0003 ug/kg TEC value for atrazine to 587 ug/kg TEC for atrazine?

PSI Response: Yes.

Page 6: 3.1.5 What is the half-life for 2,4-D?

PSI Response: According to EXTOXNET (http://extoxnet.orst.edu/pips/24-D.htm) the average half-life of 2,4-D in soils is less than 7 days.

Page 6: 3.1.5: Does USFWS concur with the calculation of the site-specific SQAGs for 2,4-D?

PSI Response: Yes.

Table 1: comp-10 should be shaded for dieldrin concentration

PSI Response: A corrected version of Table 1 reflecting dieldrin concentrations exceeding the SQAG by shading is provided in **Attachment J**.

Page 8: 2nd paragraph Does USFWS concur?

PSI Response: Yes.

Page 8:5th paragraph: Was metribuzin applied recently or not?

PSI Response: Yes.

Page 8:6th paragraph: Was phorate applied recently or not?

PSI Response: Yes.

Page 9: 3.2 The cumulative risk did not include the data for barium. Barium data were not used because it was considered background. It those data were left in the average PEC-HQ would be greater than 0.5. Does USFWS concur with deletion of barium data? Table 2: The value for SQAG PEC for dieldrin is incorrect in this table. The correct value is 0.062 mg/kg.

PSI Response: Barium was not included in the cumulative risk calculations because the PEC for barium is not based on the proper type of benchmark for average PEC calculation as discussed on Page 9 of the SLERA: "In order to calculate the potential for cumulative risk, MacDonald et al. (2003) recommends the use of the average PEC quotient (PEC-HQ) which represents the average ratio of the site chemical concentration to the PEC SQAG. This measure is only meant for use for those chemicals that have consensus-based SQAGs derived in the SQAG guidance document."

Review of the SQAG guidance document provides no information regarding the derivation of the TEC and PEC benchmarks for barium. The barium SQAGs are not representative of the typical consensus-based benchmarks provided for most of the metal contaminants in the guidance and no discussion regarding the underlying assumptions behind the benchmark is provided. A review of the referenced source for the benchmarks indicates that the author of the benchmark guidance obtained the benchmarks from a secondary source which was itself a draft document (SAIC 1991). Neither the secondary nor the primary source (USEPA 1977) were located after an extensive search for both documents. Some information on the barium benchmarks was located in the Washington State Sediment Quality Guidelines document (WADOE 1997). The Washington document indicated that the benchmarks cited in the USEPA (1977) guidance developed by USEPA Region V in order to classify Great Lakes harbor sediments. The document notes that the values are 'somewhat arbitrary and are not well founded scientifically' and that they were only adequate for 'determining the suitability of dredged material for open water disposal'. The barium benchmarks appear to be based not on benthic toxicity but on an unknown general 'contamination classification' scheme. As a result, their use in calculation of average PEC-HQs meant for consensus-based benchmarks would be inappropriate.

MacDonald, D.D., C.G. Ingersoll, D.E. Smorong, R.A. Lindskoog, G. Sloane, and T. Biernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Florida Department of Environmental Protection, Tallahassee, FL.

SAIC (Science Application International Corporation). 1991. Draft compilation of sediment quality guidelines for EPA Region 5 inventory of contaminated sediment sites. Prepared by Science Application International Corporation. Chicago, Illinois. 48 pp.

USEPA (United States Environmental Protection Agency). 1977. Guidelines for the pollution classification of Great Lakes Harbor sediments. United States Environmental Protection Agency. Region V. Chicago, Illinois. (As cited in SAIC 1991).

Washington State Department of Ecology. 1997. Creation and Analysis of Freshwater Sediment Quality Values in Washington. Publication Number 97-323a. July 1997.

Page 10: 2nd paragraph: The text says that "a screening-level approach was used to identify COPCs by using the maximum composite sample concentration from the discrete sediment samples..." This does not make sense. There were no discrete samples.

PSI Response: The comment is correct, discrete samples were not available and the sentence should read: **...***a screening-level approach was used to identify COPCs by using the maximum composite sample concentration ~~from the discrete sediment samples~~..."*

Page 10: 3rd paragraph: Treatment of barium is inconsistent through this report. It was not used in Table 2 to calculate PECs-HQ but it was used in Table 3 to calculate HQs for aquatic – feeding birds.

PSI Response: The treatment of barium is consistent throughout the document according to the Protocol.

Calculation of the average PEC-HQ (Table 2) was conducted using those COPCs whose concentration exceeded a consensus-based PEC from the MacDonald et al. (2003) document as previously discussed. This calculation is used to assess the potential to the benthic invertebrate community only and has no bearing on or relationship to the HQs calculated for aquatic-feeding birds.

HQs calculated for aquatic-feeding birds use a food web model as described in the Protocol that estimates the daily intake of COPCs, including barium. The estimated intake is then compared to laboratory-derived toxicity reference values (TRVs) to calculate the HQs shown in Table 3.

Page 10: 3rd paragraph: The text says that atrazine is a chemical with low toxicity. How do the authors reconcile the 0.0003 mg/kg SQAG-TEC values; it is the lowest concentration of TEC for the compounds detected.

PSI Response: SQAGs are screening-level benchmarks for predicting the potential for toxicity to benthic invertebrates and the comment is correct in that atrazine can be toxic to aquatic life. As a result, the potential for risk to benthic invertebrates was discussed in Section 3.1.4. However, Section 3.3 in which the quoted text is found discusses risk to aquatic-feeding birds. Atrazine is described by EXTOXNET (http://extoxnet.orst.edu/pips/atrazine.htm) as "practically nontoxic to birds" as indicated in the referenced text.

Page 11: 3.3.1 Does USFWS concur with this position?

PSI Response: Yes.

∞ ∞ ∞

We trust that these responses will be satisfactory to address the USACE's concerns regarding the report. If you have any additional questions, please do not hesitate to contact me at 303-424-5578.

Respectfully submitted,
PROFESSIONAL SERVICE INDUSTRIES, INC.

Stephen P. Long, PE, PG
Chief Engineer

Michael Rothenburg, PE
Env. Dept. Manager

Attachments:

- A- USFWS and FDEP Concurrence Letters for Phase II ESA
- B- Final Summary Environmental Report for A-2 FEB, dated 8/21/12
- C- USFWS Concurrence Letter for Phase II ESA SOW
- D- 95% UCL Calculations
- E- SPLP Results
- F- Mean analyte concentrations and standard deviations
- G- Laboratory Analytical Data Table for Soil
- H- ADaPT Data Validation Forms
- I- SLERA Figure 2
- J- SLERA Table 1(rev.)

C:\Documents and Settings\766107\My Documents\SFWMD\A-1 and A-2 Reservoir\A-2 Phase II ESA\Phase II ESA Addendum #1 - 4-22-13.doc

ATTACHMENT A

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

April 17, 2013

Robert Kukleski
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, Florida 33406

Dear Mr. Kukleski:

The U.S. Fish and Wildlife Service (Service) has reviewed the document entitled "Phase II Environmental Site Assessment for the A-2 Flow Equalization Basin, Palm Beach County, Florida," prepared by Professional Service Industries, Incorporated (PSI). This report summarizes sampling results for the approximately 14,408 acre Talisman property.

Previous due diligence assessments were performed on the A-2 Flow Equalization Basin (FEB) parcels prior to the creation of the current "Protocol for Assessment, Remediation, and Post-Remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects", therefore a reduced sampling density of 10 percent was agreed to prior to the current assessment of previously cultivated areas in the project footprint. All point source concerns within the A-2 FEB were previously assessed and remediated as necessary. A total of 30, fifty acre grids were sampled using composite samples. Analytical results were compared to the Florida Department of Environmental Protection Sediment Quality Assessment Guidelines (SQAG) and the Florida Administrative Code Soil Cleanup Target Levels (SCTL).

Results

Barium concentrations (69 to 118 mg/kg) exceeded the SQAG threshold effect concentration (20 mg/kg) and probable effect concentration (PEC) (60 mg/kg) in all of the samples. Copper (53 to 110 mg/kg) was detected at concentrations that exceeded the recommended interim screening level for protection of the Everglade snail kite (*Rostrhamus sociabilis plumbeus*) (85 mg/kg) in eight of the samples collected. The calculated 95 percent upper confidence level (UCL) of the mean copper concentrations (83.1 mg/kg) was below 85 mg/kg. The metals chromium, mercury, and selenium exceeded the SCTL for leaching to surface water in several of the sample locations. The herbicides 2,4-D, metribuzin, phorate, and atrazine were detected at some locations with concentrations above the SCTL for leaching to surface water or ground water. Atrazine (27 to 3,500 µg/kg) was relatively widespread, with detections at 16 of the sampling locations above the SQAG threshold effect concentration (TEC) (0.30 µg/kg). The pesticide dieldrin was detected above the SQAG TEC (1.9 µg/kg) in four samples, ranging from 2.7 to 5.1 µg/kg. Atrazine and dieldrin were also analyzed with the synthetic precipitation leaching procedure (SPLP). Atrazine was detected in SPLP extract at concentrations above the Florida Administrative Code (FAC) groundwater cleanup target level (GCTL) and the FAC

Surface water Cleanup Target Level (SwCTL). The detection limits for the dieldrin SPLP extracts were above the SwCTL.

Copper concentrations within the A-2 FEB did show some exceedances above the recommended interim screening level, but sitewide they are calculated to be below 85 mg/kg. In addition, the total organic carbon (TOC) content of the soils at the proposed A-2 FEB are high (20-50 percent) and will act to decrease the bioavailability of copper. The recommended interim screening level was generally established for sandy soils with roughly 1 percent TOC. To verify that copper does not present a risk to snail kites, PSI recommended a sampling program at the start-up of the A-2 FEB to monitor copper concentrations in surface water, periphyton, and any apple snails that may establish onsite. To address the exceedances of 2,4-D, atrazine, metribuzin, phorate, dieldrin, chromium, mercury, and selenium above the SCTL for leaching to surface water PSI recommended sampling surface water after start-up operations at the A-2 FEB.

Summary and Recommendations

After reviewing the analytical data, the Service concurs that the detected contaminant concentrations are unlikely to pose risk to Service trust resources at the proposed A-2 FEB. We agree that the proposed monitoring for copper is necessary to verify predictions of reduced copper bioavailability due to the high TOC. While the detected levels of barium could potentially impact the benthic community, it is unlikely that they would pose risk to federally listed species.

The Service agrees that an agrochemical best management practices (BMP) plan is appropriate to address the use of agrochemicals, if the property is used for agricultural purposes prior to project construction. We strongly recommend restricting any further use of copper and discontinuing use of atrazine a minimum of one year prior to project construction. If agrochemicals are applied during the interim use, then further sampling may be necessary to ensure that agrochemical concentrations are below thresholds for ecological risk.

Thank you for the opportunity to provide comments regarding the assessment in the A-2 FEB project area. If you have any questions, please contact Emily Bauer at 772-469-4335.

Sincerely yours,

for Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc: electronic only

Corps, West Palm Beach, Florida (Tori White)
Service, Vero Beach, Florida (Sharon Kocis, Steve Mortellaro)
PSI, Tampa, Florida (Stephen Long)

DEPARTMENT OF ENVIRONMENTAL PROTECTION

MEMORANDUM

TO: **Joe Lurix, Air/Waste/WF Program Administrator**
FROM: **William Rueckert, Environmental Mauager, Waste Compliance Assistance & Enforcement Section**
DATE: **April 4, 2013**
SUBJECT: **Phase II Environmental Site Assessment, A-2 Flow Equalization Basin, Palm Beach County; Site No. COM_157258 (Talismau); Tract Numbers: D7100-044; -047; -066; -067; -104; -139; -141; and D7200-005.**

As requested by the Department's Office of Ecosystem Projects in Tallahassee, I have reviewed the document prepared for the South Florida Water Management District (District) by Professional Service Industries, Inc. (PSI) dated March 25, 2013 (received April 1, 2013) *Phase II Environmental Site Assessment, A-2 Flow Equalization Basin (Report), Palm Beach County, Florida.* The Department's review was performed following the "Protocol for Assessment, Remediation and Post Remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects" known as the White Paper. The Waste Compliance Assistance & Enforcement Section has the following comments:

1. Based on the information and representations as presented, this Report adequately addresses the concerns of the Department's Waste Compliance Assistance & Enforcement Section with further discussion below. Therefore, the property addressed in this Report should be capable of being utilized for the intended end use as a flow equalization basin.

2. Start Up Operations - the Department concurs that during the start up operation a one-time surface water and sediment sampling event should be performed. This sampling event should be performed at the 30- or 60-day period from inundation. **In addition,** after one year of operations, an additional surface water sampling event should be performed. Sample location, minimum of three, determinations should be based upon the highest concentrations of the listed parameters presented in this Report. The Department suggests three locations with the highest copper concentrations for the metals analyses. For example, sample collection should be in the vicinity of Comp-1, Comp-16, and Comp-30.

Sample locations, minimum of three, for the pesticide and herbicide analyses should be in the areas of Comp-9, Comp-18, and Comp-28. The following parameters should be laboratory analyzed: pesticides and herbicides (2,4-D; atrazine; metribuzin; phorate) and metals (barium, chromium, copper, mercury and selenium).

3. Arsenic is not suggested for additional analyses but these soils should not be transported off site for uncontrolled disposal. As presented in Section 6.2, Recommendations, a soil management plan should be developed for project construction to ensure proper handling and disposal of the soils.

4. Also as presented in Section 6.2 of the Report, an agrochemical best management practices plan should be instituted during the continued use of agrochemicals on the property.

If you have any questions, feel free to contact William Rueckert at (561) 681-6679 or at William.Rueckert@dep.state.fl.us.

cc: (RPPS_Comp@dep.state.fl.us)

130267

ATTACHMENT B

Note: Attachment B is too large to include in electronic file. A hard copy of this report is being separately transmitted.

ATTACHMENT C

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

January 8, 2013

Robert Kukleski
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, Florida 33406

Dear Mr. Kukleski:

The U.S. Fish and Wildlife Service (Service) has reviewed the document entitled "Proposal for Phase II Environmental Site Assessment, A-2 Flow Equalization Basin (FEB) Project, Palm Beach County, Florida, Proposal No. 552-80246," prepared by Professional Service Industries, Incorporated (PSI). This proposal summarizes planned sampling for the 14,408-acre property located between US Highway 27 and the Miami Canal in southern Palm Beach County.

Due diligence assessments were performed on the A-2 FEB parcels prior to the creation of the current "Protocol for Assessment, Remediation, and Post-Remediation, Monitoring for Environmental Contamination of Everglades Restoration Projects", so reduced sampling density is satisfactory for providing a general indication of large scale concerns in the project area. Approximately 10% of the formerly cultivated sugarcane area will be sampled using composite samples from 50-acre grids. It is agreed that if exceedances based on ecological screening criteria are identified, then additional investigation will be required.

The Service concurs with the proposed sampling plan for the A-2 FEB project area. We look forward to reviewing sampling results once they become available.

Thank you for the opportunity to provide comments regarding this sampling proposal for the A-2 FEB project. If you have any questions, please contact Emily Bauer at 772-469-4335.

Sincerely yours,

for Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc: electronic only
Corps, West Palm Beach, Florida (Tori White)
Service, Vero Beach, Florida (Kevin Palmer)
PSI, Tampa, Florida (Stephen Long)

ATTACHMENT D

General UCL Statistics for Full Data Sets

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

C0

General Statistics

Number of Valid Observations	36	Number of Distinct Observations	24

Raw Statistics		Log-transformed Statistics	
Minimum	3.1	Minimum of Log Data	1.131
Maximum	6.8	Maximum of Log Data	1.917
Mean	4.593	Mean of log Data	1.501
Geometric Mean	4.484	SD of log Data	0.221
Median	4.3		
SD	1.036		
Std. Error of Mean	0.173		
Coefficient of Variation	0.226		
Skewness	0.556		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.93	Shapiro Wilk Test Statistic	0.952
Shapiro Wilk Critical Value	0.935	Shapiro Wilk Critical Value	0.935
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	4.885	95% H-UCL	4.903
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	5.335
95% Adjusted-CLT UCL (Chen-1995)	4.894	97.5% Chebyshev (MVUE) UCL	5.656
95% Modified-t UCL (Johnson-1978)	4.888	99% Chebyshev (MVUE) UCL	6.288
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	19.29	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.238		
MLE of Mean	4.593		
MLE of Standard Deviation	1.046		
nu star	1389		
Approximate Chi Square Value (.05)	1303	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0428	95% CLT UCL	4.877
Adjusted Chi Square Value	1299	95% Jackknife UCL	4.885
		95% Standard Bootstrap UCL	4.873
Anderson-Darling Test Statistic	0.537	95% Bootstrap-t UCL	4.922
Anderson-Darling 5% Critical Value	0.747	95% Hall's Bootstrap UCL	4.894
Kolmogorov-Smirnov Test Statistic	0.117	95% Percentile Bootstrap UCL	4.862
Kolmogorov-Smirnov 5% Critical Value	0.147	95% BCA Bootstrap UCL	4.924
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	5.346
		97.5% Chebyshev(Mean, Sd) UCL	5.672

Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	6.311
95% Approximate Gamma UCL (Use when n >= 40)	4.895		
95% Adjusted Gamma UCL (Use when n < 40)	4.909		
Potential UCL to Use		Use 95% Approximate Gamma UCL	4.895

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

ATTACHMENT E

SunLabs

April 11, 2013

Andrew Cadle
PSI
5801 Benjamin Center Dr, #112
Tampa, FL 33634

Re: SunLabs Project Number: **130404.09**
Client Project Description: **A-2 FEB SPLP**

Dear Mr. Cadle:

Enclosed is the report of laboratory analysis for the following samples:

Sample Number	Sample Description	Date Collected	Date Received
163830	Comp-7 012313	01/23/13 15:30	01/28/13
163831	SPLP Leachate/163830 (Comp-7)	04/05/13 9:00	
163832	Comp-12 012513	01/25/13 13:20	01/28/13
163833	SPLP Leachate/163832 (Comp-12)	04/05/13 9:00	

Narrative:

Unless otherwise noted below or in the report and where applicable:
- Samples were received at the proper temperature and analyzed as received.
- Sample condition upon receipt is recorded on the chain-of-custody attached to this report.
- Results for all solid matrices are reported on a dry weight basis.
- Appropriate calibration and QC criteria were satisfactorily met.
- All applicable holding times for analytes have been met.
- Copies of the chains-of-custody, if received, are attached to this report.

Samples 163830 (Comp-7 012313) and 163832 (Comp-12 012513) were leached outside of hold time for Mercury. All other metals were leached within holding times.

If you have any questions or comments concerning this report, please do not hesitate to contact us.

Sincerely,

Michael W. Palmer

Michael W. Palmer
Vice President, Laboratory Operations

Enclosures

Unless Otherwise Noted and Where Applicable:
The results herein relate only to the items tested or to the samples as received by the laboratory • This report shall not be reproduced except in full, without the written approval of SunLabs • All samples will be disposed of within 60 days of the date of receipt of the samples • All results meet the requirements of the NELAC standards • Uncertainty values are available upon request

Report of Laboratory Analysis

SunLabs Project Number	PSI
130404.09	Project Description: A-2 FEB SPLP

April 11, 2013

SunLabs Sample Number **163830**
Sample Designation **Comp-7 012313**

Matrix: Soil
Date Collected: 01/23/13 15:30
Date Received: 01/28/13 13:20

Parameters	Method	Units	Results	Dil Factor	MDL	PQL	CAS Number	Date/Time Analyzed	Date/Time Prep	Analyst
Synthetic Precipitation Leaching Procedure										
SPLP - Date Leached	1312		04/05/13	1				04/05/13	04/05/13	REB

Report of Laboratory Analysis

SunLabs Project Number	PSI
130404.09	Project Description: A-2 FEB SPLP

April 11, 2013

SunLabs Sample Number **163831**
Sample Designation **SPLP Leachate/163830 (Comp-7)**

Matrix: SPLP Leachate
Date Collected: 04/05/13 09:00
Date Received:

Parameters	Method	Units	Results		Dil Factor	MDL	PQL	CAS Number	Date/Time Analyzed	Date/Time Prep	Analyst
Mercury											
Date Digested	7470		04/10/13							04/10/13 12:20	CLG
Date Analyzed	7470		04/11/13		1				04/11/13 14:27		CLG
Mercury	7470	ug/L	0.062	U	1	0.062	0.25	7439-97-6	04/11/13 14:27	04/10/13 12:20	CLG
RCRA Metals											
Date Digested	3005		04/10/13							04/10/13 14:45	CLG
Date Analyzed	6010		04/10/13		1				04/10/13 23:18		CAM
Chromium	6010	ug/L	3.5	U	1	3.5	14	7440-47-3	04/10/13 23:18	04/10/13 14:45	CAM
Selenium	6010	ug/L	2.3	U	1	2.3	9.2	7782-49-2	04/10/13 23:18	04/10/13 14:45	CAM

Report of Laboratory Analysis

SunLabs Project Number	PSI
130404.09	Project Description: A-2 FEB SPLP

April 11, 2013

SunLabs Sample Number	**163832**	Matrix	Soil
Sample Designation	**Comp-12 012513**	Date Collected	01/25/13 13:20
		Date Received	01/28/13 13:20

Parameters	Method	Units	Results	Dil Factor	MDL	PQL	CAS Number	Date/Time Analyzed	Date/Time Prep	Analyst
Synthetic Precipitation Leaching Procedure										
SPLP - Date Leached	1312		04/05/13	1				04/05/13		REB

Report of Laboratory Analysis

SunLabs Project Number	PSI
130404.09	Project Description: A-2 FEB SPLP

April 11, 2013

SunLabs Sample Number **163833**
Sample Designation **SPLP Leachate/ 163832 (Comp-12)**

Matrix SPLP Leachate
Date Collected 04/05/13 09:00
Date Received

Parameters	Method	Units	Results		Dil Factor	MDL	PQL	CAS Number	Date/Time Analyzed	Date/Time Prep	Analyst
Mercury											
Date Digested	7470		04/10/13							04/10/13 12:20	CLG
Date Analyzed	7470		04/11/13		1				04/11/13 14:29		CLG
Mercury	7470	ug/L	0.062	U	1	0.062	0.25	7439-97-6	04/11/13 14:29	04/10/13 12:20	CLG
RCRA Metals											
Date Digested	3005		04/10/13							04/10/13 14:45	CLG
Date Analyzed	6010		04/10/13		1				04/10/13 23:21		CAM
Chromium	6010	ug/L	18		1	3.5	14	7440-47-3	04/10/13 23:21	04/10/13 14:45	CAM
Selenium	6010	ug/L	2.3	U	1	2.3	9.2	7782-49-2	04/10/13 23:21	04/10/13 14:45	CAM

Report of Laboratory Analysis

SunLabs Project Number	PSI
130404.09	Project Description: A-2 FEB SPLP

April 11, 2013

Footnotes	
**	SunLabs is not currently NELAC certified for this analyte.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
J	The reported value failed to meet the established quality control criteria for either precision or accuracy(see cover letter for explanation)
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Sample not analyzed at client's request.
Q	Sample held beyond the accepted holding time.
RPD	Relative Percent Difference
U	Compound was analyzed for but not detected.
U,Q	Compound was anaylzed for but not detected. Sample was analyzed beyond the accepted holding time.
V	Indicates that the analyte was detected in both the sample and the associated method blank.
Y	The laboratory analysis was from an improperly preserved sample. The data may not be accurate.
Z	Too many colonies were present (TNTC); the numeric value represents the filtration volume.

Quality Control Data

Project Number	PSI
130404.09	Project Description: A-2 FEB SPLP

April 11, 2013

Batch No: F1460
Test: Mercury
TestCode: Hg-L

Associated Samples: 163831, 163833

Compound	Blank	LCS Spike	LCS %Rec	LCSD %Rec	RPD %	---QC Limits--- RPD	LCS	MS Spike	MS %Rec	MSD %Rec	RPD %	---QC Limits--- RPD	MS	Dup RPD	Qualifiers
Parent Sample Number									*163831*	*163831*					
Date Digested	04/10/13														
Date Analyzed	04/11/13														
Mercury	0.062 U ug/L	5.0	93	97	4	20	80-120	5.0	94	97	3	20	75-125		

Batch No: F1463
Test: RCRA Metals
TestCode: RCRA-7-w-ug/L

Associated Samples: 163831, 163833

Compound	Blank	LCS Spike	LCS %Rec	LCSD %Rec	RPD %	---QC Limits--- RPD	LCS	MS Spike	MS %Rec	MSD %Rec	RPD %	---QC Limits--- RPD	MS	Dup RPD	Qualifiers
Parent Sample Number									*163833*	*163833*					
Chromium	3.5 U ug/L	1000	100	98	2	20	80-120	1000	97	96	1	20	75-125		
Selenium	2.3 U ug/L	1000	95	95	0	20	80-120	1000	97	96	1	20	75-125		

* indicates value is outside control limits for %Recovery or greater than acceptance criteria for RPD

Footnotes

U — *Compound was analyzed for but not detected.*

SunLabs, Inc.
5460 Beaumont Center Blvd., Suite 520
Tampa, FL 33634

Laboratory ID Number - E84809

Phone: (813) 881-9401
Email: Info@SunLabsInc.com
Website: www.SunLabsInc.com

Pg 1 of 3

SunLabs, Inc. Chain of Custody 130404.09

№ 37587

Client Name: PSI
Contact: Drew Cadle
Address:
Phone / Fax: onsite
E-Mail :

SunLabs Project # ~~130128.00~~ apb

Project Name: A-2 Feb
Project #: 0552114
PO #:
Alt Bill To:

SunLabs Sample #	Sample Description	Sampled Date	Sampled Time	# of Bottles	EPA 8081	EPA 8141	EPA 8151	RCRA 8 + Copper	Total Organic Carbon (TOC)			~~EPA 8081~~ RF	~~EPA 8~~ RF	
Bottle Type					S	S	S	S	S					
Preservative					I	I	I	I	I					
Matrix					SO	SO	SO	SO	SO					
159670	Comp-15 012213	1-22-13	1355	3	X	X	X	X	X					
	~~Comp-15 Sp~~ RF													
671	Comp-21 012213	1-22-13	1545	3	X	X	X	X	X					
672	Comp-27 012213	1-22-13	1710	3	X	X	X	X	X					
673	Comp-14 012213	1-22-13	1330	3	X	X	X	X	X					
674	Comp-13 012213	1-22-13	1500	3	X	X	X	X	X					
675	Comp-9 012213	1-22-13	1700	3	X	X	X	X	X					
676	Comp-9 DUP 012213	1-22-13	1700	3	X	X	X	X	X					
677	Comp-22 012313	1-23-13	1115	3	X	X	X	X	X					
678	Comp-28 012313	1-23-13	1240	3	X	X	X	X	X					
679	Comp-16 012313	1-23-13	1400	3	X	X	X	X	X					
680	Comp-17 012313	1-23-13	1545	3	X	X	X	X	X					
681	Comp-10 012313	1-23-13	1720	3	X	X	X	X	X					
682	Comp-3 012313	1-23-13	1100	3	X	X	X	X	X					

Due Date Requested*:

☐ FDEP PreApproval site
☒ ADaPT EDD (PGM:________)
Facility/Site ID:

Remarks / Comments:
3 Coolers
ADaPT EDD

Length of Record Retention if other than 5 years:*

Sampler Signature / Date: [signature] / 1-28-13

Printed Name / Affiliation: Ryan Fetter / PSI

SUNLABS, INC. RESERVES THE RIGHT TO BILL FOR DISPOSAL OF UNUSED/ UNRETURNED SAMPLES AND TO RETURN UNUSED SAMPLES.

Relinquished By:	Relinquished To:	Date:	Time:
[signature]	[signature]	1-17-13	1500
[signature]	[signature]	1-28-13	13:20

Bottle Type Codes:
GV = Glass Vial — GVS = Low Level Volatile Kit
GA = Glass Amber — T = Tedlar Bag
P = Plastic — O = Other (Specify)
S = Soil Jar

Preservative Codes:
H = Hydrochloric Acid + Ice — S = Sulfuric Acid + Ice
I = Ice only — VS = NaHSO4, MeOH, + Ice
N = Nitric Acid — T = Sodium thiosulfate + Ice
B = Sodium bisulfate + Ice — O = Other (Specify) ________

Matrix Codes:
SO = Soil — SOL = Solid
A = Air — SW = Surface Water
DW = Drinking Water — WS = Waste — WW = Waste Water
GW = Ground Water — W = Water (Blanks)
SE = Sediment — O = Other (Specify ________)

Internal Use Only
Temp upon receipt: 5.0 °C
Received on Ice? (Y) / N / NA

Internal Use Only
Sample Condition Upon Receipt:

Custody Seals present?	Y / (N) / NA
Custody Seals intact?	Y / N / (NA)
Shipping Bills attached?	Y / (N) / NA
Sample containers intact?	(Y) / N / NA
Samples within holding times?	(Y) / N / NA
Sufficient volume for all analyses?	(Y) / N / NA
Are vials head-space free?	Y / N / (NA)
Proper containers and preservatives?	(Y) / N / NA

SunLabs, Inc.
5460 Beaumont Center Blvd., Suite 520, Tampa, Florida 33634
Phone: 813-881-9401 / Fax: 813-354-4661
e-mail: info@SunLabsInc.com www.SunLabsInc.com

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SunLabs, Inc. Chain of Custody 130404.09 № 37586

Client Name: PSI
Contact: Drew Castle
Address:
Phone / Fax: on file
E-Mail:

SunLabs Project # 130128.010

Project Name: A-2 Feb
Project #: 05521114
PO #:
Alt Bill To:

	EPA 8081	EPA 8141	EPA 8151	RCRA 8 + copper	Total Organic Carbon (TOC)					
Bottle Type	S	S	S	S	S					
Preservative	I	I	I	I	I					
Matrix	SO	SO	SO	SO	SO					

SunLabs Sample #	Sample Description	Sampled Date	Sampled Time	# of Bottles	EPA 8081	EPA 8141	EPA 8151	RCRA 8 + copper	Total Organic Carbon (TOC)
1591083	Comp-1 012313	1-23-13	1340	3	X	X	X	X	X
1084	Comp-7 012313 *	1-23-13	1530	3	X	X	X	X	X
1085	Comp-7 DUP 012313	1-23-13	1530	3	X	X	X	X	X
1086	Comp-8 012313	1-23-13	1725	3	X	X	X	X	X
1087	Comp-11 012413	1-24-13	1145	3	X	X	X	X	X
1088	Comp-23 012413	1-24-13	1330	3	X	X	X	X	X
1089	Comp-29 012413	1-24-13	1610	3	X	X	X	X	X
1090	Comp-24 012413	1-24-13	1730	3	X	X	X	X	X
1091	Comp-4 012413	1-24-13	1150	3	X	X	X	X	X
1092	Comp-4 DUP 012413	1-24-13	1150	3	X	X	X	X	X
1093	Comp-20 012413	1-24-13	1400	3	X	X	X	X	X
1094	Comp-26 012413	1-24-13	1630	3	X	X	X	X	X
1095	Comp-19 012413	1-24-13	1800	3	X	X	X	X	X
1096	Comp-30 012513	1-25-13	1020	3	X	X	X	X	X

Due Date Requested*:

☐ FDEP PreApproval site
☒ ADaPT EDD (PGM:)
Facility/Site ID:

Remarks / Comments:
3 Coolers
ADaPT EDD
*SPLP Cr, Hg, Se 4/4/13

Length of Record Retention if other than 5 years:*

Sampler Signature / Date: [signature] 1-28-13
Printed Name / Affiliation: Ryan Fetter / PSI

SUNLABS, INC. RESERVES THE RIGHT TO BILL FOR DISPOSAL OF UNUSED/UNRETURNED SAMPLES AND TO RETURN UNUSED SAMPLES.

Relinquished By:	Relinquished To:	Date:	Time:
[signature]	[signature]	1-17-13	15:00
[signature]	[signature]	1-28-13	13:20

Bottle Type Codes:
GV = Glass Vial — GVS = Low Level Volatile Kit
GA = Glass Amber — T = Tedlar Bag
P = Plastic — O = Other (Specify)
S = Soil Jar

Preservative Codes:
H = Hydrochloric Acid + Ice — S = Sulfuric Acid + Ice
I = Ice only — VS = NaHSO4, MeOH, + Ice
N = Nitric Acid — T = Sodium thiosulfate + ice
B = Sodium bisulfate + Ice — O = Other (Specify)

Matrix Codes:
SO = Soil — SOL = Solid
A = Air — SW = Surface Water
DW = Drinking Water — WS = Waste — WW = Waste Water
GW = Ground Water — W = Water (Blanks)
SE = Sediment — O = Other (Specify:)

Internal Use Only
Temp upon receipt: 5.0 °C
Received on Ice? (Y) / N / NA

Internal Use Only
Sample Condition Upon Receipt:
Custody Seals present? Y / (N) / NA
Custody Seals intact? Y / N / (NA)
Shipping Bills attached? Y / (N) / NA
Sample containers intact? (Y) / N / NA
Samples within holding times? (Y) / N / NA
Sufficient volume for all analyses? (Y) / N / NA
Are vials head-space free? Y / N / (NA)
Proper containers and preservatives? (Y) / N / NA

SunLabs, Inc.
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e-mail: info@SunLabsInc.com www.SunLabsInc.com

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Pg 3 of 3

SunLabs, Inc. Chain of Custody

130404.09

№ 37585

Client Name: PSI
Contact: Drew Caddle
Address: -
Phone / Fax: on file
E-Mail:

SunLabs Project #: 130128.06

Project Name: A-2 Feb
Project #: 05521114
PO #:
Alt Bill To:

Bottle Type					S	S	S	S	S		GA	GA	GA	P
Preservative					I	I	I	I	I					
Matrix					SO	SO	SO	SO	SO		W	W	W	W
SunLabs Sample #	Sample Description	Sampled Date	Sampled Time	# of Bottles	EPA 8081	EPA 8141	EPA 8151	RCRA 8 + copper	Total Organic Carbon (TOC)		EPA 8081	EPA 8141	EPA 8151	RCRA 8 + copper
159697	Comp-18 012513	1-25-13	1150	3	X	X	X	X	X					
698	Comp-12 012513 *	1-25-13	1320	3	X	X	X	X	X					
699	Comp-6 012513	1-25-13	1430	3	X	X	X	X	X					
700	Comp-25 012513	1-25-13	1030	3	X	X	X	X	X					
701	Comp-2 012513	1-25-13	1215	3	X	X	X	X	X					
702	Comp-5 012513	1-25-13	1330	3	X	X	X	X	X					
703	Equip Blank-1	1-22-13	1130	4							X	X	X	X
704	FCEB-2	1-23-13	1735	4							X	X	X	X
705	FCEB-3	1-24-13	1015	4							X	X	X	X

Due Date Requested*:

☐ FDEP PreApproval site
☒ ADaPT EDD (PGM:)
Facility/Site ID:

Remarks / Comments:
3 coolers
ADaPT EDD
SPLP Cr, Hg, Se 4/4/13

Length of Record Retention if other than 5 years:*

Sampler Signature / Date: [signature] 1-28-13

Printed Name / Affiliation: Ryan Fetter / PSI

Bottle Type Codes:
GV = Glass Vial; GVS = Low Level Volatile Kit
GA = Glass Amber; T = Tedlar Bag
P = Plastic; O = Other (Specify)
S = Soil Jar

Preservative Codes:
H = Hydrochloric Acid + Ice; S = Sulfuric Acid + Ice
I = Ice only; VS = NaHSO4, MeOH, + Ice
N = Nitric Acid; T = Sodium thiosulfate + Ice
B = Sodium bisulfate + Ice; O = Other (Specify) ______

Matrix Codes:
SO = Soil; SOL = Solid
A = Air; SW = Surface Water
DW = Drinking Water; WS = Waste; WW = Waste Water
GW = Ground Water; W = Water (Blanks)
SE = Sediment; O = Other (Specify: ______)

Internal Use Only
Temp upon receipt: 5.0 °C
Received on Ice? (Y) / N / NA

Internal Use Only
Sample Condition Upon Receipt:
Custody Seals present? Y / (N) / NA
Custody Seals intact? Y / N / (NA)
Shipping Bills attached? Y / (N) / NA
Sample containers intact? (Y) / N / NA
Samples within holding times? (Y) / N / NA
Sufficient volume for all analyses? (Y) / N / NA
Are vials head-space free? Y / N / (NA)
Proper containers and preservatives? (Y) / N / NA

SUNLABS, INC. RESERVES THE RIGHT TO BILL FOR DISPOSAL OF UNUSED/ UNRETURNED SAMPLES AND TO RETURN UNUSED SAMPLES.

Relinquished By:	Relinquished To:	Date:	Time:
[signature]	[signature]	1-17-13	15:00
[signature]	[signature]	1-28-13	13:20

SunLabs, Inc.
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e-mail: info@SunLabsInc.com www.SunLabsInc.com

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ATTACHMENT F

Mean Concentrations and Standard Deviation for Detected Chemicals of Interest
PROJECT NAME: A-2 Flow Equalization Basin
PSI PROJECT NO.: 05521114

	Chlorinated Herbicides (ug/kg)	OPPs (ug/kg)			OCPs (ug/kg)	Metals (mg/kg)									TOC (mg/kg)
	D, 2-4'	Atrazine	Metribuzin	Phorate	Dieldrin	Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Mercury	Selenium	Silver	Total Organic Carbon
Mean Concentration	30.75	333.2	172.6	7.97	1.53	4.59	95.12	0.00	15.53	77.29	6.24	0.12	2.58	NA	401,056
Standard Deviation	2.48	832.6	366.8	24.48	1.54	1.04	9.20	0.00	5.79	12.47	0.74	0.02	0.40	NA	64,198

ATTACHMENT G

Summary of Soil Analytical Results
A-2 Flow Equalization Basin Project
(All Results in milligrams per kilogram [mg/kg])

Sample ID	Date Collected	Aldrin	Arsenic	Aspon	Atrazine	Azinphos ethyl	Azinphos methyl	Barium	BHC, a-	BHC, b-	BHC, d-
SCTL-RDE		0.06	2.1	***	4.3	***	120	120	0.1	0.5	24
SCTL-LGW		0.2	***	***	0.06	***	0.2	1600	0.0003	0.001	0.2
SCTL-LSW		0.01	***	***	0.04	***	0.0002	***	0.0003	0.003	***
SQAG-TEC		***	9.8	***	0.0003	0.000018	0.000062	20	***	***	***
Comp-1 012313	1/23/2013	0.00014 U	**6.8**	0.011 U	**0.099 I**	0.036 U	0.024 U	**110**	0.00080 U	0.00085 U	0.00064 U
Comp-10 012313	1/23/2013	0.00013 U	**4.9**	0.011 U	0.025 U	0.036 U	0.023 U	**95**	0.00079 U	0.00084 U	0.00062 U
Comp-11 012413	1/24/2013	0.00015 U	**3.6**	0.012 U	0.027 U	0.039 U	0.025 U	**98**	0.00086 U	0.00092 U	0.00069 U
Comp-12 012513	1/25/2013	0.00015 U	**3.8**	0.012 U	0.027 U	0.039 U	0.025 U	**100**	0.00086 U	0.00092 U	0.00069 U
Comp-13 012213	1/22/2013	0.00014 U	**6.2**	0.011 U	**0.110 I**	0.037 U	0.024 U	**100**	0.00081 U	0.00087 U	0.00065 U
Comp-14 012213	1/22/2013	0.00014 U	**5.5**	0.011 U	0.026 U	0.038 U	0.025 U	**80**	0.00083 U	0.00089 U	0.00066 U
Comp-15 012213	1/22/2013	0.00016 U	**3.4**	0.013 U	**3.5**	0.043 U	0.028 U	**87**	0.00096 U	0.0010 U	0.00076 U
Comp-16 012313	1/23/2013	0.00012 U	**4**	0.0098 U	**0.33**	0.033 U	0.021 U	**91**	0.00072 U	0.00077 U	0.00057 U
Comp-17 012313	1/23/2013	0.00014 U	**3.8**	0.011 U	**0.160 I**	0.038 U	0.025 U	**99**	0.00083 U	0.00089 U	0.00066 U
Comp-18 012513	1/25/2013	0.00015 U	**3.4**	0.012 U	**3.3**	0.039 U	0.025 U	**97**	0.00086 U	0.00092 U	0.00069 U
Comp-19 012413	1/24/2013	0.00013 U	**5.5**	0.010 U	0.024 U	0.034 U	0.022 U	**88**	0.00076 U	0.00081 U	0.00060 U
Comp-2 012513	1/25/2013	0.00015 U	**5.2**	0.012 U	0.029 U	0.041 U	0.027 U	**93**	0.00090 U	0.00096 U	0.00071 U
Comp-20 012413	1/24/2013	0.00013 U	**5**	0.011 U	0.025 U	0.036 U	0.023 U	**90**	0.00079 U	0.00084 U	0.00062 U
Comp-21 012213	1/22/2013	0.00012 U	**3.5**	0.0097 U	**0.055 I**	0.032 U	0.021 U	**69**	0.00071 U	0.00076 U	0.00056 U
Comp-22 012313	1/23/2013	0.00015 U	**4.3**	0.012 U	0.027 U	0.039 U	0.025 U	**100**	0.00086 U	0.00092 U	0.00069 U
Comp-23 012413	1/24/2013	0.00014 U	**4.2**	0.011 U	0.026 U	0.037 U	0.024 U	**82**	0.00081 U	0.00087 U	0.00065 U
Comp-24 012413	1/24/2013	0.00015 U	**4.1**	0.012 U	0.028 U	0.040 U	0.026 U	**99**	0.00088 U	0.00094 U	0.00070 U
Comp-25 012513	1/25/2013	0.00014 U	**6.4**	0.011 U	**0.031 I**	0.036 U	0.024 U	**100**	0.00080 U	0.00085 U	0.00064 U
Comp-26 012413	1/24/2013	0.00013 U	**5.5**	0.011 U	0.025 U	0.036 U	0.023 U	**98**	0.00079 U	0.00084 U	0.00062 U
Comp-27 012213	1/22/2013	0.00016 U	**3.5**	0.013 U	**0.035 I**	0.043 U	0.028 U	**89**	0.00096 U	0.0010 U	0.00076 U
Comp-28 012313	1/23/2013	0.00014 U	**3.1**	0.011 U	**0.19**	0.036 U	0.024 U	**83**	0.00080 U	0.00085 U	0.00064 U
Comp-29 012413	1/24/2013	0.00017 U	**4.3**	0.014 U	0.033 U	0.047 U	0.030 U	**86**	0.0010 U	0.0011 U	0.00081 U
Comp-3 012313	1/23/2013	0.00015 U	**4.3**	0.012 U	0.029 U	0.041 U	0.027 U	**91**	0.00090 U	0.00096 U	0.00071 U
Comp-30 012513	1/25/2013	0.00015 U	**3.2**	0.012 U	**0.027 I**	0.039 U	0.025 U	**96**	0.00086 U	0.00092 U	0.00069 U
Comp-4 012413	1/24/2013	0.00015 U	**4.7**	0.012 U	0.029 U	0.041 U	0.027 U	**95**	0.00090 U	0.00096 U	0.00071 U
Comp-4 DUP 012413	1/24/2013	0.00017 U	**4.1**	0.014 U	0.033 U	0.047 U	0.030 U	**93**	0.0010 U	0.0011 U	0.00081 U
Comp-5 012513	1/25/2013	0.00015 U	**4.6**	0.012 U	0.027 U	0.039 U	0.025 U	**94**	0.00086 U	0.00092 U	0.00069 U
Comp-6 012513	1/25/2013	0.00016 U	**4.5**	0.013 U	0.030 U	0.043 U	0.028 U	**110**	0.00096 U	0.0010 U	0.00076 U
Comp-7 012313	1/23/2013	0.00013 U	**6.4**	0.011 U	0.025 U	0.036 U	0.023 U	**97**	0.00079 U	0.00084 U	0.00062 U
Comp-7 DUP 012313	1/23/2013	0.00014 U	**5.7**	0.011 U	0.025 U	0.036 U	0.024 U	**97**	0.00080 U	0.00085 U	0.00064 U
Comp-8 012313	1/23/2013	0.00014 U	**3.8**	0.012 U	**1.1**	0.038 U	0.025 U	**96**	0.00085 U	0.00090 U	0.00067 U
Comp-9 012213	1/22/2013	0.00015 U	**3.9**	0.012 U	**0.38**	0.039 U	0.025 U	**92**	0.00086 U	0.00092 U	0.00069 U
Comp-9 DUP 012213	1/22/2013	0.00017 U	**3.5**	0.013 U	**0.44**	0.044 U	0.029 U	**110**	0.00098 U	0.0010 U	0.00078 U

Sample ID	Bolstar	Cadmium	Carbophenothion	Chlordane, a-	chlordane, g-	Chlorfenvinphos	Chlorpyrifos	Chlorpyrifos Methyl	Chromium	Copper	Coumaphos	Crotoxyphos	D, 2,4-
SCTL-RDE	***	82	11	2.8	2.8	***	250	***	210	150	21	***	770
SCTL-LGW	***	7.5	13	9.6	9.6	***	15	***	38	***	0.3	***	0.7
SCTL-LSW	***	***	1.5	0.003	0.003	***	0.001	***	4.2	***	0.0007	***	0.9
SQAG-TEC	***	1	***	0.0032	***	***	***	***	43	85	***	***	***
Comp-1 012313	0.022 U	0.11 U	0.011 U	0.0013 U	0.0033 U	0.020 U	0.033 U	0.022 U	**19**	**110**	0.031 U	0.031 U	0.058 U
Comp-10 012313	0.021 U	0.11 U	0.011 U	0.0012 U	0.0032 U	0.020 U	0.032 U	0.021 U	**12**	**68**	0.030 U	0.030 U	0.057 U
Comp-11 012413	0.024 U	0.11 U	0.012 U	0.0014 U	0.0035 U	0.022 U	0.035 U	0.024 U	**15**	**79**	0.033 U	0.033 U	0.063 U
Comp-12 012513	0.024 U	0.11 U	0.012 U	0.0014 U	0.0035 U	0.022 U	0.035 U	0.024 U	**13**	**87**	0.033 U	0.033 U	0.063 U
Comp-13 012213	0.022 U	**0.15 I**	0.011 U	0.0013 U	0.0033 U	0.020 U	0.033 U	0.022 U	**29**	**90**	0.031 U	0.031 U	0.059 U
Comp-14 012213	0.023 U	**0.18 I**	0.011 U	0.0013 U	0.0034 U	0.021 U	0.034 U	0.023 U	**16**	**68**	0.032 U	0.032 U	0.060 U
Comp-15 012213	0.026 U	**0.12 I**	0.013 U	0.0015 U	0.0039 U	0.024 U	0.039 U	0.026 U	**7.8**	**75**	0.037 U	0.037 U	**0.29**
Comp-16 012313	0.020 U	0.096 U	0.0098 U	0.0011 U	0.0030 U	0.018 U	0.030 U	0.020 U	**23**	**96**	0.028 U	0.028 U	0.052 U
Comp-17 012313	0.023 U	0.12 U	0.011 U	0.0013 U	0.0034 U	0.021 U	0.034 U	0.023 U	**17**	**85**	0.032 U	0.032 U	0.060 U
Comp-18 012513	0.024 U	0.11 U	0.012 U	0.0014 U	0.0035 U	0.022 U	0.035 U	0.024 U	**11**	**88**	0.033 U	0.033 U	**0.94**
Comp-19 012413	0.021 U	0.11 U	0.010 U	0.0012 U	0.0031 U	0.019 U	0.031 U	0.021 U	**17**	**59**	0.029 U	0.029 U	0.055 U
Comp-2 012513	0.024 U	0.11 U	0.012 U	0.0014 U	0.0037 U	0.022 U	0.037 U	0.024 U	**15**	**59**	0.035 U	0.035 U	0.065 U
Comp-20 012413	0.021 U	0.10 U	0.011 U	0.0012 U	0.0032 U	0.020 U	0.032 U	0.021 U	**14**	**70**	0.030 U	0.030 U	0.057 U
Comp-21 012213	0.019 U	**0.17 I**	0.0097 U	0.0011 U	0.0029 U	0.018 U	0.029 U	0.019 U	**9.4**	**79**	0.027 U	0.027 U	0.052 U
Comp-22 012313	0.024 U	**0.16 I**	0.012 U	0.0014 U	0.0035 U	0.022 U	0.035 U	0.024 U	**12**	**83**	0.033 U	0.033 U	0.063 U
Comp-23 012413	0.022 U	0.11 U	0.011 U	0.0013 U	0.0033 U	0.020 U	0.033 U	0.022 U	**13**	**59**	0.031 U	0.031 U	0.059 U
Comp-24 012413	0.024 U	**0.14 I**	0.012 U	0.0014 U	0.0036 U	0.022 U	0.036 U	0.024 U	**28**	**82**	0.034 U	0.034 U	0.064 U
Comp-25 012513	0.022 U	0.11 U	0.011 U	0.0013 U	0.0033 U	0.020 U	0.033 U	0.022 U	**19**	**67**	0.031 U	0.031 U	0.058 U
Comp-26 012413	0.021 U	0.11 U	0.011 U	0.0012 U	0.0032 U	0.020 U	0.032 U	0.021 U	**17**	**78**	0.030 U	0.030 U	0.057 U
Comp-27 012213	0.026 U	0.12 U	0.013 U	0.0015 U	0.0039 U	0.024 U	0.039 U	0.026 U	**9.1**	**74**	0.037 U	0.037 U	0.070 U
Comp-28 012313	0.022 U	**0.14 I**	0.011 U	0.0013 U	0.0033 U	0.020 U	0.033 U	0.022 U	**26**	**69**	0.031 U	0.031 U	0.058 U
Comp-29 012413	0.028 U	0.14 U	0.014 U	0.0016 U	0.0042 U	0.026 U	0.042 U	0.028 U	**7.2**	**60**	0.040 U	0.040 U	0.074 U
Comp-3 012313	0.024 U	0.11 U	0.012 U	0.0014 U	0.0037 U	0.022 U	0.037 U	0.024 U	**16**	**82**	0.035 U	0.035 U	0.065 U
Comp-30 012513	0.024 U	0.12 U	0.012 U	0.0014 U	0.0035 U	0.022 U	0.035 U	0.024 U	**21**	**100**	0.033 U	0.033 U	0.063 U
Comp-4 012413	0.024 U	0.12 U	0.012 U	0.0014 U	0.0037 U	0.022 U	0.037 U	0.024 U	**5.6**	**91**	0.035 U	0.035 U	0.065 U
Comp-4 DUP 012413	0.028 U	0.14 U	0.014 U	0.0016 U	0.0042 U	0.026 U	0.042 U	0.028 U	**6.8**	**80**	0.040 U	0.040 U	0.074 U
Comp-5 012513	0.024 U	0.11 U	0.012 U	0.0014 U	0.0035 U	0.022 U	0.035 U	0.024 U	**15**	**53**	0.033 U	0.033 U	0.063 U
Comp-6 012513	0.026 U	0.12 U	0.013 U	0.0015 U	0.0039 U	0.024 U	0.039 U	0.026 U	**18**	**75**	0.037 U	0.037 U	0.070 U
Comp-7 012313	0.021 U	0.10 U	0.011 U	0.0012 U	0.0032 U	0.020 U	0.032 U	0.021 U	**20**	**75**	0.030 U	0.030 U	0.057 U
Comp-7 DUP 012313	0.022 U	0.11 U	0.011 U	0.0013 U	0.0033 U	0.020 U	0.033 U	0.022 U	**19**	**74**	0.031 U	0.031 U	0.058 U
Comp-8 012313	0.023 U	0.12 U	0.012 U	0.0013 U	0.0035 U	0.021 U	0.035 U	0.023 U	**14**	**87**	0.033 U	0.033 U	0.062 U
Comp-9 012213	0.024 U	0.12 U	0.012 U	0.0014 U	0.0035 U	0.022 U	0.035 U	0.024 U	**13**	**67**	0.033 U	0.033 U	**0.200 I**
Comp-9 DUP 012213	0.027 U	0.14 U	0.013 U	0.0015 U	0.0040 U	0.024 U	0.040 U	0.027 U	**17**	**65**	0.038 U	0.038 U	**0.170 I**

Summary of Soil Analytical Results
A-2 Flow Equalization Basin Project
(All Results in milligrams per kilogram [mg/kg])

Sample ID	Date Collected	DB, 2,4-	DDD, 4,4'-	DDE, 4,4'-	DDT, 4,4'-	Demeton-O+S	Diazinon	Dicamba	Dichlorofenthion	Dichlorprop	Dichlorvos	Dicrotophos	Dieldrin	Dimethoate	Dinoseb	Disulfoton	Endosulfan I	Endosulfan II	Endosulfan sulfate	Endrin	Endrin aldehyde	Endrin ketone	EPN	Ethion
SCTL-RDE		***	4.2	2.9	2.9	***	70	2300	***	***	0.3	7.4	0.06	13	65	3.3	***	***	***	25	***	***	0.8	42
SCTL-LGW		***	5.8	18	11	***	0.2	2.6	***	***	0.0006	0.005	0.002	0.006	0.03	0.09	***	***	***	1	***	***	0.02	1.7
SCTL-LSW		***	0.01	0.04	0.06	***	0.00005	2.4	***	***	0.00002	0.1	0.0001	0.0004	0.03	0.1	***	***	***	0.001	***	***	0.003	0.003
SQAG-TEC		***	0.0049	0.0032	0.0042	***	0.00038	***	***	***	***	***	0.0019	***	***	***	***	***	***	0.0022	0.0011	***	***	***
Comp-1 012313	1/23/2013	0.016 U	0.00053 U	0.0024 U	0.0093 U	0.040 U	0.025 U	0.036 U	0.0036 U	0.013 U	0.022 U	0.024 U	0.0017 U	0.016 U	0.0042 U	0.038 U	0.0017 U	0.00024 U	0.00069 U	0.00062 U	0.0033 U	0.0013 U	0.020 U	0.024 U
Comp-10 012313	1/23/2013	0.016 U	0.00052 U	0.0023 U	0.0091 U	0.039 U	0.025 U	0.036 U	0.0036 U	0.013 U	0.021 U	0.023 U	**0.0045 I**	0.016 U	0.0041 U	0.038 U	0.0016 U	0.00023 U	0.00068 U	0.00061 U	0.0032 U	0.0013 U	0.020 U	0.023 U
Comp-11 012413	1/24/2013	0.017 U	0.00057 U	0.0025 U	0.010 U	0.043 U	0.027 U	0.039 U	0.0039 U	0.014 U	0.024 U	0.025 U	0.0018 U	0.018 U	0.0045 U	0.041 U	0.0018 U	0.00025 U	0.00075 U	0.00067 U	0.0035 U	0.0014 U	0.022 U	0.025 U
Comp-12 012513	1/25/2013	0.017 U	0.00057 U	0.0025 U	0.010 U	0.043 U	0.027 U	0.039 U	0.0039 U	0.014 U	0.024 U	0.025 U	0.0018 U	0.018 U	0.0045 U	0.041 U	0.0018 U	0.00025 U	0.00075 U	0.00067 U	0.0035 U	0.0014 U	0.022 U	0.025 U
Comp-13 012213	1/22/2013	0.016 U	0.00054 U	0.0024 U	0.0094 U	0.041 U	0.026 U	0.037 U	0.0037 U	0.013 U	0.022 U	0.024 U	0.0017 U	0.017 U	0.0043 U	0.039 U	0.0017 U	0.00024 U	0.00070 U	0.00063 U	0.0033 U	0.0013 U	0.020 U	0.024 U
Comp-14 012213	1/22/2013	0.017 U	0.00055 U	0.0025 U	0.0096 U	0.042 U	0.026 U	0.038 U	0.0038 U	0.013 U	0.023 U	0.025 U	0.0017 U	0.017 U	0.0043 U	0.040 U	0.0017 U	0.00025 U	0.00072 U	0.00064 U	0.0034 U	0.0014 U	0.021 U	0.025 U
Comp-15 012213	1/22/2013	0.019 U	0.00063 U	0.0028 U	0.011 U	0.048 U	0.030 U	0.043 U	0.0043 U	0.015 U	0.026 U	0.028 U	**0.0049 I**	0.020 U	0.0050 U	0.046 U	0.0020 U	0.00028 U	0.00083 U	0.00074 U	0.0039 U	0.0016 U	0.024 U	0.028 U
Comp-16 012313	1/23/2013	0.014 U	0.00048 U	0.0021 U	0.0084 U	0.036 U	0.023 U	0.033 U	0.0033 U	0.012 U	0.020 U	0.021 U	**0.0051 I**	0.015 U	0.0038 U	0.034 U	0.0015 U	0.00021 U	0.00062 U	0.00056 U	0.0030 U	0.0012 U	0.018 U	0.021 U
Comp-17 012313	1/23/2013	0.017 U	0.00055 U	0.0025 U	0.0096 U	0.042 U	0.026 U	0.038 U	0.0038 U	0.013 U	0.023 U	0.025 U	0.0017 U	0.017 U	0.0043 U	0.040 U	0.0017 U	0.00025 U	0.00072 U	0.00064 U	0.0034 U	0.0014 U	0.021 U	0.025 U
Comp-18 012513	1/25/2013	0.017 U	0.00057 U	0.0025 U	0.010 U	0.043 U	0.027 U	0.039 U	0.0039 U	0.014 U	0.024 U	0.025 U	0.0018 U	0.018 U	0.0045 U	0.041 U	0.0018 U	0.00025 U	0.00075 U	0.00067 U	0.0035 U	0.0014 U	0.022 U	0.025 U
Comp-19 012413	1/24/2013	0.015 U	0.00050 U	0.0022 U	0.0088 U	0.038 U	0.024 U	0.034 U	0.0034 U	0.012 U	0.021 U	0.022 U	0.0016 U	0.016 U	0.0040 U	0.036 U	0.0016 U	0.00022 U	0.00066 U	0.00059 U	0.0031 U	0.0012 U	0.019 U	0.022 U
Comp-2 012513	1/25/2013	0.018 U	0.00059 U	0.0027 U	0.010 U	0.045 U	0.029 U	0.041 U	0.0041 U	0.014 U	0.024 U	0.027 U	0.0019 U	0.018 U	0.0047 U	0.043 U	0.0019 U	0.00027 U	0.00078 U	0.00069 U	0.0037 U	0.0015 U	0.022 U	0.027 U
Comp-20 012413	1/24/2013	0.016 U	0.00052 U	0.0023 U	0.0091 U	0.039 U	0.025 U	0.036 U	0.0036 U	0.013 U	0.021 U	0.023 U	0.0016 U	0.016 U	0.0041 U	0.038 U	0.0016 U	0.00023 U	0.00068 U	0.00061 U	0.0032 U	0.0013 U	0.020 U	0.023 U
Comp-21 012213	1/22/2013	0.014 U	0.00047 U	0.0021 U	0.0082 U	0.035 U	0.023 U	0.032 U	0.0032 U	0.011 U	0.019 U	0.021 U	0.0015 U	0.015 U	0.0037 U	0.034 U	0.0015 U	0.00021 U	0.00061 U	0.00055 U	0.0029 U	0.0012 U	0.018 U	0.021 U
Comp-22 012313	1/23/2013	0.017 U	0.00057 U	0.0025 U	0.010 U	0.043 U	0.027 U	0.039 U	0.0039 U	0.014 U	0.024 U	0.025 U	0.0018 U	0.018 U	0.0045 U	0.041 U	0.0018 U	0.00025 U	0.00075 U	0.00067 U	0.0035 U	0.0014 U	0.022 U	0.025 U
Comp-23 012413	1/24/2013	0.016 U	0.00054 U	0.0024 U	0.00094 U	0.041 U	0.026 U	0.037 U	0.0037 U	0.013 U	0.022 U	0.024 U	**0.0027 I**	0.017 U	0.0043 U	0.039 U	0.0017 U	0.00024 U	0.00070 U	0.00063 U	0.0033 U	0.0013 U	0.020 U	0.024 U
Comp-24 012413	1/24/2013	0.018 U	0.00058 U	0.0026 U	0.0010 U	0.044 U	0.028 U	0.040 U	0.0040 U	0.014 U	0.024 U	0.026 U	0.0018 U	0.018 U	0.0046 U	0.042 U	0.0018 U	0.00026 U	0.00076 U	0.00068 U	0.0036 U	0.0014 U	0.022 U	0.026 U
Comp-25 012513	1/25/2013	0.016 U	0.00053 U	0.0024 U	0.0093 U	0.040 U	0.025 U	0.036 U	0.0036 U	0.013 U	0.022 U	0.024 U	0.0017 U	0.016 U	0.0042 U	0.038 U	0.0017 U	0.00024 U	0.00069 U	0.00062 U	0.0033 U	0.0013 U	0.020 U	0.024 U
Comp-26 012413	1/24/2013	0.016 U	0.00052 U	0.0023 U	0.0091 U	0.039 U	0.025 U	0.036 U	0.0036 U	0.013 U	0.021 U	0.023 U	0.0016 U	0.016 U	0.0041 U	0.038 U	0.0016 U	0.00023 U	0.00068 U	0.00061 U	0.0032 U	0.0013 U	0.020 U	0.023 U
Comp-27 012213	1/22/2013	0.019 U	0.00063 U	0.0028 U	0.011 U	0.048 U	0.030 U	0.043 U	0.0043 U	0.015 U	0.026 U	0.028 U	0.00099 U	0.020 U	0.0050 U	0.046 U	0.0020 U	0.00028 U	0.00083 U	0.00074 U	0.0039 U	0.0016 U	0.024 U	0.028 U
Comp-28 012313	1/23/2013	0.016 U	0.00053 U	0.0024 U	0.0093 U	0.040 U	0.025 U	0.036 U	0.0036 U	0.013 U	0.022 U	0.024 U	0.0017 U	0.016 U	0.0042 U	0.038 U	0.0017 U	0.00024 U	0.00069 U	0.00062 U	0.0033 U	0.0013 U	0.020 U	0.024 U
Comp-29 012413	1/24/2013	0.020 U	0.00067 U	0.0030 U	0.0012 U	0.051 U	0.033 U	0.047 U	0.0047 U	0.017 U	0.028 U	0.030 U	0.0011 U	0.021 U	0.0053 U	0.049 U	0.0021 U	0.00030 U	0.00088 U	0.00079 U	0.0042 U	0.0017 U	0.026 U	0.030 U
Comp-3 012313	1/23/2013	0.018 U	0.00059 U	0.0027 U	0.010 U	0.045 U	0.029 U	0.041 U	0.0041 U	0.014 U	0.024 U	0.027 U	0.0019 U	0.018 U	0.0047 U	0.043 U	0.0019 U	0.00027 U	0.00078 U	0.00069 U	0.0037 U	0.0015 U	0.022 U	0.027 U
Comp-30 012513	1/25/2013	0.017 U	0.00057 U	0.0025 U	0.010 U	0.043 U	0.027 U	0.039 U	0.0039 U	0.014 U	0.024 U	0.025 U	0.0018 U	0.018 U	0.0045 U	0.041 U	0.0018 U	0.00025 U	0.00075 U	0.00067 U	0.0035 U	0.0014 U	0.022 U	0.025 U
Comp-4 012413	1/24/2013	0.018 U	0.00059 U	0.0027 U	0.010 U	0.045 U	0.029 U	0.041 U	0.0041 U	0.014 U	0.024 U	0.027 U	0.0019 U	0.018 U	0.0047 U	0.043 U	0.0019 U	0.00027 U	0.00078 U	0.00069 U	0.0037 U	0.0015 U	0.022 U	0.027 U
Comp-4 DUP 012413	1/24/2013	0.020 U	0.00067 U	0.0030 U	0.012 U	0.051 U	0.033 U	0.047 U	0.0047 U	0.017 U	0.028 U	0.030 U	0.0011 U	0.021 U	0.0053 U	0.049 U	0.0021 U	0.00030 U	0.00088 U	0.00079 U	0.0042 U	0.0017 U	0.026 U	0.030 U
Comp-5 012513	1/25/2013	0.017 U	0.00057 U	0.0025 U	0.010 U	0.043 U	0.027 U	0.039 U	0.0039 U	0.014 U	0.024 U	0.025 U	0.0018 U	0.018 U	0.0045 U	0.041 U	0.0018 U	0.00025 U	0.00075 U	0.00067 U	0.0035 U	0.0014 U	0.022 U	0.025 U
Comp-6 012513	1/25/2013	0.019 U	0.00063 U	0.0028 U	0.011 U	0.048 U	0.030 U	0.043 U	0.0043 U	0.015 U	0.026 U	0.028 U	0.00099 U	0.020 U	0.0050 U	0.046 U	0.0020 U	0.00028 U	0.00083 U	0.00074 U	0.0039 U	0.0016 U	0.024 U	0.028 U
Comp-7 012313	1/23/2013	0.016 U	0.00052 U	0.0023 U	0.0091 U	0.039 U	0.025 U	0.036 U	0.0036 U	0.013 U	0.021 U	0.023 U	0.0016 U	0.016 U	0.0041 U	0.038 U	0.0016 U	0.00023 U	0.00068 U	0.00061 U	0.0032 U	0.0013 U	0.020 U	0.023 U
Comp-7 DUP 012313	1/23/2013	0.016 U	0.00053 U	0.0024 U	0.0093 U	0.040 U	0.025 U	0.036 U	0.0036 U	0.013 U	0.022 U	0.024 U	0.0017 U	0.016 U	0.0042 U	0.038 U	0.0017 U	0.00024 U	0.00069 U	0.00062 U	0.0033 U	0.0013 U	0.020 U	0.024 U
Comp-8 012313	1/23/2013	0.017 U	0.00056 U	0.0025 U	0.0098 U	0.042 U	0.027 U	0.038 U	0.0038 U	0.014 U	0.023 U	0.025 U	0.0018 U	0.017 U	0.0044 U	0.040 U	0.0018 U	0.00025 U	0.00073 U	0.00065 U	0.0035 U	0.0014 U	0.021 U	0.025 U
Comp-9 012213	1/22/2013	0.017 U	0.00057 U	0.0025 U	0.010 U	0.043 U	0.027 U	0.039 U	0.0039 U	0.014 U	0.024 U	0.025 U	0.0018 U	0.018 U	0.0045 U	0.041 U	0.0018 U	0.00025 U	0.00075 U	0.00067 U	0.0035 U	0.0014 U	0.022 U	0.025 U
Comp-9 DUP 012213	1/22/2013	0.020 U	0.00064 U	0.0029 U	0.011 U	0.049 U	0.031 U	0.044 U	0.0044 U	0.016 U	0.027 U	0.029 U	0.0010 U	0.020 U	0.0051 U	0.047 U	0.0020 U	0.00029 U	0.00084 U	0.00076 U	0.0040 U	0.0016 U	0.024 U	0.029 U

Summary of Soil Analytical Results
A-2 Flow Equalization Basin Project
(All Results in milligrams per kilogram [mg/kg])

Sample ID	Date Collected	Ethoprop	Famphur	Fenitrothion	Fensulfothion	Fenthion	Fonophos	Heptachlor	Heptachlor epoxide	Lead	Leptophos	Lindane	Malathion	MCPA	MCPP	Mercury	Merphos	Methoxychlor	Methyl Parathion	Metribuzin	Mevinphos	Mirex	Monocrotophos	Naled
SCTL-RDE		7.4	***	***	19	***	***	0.2	0.1	400	***	0.7	1500	35	64	3	2.5	420	20	54	18	***	***	150
SCTL-LGW		0.005	***	***	0.01	***	***	23	0.6	***	***	0.009	4.2	0.02	0.03	2.1	0.5	160	0.06	2.2	0.01	***	***	0.1
SCTL-LSW		0.002	***	***	0.004	***	***	0.01	0.0001	***	***	0.003	0.003	0.4	***	0.01	***	0.1	0.0003	0.8	0.0003	***	***	0.0002
SQAG-TEC		***	***	***	***	***	***	***	0.0025	36	***	0.0024	***	***	***	0.18	***	***	***	***	***	***	***	***
Comp-1 012313	1/23/2013	0.018 U	0.033 U	0.170 U	0.022 U	0.018 U	0.018 U	0.00078 U	0.0010 U	**7.8**	0.022 U	0.00064 U	0.020 U	0.0053 U	0.016 U	**0.1**	0.029 U	0.017 U	0.013 U	**0.041 I**	0.018 U	0.0013 U	0.020 U	0.022 U
Comp-10 012313	1/23/2013	0.018 U	0.032 U	0.170 U	0.021 U	0.018 U	0.018 U	0.00077 U	0.0010 U	**5.9**	0.021 U	0.00062 U	0.020 U	0.0052 U	0.016 U	**0.13**	0.029 U	0.017 U	0.012 U	0.018 U	0.018 U	0.0012 U	0.020 U	0.021 U
Comp-11 012413	1/24/2013	0.020 U	0.035 U	0.190 U	0.024 U	0.020 U	0.020 U	0.00084 U	0.0011 U	**5.6**	0.024 U	0.00069 U	0.022 U	0.0057 U	0.017 U	**0.14**	0.031 U	0.019 U	0.014 U	0.020 U	0.020 U	0.0014 U	0.022 U	0.024 U
Comp-12 012513	1/25/2013	0.020 U	0.035 U	0.190 U	0.024 U	0.020 U	0.020 U	0.00084 U	0.0011 U	**6.8**	0.024 U	0.00069 U	0.022 U	0.0057 U	0.017 U	**0.14**	0.031 U	0.019 U	0.014 U	0.020 U	0.020 U	0.0014 U	0.022 U	0.024 U
Comp-13 012213	1/22/2013	0.019 U	0.033 U	0.180 U	0.022 U	0.019 U	0.019 U	0.00080 U	0.0010 U	**6.7**	0.022 U	0.00065 U	0.020 U	0.0054 U	0.016 U	**0.13**	0.030 U	0.018 U	0.013 U	0.019 U	0.019 U	0.0013 U	0.020 U	0.022 U
Comp-14 012213	1/22/2013	0.019 U	0.034 U	0.180 U	0.023 U	0.019 U	0.019 U	0.00081 U	0.0011 U	**6.6**	0.023 U	0.00066 U	0.021 U	0.0055 U	0.017 U	**0.11**	0.030 U	0.018 U	0.013 U	0.019 U	0.019 U	0.0013 U	0.021 U	0.023 U
Comp-15 012213	1/22/2013	0.022 U	0.039 U	0.210 U	0.026 U	0.022 U	0.022 U	0.00093 U	0.0012 U	**7**	0.026 U	0.00076 U	0.024 U	0.0063 U	0.019 U	**0.11**	0.035 U	0.021 U	0.015 U	**0.73**	0.022 U	0.0015 U	0.024 U	0.026 U
Comp-16 012313	1/23/2013	0.016 U	0.030 U	0.160 U	0.020 U	0.016 U	0.016 U	0.00070 U	0.00092 U	**6.1**	0.020 U	0.00057 U	0.018 U	0.0048 U	0.015 U	**0.13**	0.026 U	0.016 U	0.011 U	**0.058 I**	0.016 U	0.0011 U	0.018 U	0.020 U
Comp-17 012313	1/23/2013	0.019 U	0.034 U	0.180 U	0.023 U	0.019 U	0.019 U	0.00081 U	0.0011 U	**6.4**	0.023 U	0.00066 U	0.021 U	0.0055 U	0.017 U	**0.13**	0.030 U	0.018 U	0.013 U	**0.6**	0.019 U	0.0013 U	0.021 U	0.023 U
Comp-18 012513	1/25/2013	0.020 U	0.035 U	0.190 U	0.024 U	0.020 U	0.020 U	0.00084 U	0.0011 U	**4.7**	0.024 U	0.00069 U	0.022 U	0.0057 U	0.017 U	**0.15**	0.031 U	0.019 U	0.014 U	**1.1**	0.020 U	0.0014 U	0.022 U	0.024 U
Comp-19 012413	1/24/2013	0.017 U	0.031 U	0.160 U	0.021 U	0.017 U	0.017 U	0.00074 U	0.00097 U	**6.5**	0.021 U	0.00060 U	0.019 U	0.0050 U	0.015 U	**0.12**	0.028 U	0.016 U	0.012 U	0.017 U	0.017 U	0.0012 U	0.019 U	0.021 U
Comp-2 012513	1/25/2013	0.020 U	0.037 U	0.190 U	0.024 U	0.020 U	0.020 U	0.00088 U	0.0011 U	**6.7**	0.024 U	0.00071 U	0.022 U	0.0059 U	0.018 U	**0.098**	0.033 U	0.019 U	0.014 U	0.020 U	0.020 U	0.0014 U	0.022 U	0.024 U
Comp-20 012413	1/24/2013	0.018 U	0.032 U	0.170 U	0.021 U	0.018 U	0.018 U	0.00077 U	0.0010 U	**6.3**	0.021 U	0.00062 U	0.020 U	0.0052 U	0.016 U	**0.11**	0.029 U	0.017 U	0.012 U	**0.14**	0.018 U	0.0012 U	0.020 U	0.021 U
Comp-21 012213	1/22/2013	0.016 U	0.029 U	0.150 U	0.019 U	0.016 U	0.016 U	0.00069 U	0.00090 U	**8.4**	0.019 U	0.00056 U	0.018 U	0.0047 U	0.014 U	**0.099**	0.026 U	0.015 U	0.011 U	**0.2**	0.016 U	0.0011 U	0.018 U	0.019 U
Comp-22 012313	1/23/2013	0.020 U	0.035 U	0.190 U	0.024 U	0.020 U	0.020 U	0.00084 U	0.0011 U	**6.2**	0.024 U	0.00069 U	0.022 U	0.0057 U	0.017 U	**0.14**	0.031 U	0.019 U	0.014 U	0.020 U	0.020 U	0.0014 U	0.022 U	0.024 U
Comp-23 012413	1/24/2013	0.019 U	0.033 U	0.180 U	0.022 U	0.019 U	0.019 U	0.00080 U	0.0010 U	**5.4**	0.022 U	0.00065 U	0.020 U	0.0054 U	0.016 U	**0.12**	0.030 U	0.0018 U	0.013 U	0.019 U	0.019 U	0.0013 U	0.020 U	0.022 U
Comp-24 012413	1/24/2013	0.020 U	0.036 U	0.190 U	0.024 U	0.020 U	0.020 U	0.00086 U	0.0011 U	**6.6**	0.024 U	0.00070 U	0.022 U	0.0058 U	0.018 U	**0.14**	0.032 U	0.0019 U	0.014 U	0.020 U	0.020 U	0.0014 U	0.022 U	0.024 U
Comp-25 012513	1/25/2013	0.018 U	0.033 U	0.170 U	0.022 U	0.018 U	0.018 U	0.00078 U	0.0010 U	**5.6**	0.022 U	0.00064 U	0.020 U	0.0053 U	0.016 U	**0.11**	0.029 U	0.017 U	0.013 U	**0.12**	0.018 U	0.0013 U	0.020 U	0.022 U
Comp-26 012413	1/24/2013	0.018 U	0.032 U	0.170 U	0.021 U	0.018 U	0.018 U	0.00077 U	0.0010 U	**6.4**	0.021 U	0.00062 U	0.020 U	0.0052 U	0.016 U	**0.13**	0.029 U	0.017 U	0.012 U	0.018 U	0.018 U	0.0012 U	0.020 U	0.021 U
Comp-27 012213	1/22/2013	0.022 U	0.039 U	0.210 U	0.026 U	0.022 U	0.022 U	0.00093 U	0.0012 U	**5.9**	0.026 U	0.00076 U	0.024 U	0.0063 U	0.019 U	**0.14**	0.035 U	0.021 U	0.015 U	0.022 U	0.022 U	0.0015 U	0.024 U	0.026 U
Comp-28 012313	1/23/2013	0.018 U	0.033 U	0.170 U	0.022 U	0.018 U	0.018 U	0.00078 U	0.0010 U	**5.8**	0.022 U	0.00064 U	0.020 U	0.0053 U	0.016 U	**0.13**	0.029 U	0.017 U	0.013 U	**1.7**	0.018 U	0.0013 U	0.020 U	0.022 U
Comp-29 012413	1/24/2013	0.023 U	0.042 U	0.220 U	0.028 U	0.023 U	0.023 U	0.0010 U	0.0013 U	**5.2**	0.028 U	0.00081 U	0.026 U	0.0067 U	0.021 U	**0.13**	0.037 U	0.0022 U	0.016 U	0.023 U	0.023 U	0.0016 U	0.026 U	0.028 U
Comp-3 012313	1/23/2013	0.020 U	0.037 U	0.190 U	0.024 U	0.020 U	0.020 U	0.00088 U	0.0011 U	**5.4**	0.024 U	0.00071 U	0.022 U	0.0059 U	0.018 U	**0.11**	0.033 U	0.019 U	0.014 U	0.020 U	0.020 U	0.0014 U	0.022 U	0.024 U
Comp-30 012513	1/25/2013	0.020 U	0.035 U	0.190 U	0.024 U	0.020 U	0.020 U	0.00084 U	0.0011 U	**6.9**	0.024 U	0.00069 U	0.022 U	0.0057 U	0.017 U	**0.15**	0.031 U	0.019 U	0.014 U	0.020 U	0.020 U	0.0014 U	0.022 U	0.024 U
Comp-4 012413	1/24/2013	0.020 U	0.037 U	0.190 U	0.024 U	0.020 U	0.020 U	0.00088 U	0.0011 U	**5.9**	0.024 U	0.00071 U	0.022 U	0.0059 U	0.018 U	**0.14**	0.033 U	0.019 U	0.014 U	0.020 U	0.020 U	0.0014 U	0.022 U	0.024 U
Comp-4 DUP 012413	1/24/2013	0.023 U	0.042 U	0.220 U	0.028 U	0.023 U	0.023 U	0.0010 U	0.0013 U	**5.7**	0.028 U	0.00081 U	0.026 U	0.0067 U	0.021 U	**0.13**	0.037 U	0.022 U	0.016 U	0.023 U	0.023 U	0.0016 U	0.026 U	0.028 U
Comp-5 012513	1/25/2013	0.020 U	0.035 U	0.190 U	0.024 U	0.020 U	0.020 U	0.00084 U	0.0011 U	**5.5**	0.024 U	0.00069 U	0.022 U	0.0057 U	0.017 U	**0.12**	0.031 U	0.019 U	0.014 U	0.020 U	0.020 U	0.0014 U	0.022 U	0.024 U
Comp-6 012513	1/25/2013	0.022 U	0.039 U	0.210 U	0.026 U	0.022 U	0.022 U	0.00093 U	0.0012 U	**6.1**	0.026 U	0.00076 U	0.024 U	0.0063 U	0.019 U	**0.12**	0.035 U	0.021 U	0.015 U	0.022 U	0.022 U	0.0015 U	0.024 U	0.026 U
Comp-7 012313	1/23/2013	0.018 U	0.032 U	0.170 U	0.021 U	0.018 U	0.018 U	0.00077 U	0.0010 U	**6.3**	0.021 U	0.00062 U	0.020 U	0.0052 U	0.016 U	**0.11**	0.029 U	0.017 U	0.012 U	0.018 U	0.018 U	0.0012 U	0.020 U	0.021 U
Comp-7 DUP 012313	1/23/2013	0.018 U	0.033 U	0.170 U	0.022 U	0.018 U	0.018 U	0.00078 U	0.0010 U	**7.1**	0.022 U	0.00064 U	0.020 U	0.0053 U	0.016 U	**0.11**	0.029 U	0.017 U	0.013 U	0.018 U	0.018 U	0.0013 U	0.020 U	0.022 U
Comp-8 012313	1/23/2013	0.019 U	0.035 U	0.180 U	0.023 U	0.019 U	0.019 U	0.00083 U	0.0011 U	**6.3**	0.023 U	0.00067 U	0.021 U	0.0056 U	0.017 U	**0.13**	0.031 U	0.018 U	0.013 U	**0.24**	0.019 U	0.0013 U	0.021 U	0.023 U
Comp-9 012213	1/22/2013	0.020 U	0.035 U	0.190 U	0.024 U	0.020 U	0.020 U	0.00084 U	0.0011 U	**5.3**	0.024 U	0.00069 U	0.022 U	0.0057 U	0.017 U	**0.12**	0.031 U	0.019 U	0.014 U	**0.28**	0.020 U	0.0014 U	0.022 U	0.024 U
Comp-9 DUP 012213	1/22/2013	0.022 U	0.040 U	0.210 U	0.027 U	0.022 U	0.022 U	0.00096 U	0.0012 U	**5.8**	0.027 U	0.00078 U	0.024 U	0.0064 U	0.020 U	**0.12**	0.036 U	0.021 U	0.016 U	**0.28**	0.022 U	0.0016 U	0.024 U	0.027 U

Summary of Soil Analytical Results
A-2 Flow Equalization Basin Project
(All Results in milligrams per kilogram [mg/kg])

Sample ID	Date Collected	Parathion	Phorate	Phosmet	Phosphamidon	Ronnel	Selenium	Silver	Silvex	Simazine	Stirofos	Sulfotepp	T, 2,4,5-	TEPP	Terbufos	Thionazin	Tokuthion	Total Organic Carbon	Toxaphene	Trichloronate
SCTL-RDE		500	16	1600	***	4200	440	410	660	7.8	***	35	690	***	1.9	***	***	***	0.9	***
SCTL-LGW		1	0.3	5	***	1300	5.2	17	5.4	0.08	***	0.1	0.4	***	0.02	***	***	***	31	***
SCTL-LSW		0.01	0.001	0.004	***	0.2	0.5	0.01	***	0.1	***	***	0.8	***	0.001	***	***	***	0.002	***
SQAG-TEC		***	***	***	***	***	***	1	***	0.00034	***	***	***	***	***	***	***	***	***	***
Comp-1 012313	1/23/2013	0.015 U	0.0036 U	0.013 U	0.031 U	0.022 U	1.7 I	0.33 U	0.013 U	0.024 U	0.022 U	0.022 U	0.013 U	0.022 U	0.0036 U	0.022 U	0.024 U	**320000**	0.053 U	0.022 U
Comp-10 012313	1/23/2013	0.014 U	0.0036 U	0.012 U	0.030 U	0.021 U	1.6 I	0.31 U	0.013 U	0.023 U	0.021 U	0.021 U	0.013 U	0.021 U	0.0036 U	0.021 U	0.023 U	**384000**	0.052 U	0.021 U
Comp-11 012413	1/24/2013	0.016 U	0.0039 U	0.014 U	0.033 U	0.024 U	0.58 U	0.31 U	0.014 U	0.025 U	0.024 U	0.024 U	0.014 U	0.024 U	0.0039 U	0.024 U	0.025 U	**450000**	0.057 U	0.024 U
Comp-12 012513	1/25/2013	0.016 U	0.0039 U	0.014 U	0.033 U	0.024 U	**3.7**	0.32 U	0.014 U	0.025 U	0.024 U	0.024 U	0.014 U	0.024 U	0.0039 U	0.024 U	0.025 U	**470000**	0.057 U	0.024 U
Comp-13 012213	1/22/2013	0.015 U	0.0037 U	0.013 U	0.031 U	0.022 U	**2.3**	0.32 U	0.013 U	0.024 U	0.022 U	0.022 U	0.013 U	0.022 U	0.0037 U	0.022 U	0.024 U	**400000**	0.054 U	0.022 U
Comp-14 012213	1/22/2013	0.015 U	0.0038 U	0.013 U	0.032 U	0.023 U	**2.2 I**	0.34 U	0.014 U	0.025 U	0.023 U	0.023 U	0.013 U	0.023 U	0.0038 U	0.023 U	0.025 U	**374000**	0.055 U	0.023 U
Comp-15 012213	1/22/2013	0.017 U	0.0043 U	0.015 U	0.037 U	0.026 U	**2.6**	0.35 U	0.016 U	0.028 U	0.026 U	0.026 U	0.015 U	0.026 U	0.0043 U	0.026 U	0.028 U	**477000**	0.063 U	0.026 U
Comp-16 012313	1/23/2013	0.013 U	**0.120 I**	0.011 U	0.028 U	0.020 U	**2.3**	0.29 U	0.012 U	0.021 U	0.020 U	0.020 U	0.012 U	0.020 U	0.0033 U	0.020 U	0.021 U	**388000**	0.048 U	0.020 U
Comp-17 012313	1/23/2013	0.015 U	0.0038 U	0.013 U	0.032 U	0.023 U	**2.6**	0.33 U	0.014 U	0.025 U	0.023 U	0.023 U	0.013 U	0.023 U	0.0038 U	0.023 U	0.025 U	**409000**	0.055 U	0.023 U
Comp-18 012513	1/25/2013	0.016 U	0.0039 U	0.014 U	0.033 U	0.024 U	1.5 I	0.32 U	0.014 U	0.025 U	0.024 U	0.024 U	0.014 U	0.024 U	0.0039 U	0.024 U	0.025 U	**450000**	0.057 U	0.024 U
Comp-19 012413	1/24/2013	0.014 U	0.0034 U	0.012 U	0.029 U	0.021 U	0.57 U	0.31 U	0.012 U	0.022 U	0.021 U	0.021 U	0.012 U	0.021 U	0.0034 U	0.021 U	0.022 U	**198000**	0.050 U	0.021 U
Comp-2 012513	1/25/2013	0.016 U	0.0041 U	0.014 U	0.035 U	0.024 U	**2.0 I**	0.33 U	0.015 U	0.027 U	0.024 U	0.024 U	0.014 U	0.024 U	0.0041 U	0.024 U	0.027 U	**383000**	0.059 U	0.024 U
Comp-20 012413	1/24/2013	0.014 U	0.0036 U	0.012 U	0.030 U	0.021 U	0.55 U	0.30 U	0.013 U	0.023 U	0.021 U	0.021 U	0.013 U	0.021 U	0.0036 U	0.021 U	0.023 U	**361000**	0.052 U	0.021 U
Comp-21 012213	1/22/2013	0.013 U	**0.093 I**	0.011 U	0.027 U	0.019 U	0.47 U	0.26 U	0.012 U	0.021 U	0.019 U	0.019 U	0.011 U	0.019 U	0.0032 U	0.019 U	0.021 U	**308000**	0.047 U	0.019 U
Comp-22 012313	1/23/2013	0.016 U	0.0039 U	0.014 U	0.033 U	0.024 U	**2.5**	0.35 U	0.014 U	0.025 U	0.024 U	0.024 U	0.014 U	0.024 U	0.0039 U	0.024 U	0.025 U	**448000**	0.057 U	0.024 U
Comp-23 012413	1/24/2013	0.015 U	0.0037 U	0.013 U	0.031 U	0.022 U	**2.6**	0.32 U	0.013 U	0.024 U	0.022 U	0.022 U	0.013 U	0.022 U	0.0037 U	0.022 U	0.024 U	**384000**	0.054 U	0.022 U
Comp-24 012413	1/24/2013	0.016 U	0.0040 U	0.014 U	0.034 U	0.024 U	**2.5**	0.35 U	0.014 U	0.026 U	0.024 U	0.024 U	0.014 U	0.024 U	0.0040 U	0.024 U	0.026 U	**464000**	0.058 U	0.024 U
Comp-25 012513	1/25/2013	0.015 U	0.0036 U	0.013 U	0.031 U	0.022 U	**2.5**	0.32 U	0.013 U	0.024 U	0.022 U	0.022 U	0.013 U	0.022 U	0.0036 U	0.022 U	0.024 U	**392000**	0.053 U	0.022 U
Comp-26 012413	1/24/2013	0.014 U	0.0036 U	0.012 U	0.030 U	0.021 U	0.58 U	0.32 U	0.013 U	0.023 U	0.021 U	0.021 U	0.013 U	0.021 U	0.0036 U	0.021 U	0.023 U	**355000**	0.052 U	0.021 U
Comp-27 012213	1/22/2013	0.017 U	0.0043 U	0.015 U	0.037 U	0.026 U	**2.9**	0.36 U	0.016 U	0.028 U	0.026 U	0.026 U	0.015 U	0.026 U	0.0043 U	0.026 U	0.028 U	**503000**	0.063 U	0.026 U
Comp-28 012313	1/23/2013	0.015 U	0.0036 U	0.013 U	0.031 U	0.022 U	1.8 I	0.30 U	0.013 U	0.024 U	0.022 U	0.022 U	0.013 U	0.022 U	0.0036 U	0.022 U	0.024 U	**415000**	0.053 U	0.022 U
Comp-29 012413	1/24/2013	0.019 U	0.0047 U	0.016 U	0.040 U	0.028 U	**2.3 I**	0.42 U	0.017 U	0.030 U	0.028 U	0.028 U	0.017 U	0.028 U	0.0047 U	0.028 U	0.030 U	**485000**	0.067 U	0.028 U
Comp-3 012313	1/23/2013	0.016 U	0.0041 U	0.014 U	0.035 U	0.024 U	**2.5**	0.33 U	0.015 U	0.027 U	0.024 U	0.024 U	0.014 U	0.024 U	0.0041 U	0.024 U	0.027 U	**440000**	0.059 U	0.024 U
Comp-30 012513	1/25/2013	0.016 U	0.0039 U	0.014 U	0.033 U	0.024 U	0.65 U	0.35 U	0.014 U	0.025 U	0.024 U	0.024 U	0.014 U	0.024 U	0.0039 U	0.024 U	0.025 U	**424000**	0.057 U	0.024 U
Comp-4 012413	1/24/2013	0.016 U	**0.0096 I**	0.014 U	0.035 U	0.024 U	**2.3 I**	0.36 U	0.015 U	0.027 U	0.024 U	0.024 U	0.014 U	0.024 U	0.0041 U	0.024 U	0.027 U	**354000**	0.059 U	0.024 U
Comp-4 DUP 012413	1/24/2013	0.019 U	0.0047 U	0.016 U	0.040 U	0.028 U	1.8 I	0.42 U	0.017 U	0.030 U	0.028 U	0.028 U	0.017 U	0.028 U	0.0047 U	0.028 U	0.030 U	**259000**	0.067 U	0.028 U
Comp-5 012513	1/25/2013	0.016 U	0.0039 U	0.014 U	0.033 U	0.024 U	**2.1 I**	0.33 U	0.014 U	0.025 U	0.024 U	0.024 U	0.014 U	0.024 U	0.0039 U	0.024 U	0.025 U	**423000**	0.057 U	0.024 U
Comp-6 012513	1/25/2013	0.017 U	0.0043 U	0.015 U	0.037 U	0.026 U	0.66 U	0.36 U	0.016 U	0.028 U	0.026 U	0.026 U	0.015 U	0.026 U	0.0043 U	0.026 U	0.028 U	**440000**	0.063 U	0.026 U
Comp-7 012313	1/23/2013	0.014 U	0.0036 U	0.012 U	0.030 U	0.021 U	0.55 U	0.30 U	0.013 U	0.023 U	0.021 U	0.021 U	0.013 U	0.021 U	0.0036 U	0.021 U	0.023 U	**389000**	0.052 U	0.021 U
Comp-7 DUP 012313	1/23/2013	0.015 U	0.0036 U	0.013 U	0.031 U	0.022 U	**2.8**	0.33 U	0.013 U	0.024 U	0.022 U	0.022 U	0.013 U	0.022 U	0.0036 U	0.022 U	0.024 U	**329000**	0.053 U	0.022 U
Comp-8 012313	1/23/2013	0.015 U	0.0038 U	0.013 U	0.033 U	0.023 U	0.62 U	0.34 U	0.014 U	0.025 U	0.023 U	0.023 U	0.014 U	0.023 U	0.0038 U	0.023 U	0.025 U	**358000**	0.056 U	0.023 U
Comp-9 012213	1/22/2013	0.016 U	0.0039 U	0.014 U	0.033 U	0.024 U	**2.4 I**	0.35 U	0.014 U	0.025 U	0.024 U	0.024 U	0.014 U	0.024 U	0.0039 U	0.024 U	0.025 U	**430000**	0.057 U	0.024 U
Comp-9 DUP 012213	1/22/2013	0.018 U	0.0044 U	0.016 U	0.038 U	0.027 U	**3**	0.40 U	0.016 U	0.029 U	0.027 U	0.027 U	0.016 U	0.027 U	0.0044 U	0.027 U	0.029 U	**419000**	0.064 U	0.027 U

ATTACHMENT H

Field Duplicate Outlier Report* (non-qualifying outliers)

Lab Report Batch: 130128.06 **Lab ID:** E84809

Field Sample: Comp-4 012413
Field Sample Duplicate: Comp-4 DUP 012413
Matrix ID: SOILS

Analysis Method EPA 8270		Total Or Dissolved	Result	Reporting Limit	MDL	Units	Lab Qualifier	RPD	RPD Criteria
Phorate	Sample result:	N/A	9.6	200	4.1		I		
	Duplicate result:	N/A	4.7	230	4.7	ug/kg	U	**200**	50
Phorate	Sample result:	N/A	9.6	200	4.1		I		
	Duplicate result:	N/A	4.7	230	4.7	ug/kg	U	**200**	50

*Outlier report also includes analytes detected in the parent sample but not in the duplicate sample or vice versa. In this case, RPD value for the field duplicate defaults to 200. RPD values that exceed project requirements do not qualify samples.

Project Number and Name: **A-2 FEB _ A-2 FEB**

Surrogate Recovery Outlier Report

Lab Report Batch: 130128.06 **Lab ID:** E84809

Client Sample ID	Lab Sample ID	Analysis Method	Dilution	Matrix	Surrogate	Percent Recovery	Criteria (percent) Lower Limit	Upper Limit	Reject Point	Associated Target Analytes
Comp-12 012513	159698	EPA 8081	1.00	SO	Tetrachloro-m-xylene	43	50.0	130.0	10.0	All Target
		EPA 8270			p-terphenyl-d14	36	40.0	140.0	10.0	Base/Neutral
Comp-15 012213	159670	EPA 8321			2,4-Dichlorophenylacetic acid	40	50.0	150.0	10.0	Base/Neutral
Comp-16 012313	159679	EPA 8081			Tetrachloro-m-xylene	46	50.0	130.0	10.0	All Target
		EPA 8321			2,4-Dichlorophenylacetic acid	48	50.0	150.0	10.0	Base/Neutral
Comp-18 012513	159697	EPA 8081			Tetrachloro-m-xylene	42	50.0	130.0	10.0	All Target
		EPA 8270			p-terphenyl-d14	36	40.0	140.0	10.0	Base/Neutral
Comp-19 012413	159695	EPA 8081			Tetrachloro-m-xylene	46	50.0	130.0	10.0	All Target
		EPA 8270			p-terphenyl-d14	37	40.0	140.0	10.0	Base/Neutral
		EPA 8321			2,4-Dichlorophenylacetic acid	42	50.0	150.0	10.0	Base/Neutral
Comp-2 012513	159701	EPA 8081			Tetrachloro-m-xylene	48	50.0	130.0	10.0	All Target
Comp-20 012413	159693				Tetrachloro-m-xylene	43	50.0	130.0	10.0	All Target
Comp-22 012313	159677	EPA 8321			2,4-Dichlorophenylacetic acid	38	50.0	150.0	10.0	Base/Neutral
Comp-23 012413	159688				2,4-Dichlorophenylacetic acid	43	50.0	150.0	10.0	Base/Neutral
Comp-24 012413	159690	EPA 8270			p-terphenyl-d14	39	40.0	140.0	10.0	Base/Neutral
Comp-25 012513	159700				p-terphenyl-d14	38	40.0	140.0	10.0	Base/Neutral
Comp-26 012413	159694	EPA 8081			Tetrachloro-m-xylene	46	50.0	130.0	10.0	All Target
Comp-27 012213	159672	EPA 8321			2,4-Dichlorophenylacetic acid	47	50.0	150.0	10.0	Base/Neutral
Comp-28 012313	159678	EPA 8081			Tetrachloro-m-xylene	49	50.0	130.0	10.0	All Target
Comp-30 012513	159696	EPA 8270			p-terphenyl-d14	35	40.0	140.0	10.0	Base/Neutral
Comp-4 012413	159691	EPA 8081			Tetrachloro-m-xylene	43	50.0	130.0	10.0	All Target
		EPA 8321			2,4-Dichlorophenylacetic acid	48	50.0	150.0	10.0	Base/Neutral
Comp-4 DUP 012413	159692	EPA 8081			Tetrachloro-m-xylene	44	50.0	130.0	10.0	All Target
		EPA 8270			p-terphenyl-d14	38	40.0	140.0	10.0	Base/Neutral
Comp-5 012513	159702				p-terphenyl-d14	35	40.0	140.0	10.0	Base/Neutral
Comp-6 012513	159699				2-Fluorobiphenyl	39	40.0	140.0	10.0	Base/Neutral
					p-terphenyl-d14	31	40.0	140.0	10.0	Base/Neutral
Comp-7 DUP 012313	159685	EPA 8321			2,4-Dichlorophenylacetic acid	49	50.0	150.0	10.0	Base/Neutral

Project Number and Name: A-2 FEB _ A-2 FEB

Matrix Spike / Matrix Spike Duplicate Outlier Report

Method Batch : E9377
Analysis Method : EPA 8321
Analysis Date : 01/31/2013
Matrix ID : Soils
Preparation Type : 3545
Preparation Date : 01/29/2013
Lab Reporting Batch : 130128.06
Lab ID: E84809

MS and/or MSD Analyte Recovery/RPD Outside Project Limits

				Reported *		Project Limits (Percent)			
Client Sample ID	**Lab Sample ID**	**Analyte Name**	**Total or Dissolved**	**Percent Recovery**	**RPD**	**Rejection Point**	**Lower Limit**	**Upper Limit**	**RPD**
Comp-21 012213MS	E9377.04	2,4,5-T	N/A	20		10.00	30.00	170.00	35.00
		Dichlorprop	N/A	30		10.00	45.00	96.00	35.00
		MCPA	N/A	25		10.00	31.00	96.00	35.00
Comp-21 012213MSD	E9377.05	2,4,5-T	N/A	25		10.00	30.00	170.00	35.00
		Dichlorprop	N/A	29		10.00	45.00	96.00	35.00
		MCPA	N/A	25		10.00	31.00	96.00	35.00

Associated Samples

All samples in Method Batch

Client Sample ID	Lab Sample ID
Comp-1 012313	159683
Comp-10 012313	159681
Comp-13 012213	159674
Comp-14 012213	159673
Comp-15 012213	159670
Comp-16 012313	159679
Comp-17 012313	159680
Comp-21 012213	159671
Comp-22 012313	159677
Comp-27 012213	159672
Comp-28 012313	159678
Comp-3 012313	159682
Comp-7 012313	159684
Comp-7 DUP 012313	159685
Comp-9 012213	159675
Comp-9 DUP 012213	159676

* Only those Percent Recovery and/or RPD values outside project limits are listed in this report.

If the multiplier rule was selected for MS/MSD data review then spike recovery or RPD outliers will not show up on this report if that analyte did not get qualified in any associated samples during automated data review.

Project Number and Name: **A-2 FEB - A-2 FEB**

Matrix Spike / Matrix Spike Duplicate Outlier Report

Method Batch : E9383 **Analysis Method :** EPA 8321 **Analysis Date :** 02/04/2013
Matrix ID : Soils **Preparation Type :** 3545 **Preparation Date :** 01/30/2013
Lab Reporting Batch : 130128.06 **Lab ID:** E84809

MS and/or MSD Analyte Recovery/RPD Outside Project Limits

				Reported *		Project Limits (Percent)			
Client Sample ID	Lab Sample ID	Analyte Name	Total or Dissolved	Percent Recovery	RPD	Rejection Point	Lower Limit	Upper Limit	RPD
Comp-11 012413MSD	E9383.05	2,4,5-T	N/A	27		10.00	30.00	170.00	35.00
		Dichlorprop	N/A	44		10.00	45.00	96.00	35.00

Associated Samples

All samples in Method Batch	
Client Sample ID	**Lab Sample ID**
Comp-11 012413	159687
Comp-12 012513	159698
Comp-18 012513	159697
Comp-19 012413	159695
Comp-2 012513	159701
Comp-20 012413	159693
Comp-23 012413	159688
Comp-24 012413	159690
Comp-25 012513	159700
Comp-26 012413	159694
Comp-29 012413	159689
Comp-30 012513	159696
Comp-4 012413	159691
Comp-4 DUP 012413	159692
Comp-5 012513	159702
Comp-6 012513	159699
Comp-8 012313	159686

* Only those Percent Recovery and/or RPD values outside project limits are listed in this report.

If the multiplier rule was selected for MS/MSD data review then spike recovery or RPD outliers will not show up on this report if that analyte did not get qualified in any associated samples during automated data review.

Project Number and Name: **A-2 FEB - A-2 FEB**

Matrix Spike / Matrix Spike Duplicate Outlier Report

Method Batch : E9388 **Analysis Method :** EPA 6010 **Analysis Date :** 02/04/2013
Matrix ID : Soils **Preparation Type :** 3050B **Preparation Date :** 01/31/2013
Lab Reporting Batch : 130128.06 **Lab ID:** E84809

MS and/or MSD Analyte Recovery/RPD Outside Project Limits

				Reported *		Project Limits (Percent)			
Client Sample ID	**Lab Sample ID**	**Analyte Name**	**Total or Dissolved**	**Percent Recovery**	**RPD**	**Rejection Point**	**Lower Limit**	**Upper Limit**	**RPD**
Comp-21 012213MS	E9388.04	Barium	N/A	64		10.00	75.00	125.00	25.00
		Copper	N/A	58		10.00	75.00	125.00	25.00
		Lead	N/A	74		10.00	75.00	125.00	25.00
Comp-21 012213MSD	E9388.05	Barium	N/A	72		10.00	75.00	125.00	25.00
		Copper	N/A	71		10.00	75.00	125.00	25.00

Associated Samples

All samples in Method Batch	
Client Sample ID	**Lab Sample ID**
Comp-21 012213	159671

* Only those Percent Recovery and/or RPD values outside project limits are listed in this report.

If the multiplier rule was selected for MS/MSD data review then spike recovery or RPD outliers will not show up on this report if that analyte did not get qualified in any associated samples during automated data review.

Project Number and Name: **A-2 FEB - A-2 FEB** 4/23/

Matrix Spike / Matrix Spike Duplicate Outlier Report

Method Batch : E9408 **Analysis Method :** EPA 8270 **Analysis Date :** 02/01/2013

Matrix ID : Soils **Preparation Type :** 3545 **Preparation Date :** 01/31/2013

Lab Reporting Batch : 130128.06 **Lab ID:** E84809

MS and/or MSD Analyte Recovery/RPD Outside Project Limits

				Reported *		Project Limits (Percent)			
Client Sample ID	Lab Sample ID	Analyte Name	Total or Dissolved	Percent Recovery	RPD	Rejection Point	Lower Limit	Upper Limit	RPD
Comp-23 012413MSD	E9408.05	Bolstar	N/A	31		10.00	35.00	115.00	64.00
		Demeton-O+S	N/A		52	10.00	0.00	134.00	40.00
		Disulfoton	N/A		49	10.00	8.00	102.00	26.00
		Fenthion	N/A		47	10.00	40.00	126.00	24.00
		Phorate	N/A		50	10.00	6.00	141.00	20.00

Associated Samples

All samples in Method Batch

Client Sample ID	Lab Sample ID
Comp-12 012513	159698
Comp-18 012513	159697
Comp-19 012413	159695
Comp-2 012513	159701
Comp-20 012413	159693
Comp-23 012413	159688
Comp-24 012413	159690
Comp-25 012513	159700
Comp-26 012413	159694
Comp-29 012413	159689
Comp-30 012513	159696
Comp-4 012413	159691
Comp-4 DUP 012413	159692
Comp-5 012513	159702
Comp-6 012513	159699

* Only those Percent Recovery and/or RPD values outside project limits are listed in this report.

If the multiplier rule was selected for MS/MSD data review then spike recovery or RPD outliers will not show up on this report if that analyte did not get qualified in any associated samples during automated data review.

Project Number and Name: **A-2 FEB - A-2 FEB**

Laboratory Control Sample / Laboratory Control Sample Duplicate Outlier Report

Preparation Batch : E9374 **Analysis Method :** EPA 8270 **Analysis Date :** 01/31/2013
MatrixID: Soils **Preparation Type :** 3545 **Preparation Date :** 01/29/2013
Lab Reporting Batch : 130128.06 **Lab ID:** E84809

LCS and/or LCSD Spike Recovery/RPD Outside Project Limits			Reported *		Project Limits (Percent)			
LCS Lab Sample ID	**Analyte Name**	**Total or Dissolved**	**Percent Recovery**	**RPD**	**Rejection Point**	**Lower Limit**	**Upper Limit**	**RPD**
E9374.02	Bolstar	N/A	33		10.00	40.00	111.00	40.00
	Tokuthion	N/A	51		10.00	55.00	104.00	40.00
E9374.03	Bolstar	N/A	34	3	10.00	40.00	111.00	40.00
	Tokuthion	N/A	52	2	10.00	55.00	104.00	40.00

Associated Samples

Client Sample ID	Lab Sample ID
Comp-1 012313	159683
Comp-10 012313	159681
Comp-11 012413	159687
Comp-13 012213	159674
Comp-14 012213	159673
Comp-15 012213	159670
Comp-16 012313	159679
Comp-17 012313	159680
Comp-21 012213	159671
Comp-22 012313	159677
Comp-27 012213	159672
Comp-28 012313	159678
Comp-3 012313	159682
Comp-7 012313	159684
Comp-7 DUP 012313	159685
Comp-8 012313	159686
Comp-9 012213	159675
Comp-9 DUP 012213	159676

*Only those Percent Recovery and/or RPD values outside project limits are listed in this report
Scope of Data Qualification: The outlier in the LCS qualifies that analyte in all samples with the same Preparation Batch ID as the LCS

Project Number and Name: A-2 FEB - A-2 FEB

Laboratory Control Sample / Laboratory Control Sample Duplicate Outlier Report

Preparation Batch : E9375 **Analysis Method :** EPA 8081 **Analysis Date :** 02/05/2013
MatrixID: Aqueous-Other **Preparation Type :** 3510 **Preparation Date :** 01/29/2013
Lab Reporting Batch : 130128.06 **Lab ID:** E84809

LCS and/or LCSD Spike Recovery/RPD Outside Project Limits			Reported *		Project Limits (Percent)			
LCS Lab Sample ID	Analyte Name	Total or Dissolved	Percent Recovery	RPD	Rejection Point	Lower Limit	Upper Limit	RPD
E9375.03	Methoxychlor	Tot	136	8	10.00	50.00	130.00	40.00

Associated Samples

Client Sample ID	Lab Sample ID
Equip Blank-1	159703
FCEB-2	159704
FCEB-3	159705

*Only those Percent Recovery and/or RPD values outside project limits are listed in this report
Scope of Data Qualification: The outlier in the LCS qualifies that analyte in all samples with the same Preparation Batch ID as the LCS

Project Number and Name: **A-2 FEB - A-2 FEB**

Laboratory Control Sample / Laboratory Control Sample Duplicate Outlier Report

Preparation Batch : E9376 **Analysis Method :** EPA 8270 **Analysis Date :** 01/31/2013

MatrixID: Aqueous-Other **Preparation Type :** 3510 **Preparation Date :** 01/29/2013

Lab Reporting Batch : 130128.06 **Lab ID:** E84809

LCS and/or LCSD Spike Recovery/RPD Outside Project Limits			Reported *		Project Limits (Percent)			
LCS Lab Sample ID	**Analyte Name**	**Total or Dissolved**	**Percent Recovery**	**RPD**	**Rejection Point**	**Lower Limit**	**Upper Limit**	**RPD**
E9376.02	Dimethoate	Tot	57		10.00	60.00	140.00	40.00
	Monocrotophos	Tot	8		10.00	60.00	140.00	40.00
	Naled	Tot	12		10.00	60.00	140.00	40.00
E9376.03	Monocrotophos	Tot	8	0	10.00	60.00	140.00	40.00
	Naled	Tot	13	8	10.00	60.00	140.00	40.00

Associated Samples

Client Sample ID	Lab Sample ID
Equip Blank-1	159703
FCEB-2	159704
FCEB-3	159705

*Only those Percent Recovery and/or RPD values outside project limits are listed in this report

Scope of Data Qualification: The outlier in the LCS qualifies that analyte in all samples with the same Preparation Batch ID as the LCS

Project Number and Name: A-2 FEB - A-2 FEB

Laboratory Control Sample / Laboratory Control Sample Duplicate Outlier Report

Preparation Batch : E9408 **Analysis Method :** EPA 8270 **Analysis Date :** 02/01/2013

MatrixID: Soils **Preparation Type :** 3545 **Preparation Date :** 01/31/2013

Lab Reporting Batch : 130128.06 **Lab ID:** E84809

LCS and/or LCSD Spike Recovery/RPD Outside Project Limits			Reported *		Project Limits (Percent)			
LCS Lab Sample ID	**Analyte Name**	**Total or Dissolved**	**Percent Recovery**	**RPD**	**Rejection Point**	**Lower Limit**	**Upper Limit**	**RPD**
E9408.03	Phorate	N/A	33	41	10.00	0.00	119.00	40.00

Associated Samples

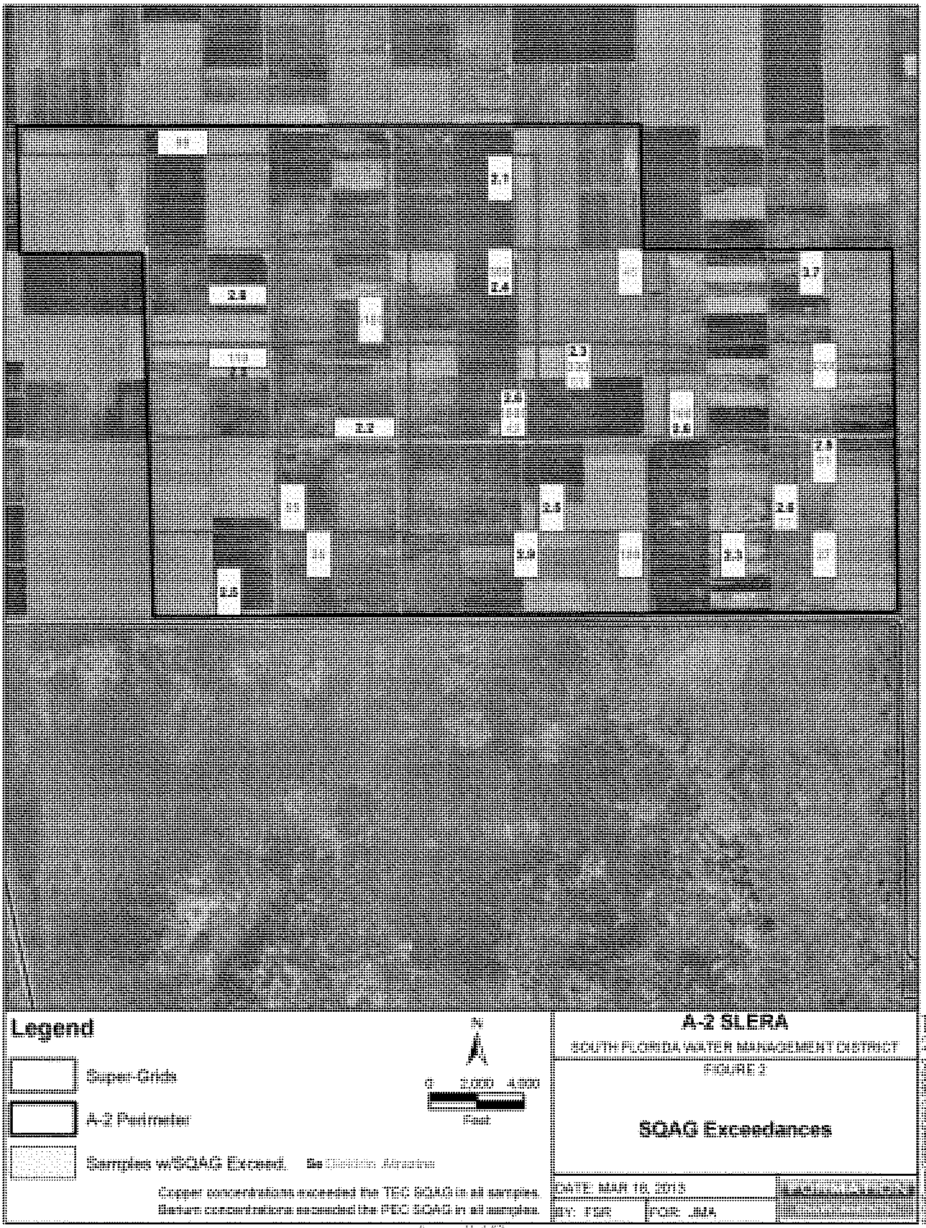
Client Sample ID	Lab Sample ID
Comp-12 012513	159698
Comp-18 012513	159697
Comp-19 012413	159695
Comp-2 012513	159701
Comp-20 012413	159693
Comp-23 012413	159688
Comp-24 012413	159690
Comp-25 012513	159700
Comp-26 012413	159694
Comp-29 012413	159689
Comp-30 012513	159696
Comp-4 012413	159691
Comp-4 DUP 012413	159692
Comp-5 012513	159702
Comp-6 012513	159699

*Only those Percent Recovery and/or RPD values outside project limits are listed in this report

Scope of Data Qualification: The outlier in the LCS qualifies that analyte in all samples with the same Preparation Batch ID as the LCS

Project Number and Name: A-2 FEB - A-2 FEB

ATTACHMENT I


Legend
Super-Grids
A-2 Perimeter
Samples w/SQAG Exceed.
N
0 2,000 4,000
Feet
Copper concentrations exceeded the TEC SQAG in all samples.
A-2 SLERA
SOUTH FLORIDA WATER MANAGEMENT DISTRICT
FIGURE 2
SQAG Exceedances
DATE: MAR 18, 2013
BY: FSR
FOR: JMA

ATTACHMENT J

SunLabs Summary Sample Report

Table 1
Summary of COIs Detected in Composite Soil Samples
A-2 Flow Equalization Basin

Sample ID	Date Collected	Arsenic	Atrazine	Barium	Cadmium	Chromium	Copper	D, 2,4-	Dieldrin	Lead	Mercury	Metribuzin	Phorate	Selenium	Total Organic Carbon
SQAG -TEC		**9.8**	**0.0003**	**20**	**1**	**43**	**32**	**N/A**	**0.0019**	**36**	**0.18**	**N/A**	**N/A**	**N/A**	**N/A**
SQAG - PEC		**33**	**N/A**	**60**	**5**	**110**	**150**	**N/A**	**0.062**	**130**	**1.1**	**N/A**	**N/A**	**N/A**	**N/A**
Comp-1 012313	1/23/2013	6.8	0.099 I	110	0.11 U	19	110	0.058 U	0.0017 U	7.8	0.1	0.041 I	0.0036 U	1.7 I	320000
Comp-10 012313	1/23/2013	4.9	0.025 U	95	0.11 U	12	68	0.057 U	0.0045 I	5.9	0.13	0.018 U	0.0036 U	1.6 I	384000
Comp-11 012413	1/24/2013	3.6	0.027 U	98	0.11 U	15	79	0.063 U	0.0018 U	5.6	0.14	0.020 U	0.0039 U	0.58 U	450000
Comp-12 012513	1/25/2013	3.8	0.027 U	100	0.11 U	13	87	0.063 U	0.0018 U	6.8	0.14	0.020 U	0.0039 U	3.7	470000
Comp-13 012213	1/22/2013	6.2	0.110 I	100	0.15 I	29	90	0.059 U	0.0017 U	6.7	0.13	0.019 U	0.0037 U	2.3	400000
Comp-14 012213	1/22/2013	5.5	0.026 U	80	0.18 I	16	68	0.060 U	0.0017 U	6.6	0.11	0.019 U	0.0038 U	2.2 I	374000
Comp-15 012213	1/22/2013	3.4	3.5	87	0.12 I	7.8	75	0.29	0.0049 I	7	0.11	0.73	0.0043 U	2.6	477000
Comp-16 012313	1/23/2013	4	0.33	91	0.096 U	23	96	0.052 U	0.0051 I	6.1	0.13	0.058 I	0.120 I	2.3	388000
Comp-17 012313	1/23/2013	3.8	0.160 I	99	0.12 U	17	85	0.060 U	0.0017 U	6.4	0.13	0.6	0.0038 U	2.6	409000
Comp-18 012513	1/25/2013	3.4	3.3	97	0.11 U	11	88	0.94	0.0018 U	4.7	0.15	1.1	0.0039 U	1.5 I	450000
Comp-19 012413	1/24/2013	5.5	0.024 U	88	0.11 U	17	59	0.055 U	0.0016 U	6.5	0.12	0.017 U	0.0034 U	0.57 U	198000
Comp-2 012513	1/25/2013	5.2	0.029 U	93	0.11 U	15	59	0.065 U	0.0019 U	6.7	0.098	0.020 U	0.0041 U	2.0 I	383000
Comp-20 012413	1/24/2013	5	0.025 U	90	0.10 U	14	70	0.057 U	0.0016 U	6.3	0.11	0.14	0.0036 U	0.55 U	361000
Comp-21 012213	1/22/2013	3.5	0.055 I	69	0.17 I	9.4	79	0.052 U	0.0015 U	8.4	0.099	0.2	0.093 I	0.47 U	308000
Comp-22 012313	1/23/2013	4.3	0.027 U	100	0.16 I	12	83	0.063 U	0.0018 U	6.2	0.14	0.020 U	0.0039 U	2.5	448000
Comp-23 012413	1/24/2013	4.2	0.026 U	82	0.11 U	13	59	0.059 U	0.0027 I	5.4	0.12	0.019 U	0.0037 U	2.6	384000
Comp-24 012413	1/24/2013	4.1	0.028 U	99	0.14 I	28	82	0.064 U	0.0018 U	6.6	0.14	0.020 U	0.0040 U	2.5	464000
Comp-25 012513	1/25/2013	6.4	0.031 I	100	0.11 U	19	67	0.058 U	0.0017 U	5.6	0.11	0.12	0.0036 U	2.5	392000
Comp-26 012413	1/24/2013	5.5	0.025 U	98	0.11 U	17	78	0.057 U	0.0016 U	6.4	0.13	0.018 U	0.0036 U	0.58 U	355000
Comp-27 012213	1/22/2013	3.5	0.035 I	89	0.12 U	9.1	74	0.070 U	0.00099 U	5.9	0.14	0.022 U	0.0043 U	2.9	503000
Comp-28 012313	1/23/2013	3.1	0.19	83	0.14 I	26	69	0.058 U	0.0017 U	5.8	0.13	1.7	0.0036 U	1.8 I	415000
Comp-29 012413	1/24/2013	4.3	0.033 U	86	0.14 U	7.2	60	0.074 U	0.0011 U	5.2	0.13	0.023 U	0.0047 U	2.3 I	485000
Comp-3 012313	1/23/2013	4.3	0.029 U	91	0.11 U	16	82	0.065 U	0.0019 U	5.4	0.11	0.020 U	0.0041 U	2.5	440000
Comp-30 012513	1/25/2013	3.2	0.027 I	96	0.12 U	21	100	0.063 U	0.0018 U	6.9	0.15	0.020 U	0.0039 U	0.65 U	424000
Comp-4 012413	1/24/2013	4.7	0.029 U	95	0.12 U	5.6	91	0.065 U	0.0019 U	5.9	0.14	0.020 U	0.0096 I	2.3 I	354000
Comp-4 DUP 012413	1/24/2013	4.1	0.033 U	93	0.14 U	6.8	80	0.074 U	0.0011 U	5.7	0.13	0.023 U	0.0047 U	1.8 I	259000
Comp-5 012513	1/25/2013	4.6	0.027 U	94	0.11 U	15	53	0.063 U	0.0018 U	5.5	0.12	0.020 U	0.0039 U	2.1 I	423000
Comp-6 012513	1/25/2013	4.5	0.030 U	110	0.12 U	18	75	0.070 U	0.00099 U	6.1	0.12	0.022 U	0.0043 U	0.66 U	440000
Comp-7 012313	1/23/2013	6.4	0.025 U	97	0.10 U	20	75	0.057 U	0.0016 U	6.3	0.11	0.018 U	0.0036 U	0.55 U	389000
Comp-7 DUP 012313	1/23/2013	5.7	0.025 U	97	0.11 U	19	74	0.058 U	0.0017 U	7.1	0.11	0.018 U	0.0036 U	2.8	329000
Comp-8 012313	1/23/2013	3.8	1.1	96	0.12 U	14	87	0.062 U	0.0018 U	6.3	0.13	0.24	0.0038 U	0.62 U	358000
Comp-9 012213	1/22/2013	3.9	0.38	92	0.12 U	13	67	0.200 I	0.0018 U	5.3	0.12	0.28	0.0039 U	2.4 I	430000
Comp-9 DUP 012213	1/22/2013	3.5	0.44	110	0.14 U	17	65	0.170 I	0.0010 U	5.8	0.12	0.28	0.0044 U	3	419000

All units mg/kg DW
Detected Conc. > TEC
Detected Conc. > PEC

H.2 A-2 FEB Lands Correspondence

From: Shafer, Mark D SAJ
To: Kukleski, Robert; Taylor, Robert
Cc: Gued, Lisa R SAJ; Morrison, Matthew; Taplin, Kimberley A SAJ
Subject: Shafer review of Phase II Environmental Assessment; Screening Level Ecological Risk Assessment; A-2 Flow Equalization Basin Project; Former Talisman Sugar Corporation Property (Tract No. D7 100-104) (UNCLASSIFIED)
Date: Tuesday, April 02, 2013 12:36:00 PM

Classification: UNCLASSIFIED
Caveats: NONE

Bob(s)

Here are my comments on the A2 Sampling report. Lisa Gued indicated that she would send you comments under separate cover hopefully by end of the week.

In addition to the comments below the following are requested.

a. Documentation of FWS review of A2 sampling results.
b. Documentation of FDEP review of A2 Sampling results.
c. Letter from SFWMD to USACE requesting application of Sep 2011 AG-Chem policy to this project.

Shafer Comments:
Overall comment: In addition to USFWS review, this report must be reviewed by FDEP to satisfy USACE Ag-Chem policy.

1. Page 1. In reviewing the A2 Phase II report of March 25th, 2012, it references on page 1 the draft Summary Env. Report for the A-2 FEB, dated September 17, 2012. I have a copy of that report and it does not include much of the information that was originally included in the August 21st, 2012 version. I believe that the WMD solution to USACE concerns about the Sep 17 version was to revert back to the August 21st, 2012 version. I will be referencing the August 21st 2012 version in the CEPP PIR. To do this, page 1 of the March 25 report should be changed to reference the August 21st Summary report and the August 21st report should be provided with a signature from Steve Long.

2. Page 6. Section 3.1. Should provide statement that USFWS and USACE reviewed the sampling scope of work and approved the sampling plan. Provide copy of USFWS review letter in appendix.

3. Page 4.1.1 Soil, 4th bullet. Second sentence says SCTL-LSW is appropriate. Third sentence essentially says SCTL-LSW not relevant. Please confirm with FDEP that FEB would not be a class III water though since the FEB eventually discharges to Class III water body don't know of relevance. Also, a discussion that FEB will discharge to STA34 or STA2B before being discharged to a Class III water.

4. Page 12. Metals Results. Chromium exceeded the SCTL-LSW in all samples. Add discussion of why was this analyte not tested using SPLP protocol.

5. Page 21. Arsenic: Concentrations do exceed the residential exposure criteria. The FEB may be open to the public for recreation. Some discussion of risks associated with public access should be provided in text. Perhaps a reference to other sites where FDEP has developed a "recreational" exposure criteria (Lake Okeechobee Scenic Trail for instance.)

5. Page 21. Chromium. Not sure that it is relevant that the planned FEB will or will not be classified as a Class III water body. The FEB will discharge to the STAs and eventually a class III water body. By the way, this paragraph on the SCTL-LSW exceedances is in direct contrast to the discussion that begins in the next paragraph that follows which begins "Class III surface water criteria".

6. Page 21. Bullet on Chromium, mercury, and selenium were.... Actual testing of these analytes using the SPLP test procedure would have been useful so you could say for sure if these "leach to a significant degree". This lack of testing should be further justified or corrected by additional testing.

7. Page 22. Arsenic: The recommendation should indicate whether the results for Arsenic should warrant measures taken in the soil management plan to reduce possible human exposure due to potential for arsenic on levee soils. (Blending or capping with low-arsenic soils, for instance.)

Thanks

Mark Shafer

-----Original Message-----
From: Kukleski, Robert [mailto:rkuklesk@sfwmd.gov]
Sent: Tuesday, March 26, 2013 2:30 PM
To: Barnett, Ernie; Teets, Thomas M; Morgan, Temperince; Morrison, Matthew; Thourot, Scott; Burns, Kirk; Cooper, Abner; Warner, Paul; Kivett, Jeff; Mitnik, John; Shirkey, Alan; Leeds, Jennifer; Sciotto, Sara; Jeyakumar, Nirmala; Bertolotti, Lesley; Shaffer, John; Ramirez, Armando; Virgil, Richard; Loehrlein, Vincent; Collins, Kathleen; Story, Ester; Bassell, Richard; Palmer, Ray; Schaeffer, Robert; Arias, Dolores; Taylor, Robert; Smith, Jeffrey; Coughlin, Steve; Trammell, Herbert; Pfeuffer, Richard
Cc: robert_frakes@fws.gov; Emily Bauer; 'Anthony Sowers'; Shafer, Mark D SAJ; Gued, Lisa R SAJ; 'Dougherty, Brian'; 'Stuckey, Mark'; 'Lurix, Joe'; 'william.rueckert@dep.state.fl.us'; William C. Kennedy; 'Steve Long'; Michael Rothenburg; 'andrew.cadle@psiusa.com'; 'Joe Allen'; 'Mark Lewis'
Subject: Phase II Environmental Assessment; Screening Level Ecological Risk Assessment; A-2 Flow Equalization Basin Project; Former Talisman Sugar Corporation Property (Tract No. D7 100-104)

The attached memorandum is intended to accompany the Phase II Environmental Assessment and Screening Level Ecological Risk Assessment (SLERA) of the A-2 Flow Equalization Basin (FEB) Project, comprised of the former Talisman Sugar Corporation property (Tract No. D7 100-104). All known "point-sources" within the Project footprint have been previously assessed/remediated, with Florida Department of Environmental Protection (FDEP) concurrence with the completeness of corrective actions. The current Phase II Sampling Investigation (and accompanying SLERA) were focused upon the cultivated portions of the subject property that were not previously sampled in order to quantify the residual agrochemical concentrations associated with routine application, and to determine the environmental suitability of the subject property for the proposed Project.

The report was completed by Professional Service Industries, Inc. (PSI). A condensed electronic version (Text, Tables, and Figures) of the PSI report is also attached. A complete version of the report (including all Appendices) has been uploaded into Documentum. Complete printed versions of the report are being transmitted separately by PSI to selected recipients (as detailed in the memorandum).

We value your opinion. Please take a few minutes to share your comments on the service you received from the District by clicking on this link
<http://my.sfwmd.gov/portal/page/portal/pg_grp_surveysystem/survey%20ext?pid=1653> .

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Comments for Phase II Environmental Site Assessment for the A-2 Flow Equalization Basin

Commenter: Lisa R. Gued, Ph.D., USACE

Date: April 11, 2013

Page 2: 1st bullet: How were ND values incorporated in the statistical analyses?

Page 2: 1st bullet: A table listing the mean and the standard deviation of detected compounds would be useful.

Page 7: 2nd paragraph: Which chemicals were recently applied?

Page 8: 2nd bullet: Split samples were not accomplished with OP pesticides and herbicides because the primary split laboratory subcontracted these analyses to Sunlabs. Sunlabs was the primary laboratory.

Page 10: 3rd paragraph: FWS protocols recommend consideration of ESV established by EPA Region IV when Florida SQAGs are not available. Where these values considered in this assessment?

Pages 11-13: In the discussion of the results, the mean and the standard deviation should be reported.

Pages 11-13: For compounds where the detection limit was higher than the criteria, this should be reported.

Page 11: Last paragraph. The MDL that the laboratory reported is approximately 100 times the SQAG-TEC for atrazine.

Page 12: 2nd paragraph: The text fails to state that the holding times for SPLP analyses per method EPA 1312 were exceeded. This makes the data questionable.

Page 13: 4.3 Data validation: ADaPT data validation forms were not provided with the laboratory reports in Appendix A.

Page 13: 4th paragraph: Does USFWS concur with the value used of 4.2 mg/kg selenium?

Page 14: 4th bullet: A spot check of the data indicate that this statement is inaccurate. The method blank run 1/30/13 by CAS has barium, cadmium, copper, mercury in it.

Page 14|: It should be noted that the laboratory did not achieve the SQAGs TEC concentrations for any of the organophosphate pesticides (OPP), the triazine herbicides (including atrazine) or toxaphene. The SOW that this assessment was supposed to follow named EPA 8140 as the method for OPP. The chain of custody from the field requested EPA 8141 + atrazine for the split samples; the chain of custody between ALS and their subcontractor, Sunlabs was changed to EPA 8270. The chain of custody from the field produced to Sunlabs (the primary laboratory) requested EPA 8141. The data was reported out from EPA 8270 which did not conform to the scope. Typically, EPA 8140 provides lower detection limits than EPA 8270 due to use of a more selective detector.

Page 14: Bullets 6&7: There are a wide variety of MDLs being reported by commercial laboratories. Were the labs told which criteria the data was going to be compared to? Were different labs contacted?

Page 17: 1st bullet: Please confirm that the 95% UCL of dieldrin exceeds the SQAG-TEC.

Page 17: 2nd bullet: Does the FWS concur with no risk for barium?

Page 17: 2nd bullet: The range of barium concentration defined by FDEP (Carvalho and Schropp, 2002) in the Florida DEPs Interpretive Tool for Assessment of Metal Enrichment in Florida Freshwater Sediment warns of the limitation that "the majority of the freshwater sediment systems used to build the sediment metals database from which this tool was developed came from central peninsular and north Florida. Therefore, this tool should be used to evaluate sediments from the same region". It goes on to say in the Recommendations: "... the interpretive tool should be used with a cautionary note outside of central peninsular and north Florida."

Table 1: SPLP should have a footnote.

Tables: A complete table listing the criteria and the found value and or detection limit would be useful to see at a glance the detection limit vs the criteria.

Appendix B Screening Level Ecological Risk Assessment

Page 3: 4th paragraph I have been unable to locate the full dataset.

Page 3: 5th paragraph: Which samples are discrete?

Page 4: 3.1.1 Does USFWS concur with this?

Page 4: 3.1.1 The range of barium concentration defined by FDEP (Carvalho and Schropp, 2002) in the Florida DEPs Interpretive Tool for Assessment of Metal Enrichment in Florida Freshwater Sediment warns of the limitation that "the majority of the freshwater sediment systems used to build the sediment metals database from which this tool was developed came from central peninsular and north Florida. Therefore, this tool should be used to evaluate sediments from the same region". It goes on to say in the Recommendations: "... the interpretive tool should be used with a cautionary note outside of central peninsular and north Florida."

Page 5: 1st paragraph: Does the USFWS concur with the barium concentrations are not likely to cause effects?

Page 5: 4th paragraph: Does the USFWS concur with the lack of PEC exceedance in any sample and the unique properties of muck soils with the A-2 cultivated area suggest that the potential for toxic effects would be lower than predicted by SQAGs?

Page 5: 4th paragraph: Define unique properties.

Page 6: 3.1.3: The information is in conflict with the ESA assertion on page 13. The recommended value for selenium should be inserted in to the detected table 1 and footnoted.

Page 6: 3.1.4 I am unable to identify a Figure 2 in the hard copy report.

Page 6: Does USFWS concur with the recalculation of the 0.0003 ug/kg TEC value for atrazine to 587 ug/kg TEC for atrazine?

Page 6: 3.1.5 What is the half-life for 2,4-D?

Page 6: 3.1.5: Does USFWS concur with the calculation of the site-specific SQAGs for 2,4-D?

Table 1: comp-10 should be shaded for dieldrin concentration

Page 8: 2nd paragraph Does USFWS concur?

Page 8:5th paragraph: Was metribuzin applied recently or not?

Page 8:6th paragraph: Was phorate applied recently or not?

Page 9: 3.2 The cumulative risk did not include the data for barium. Barium data were not used because it was considered background. It those data were left in the average PEC-HQ would be greater than 0.5. Does USFWS concur with deletion of barium data?

Table 2: The value for SQAG PEC for dieldrin is incorrect in this table. The correct value is 0.062 mg/kg.

Page 10: 2nd paragraph: The text says that "a screening-level approach was used to identify COPCs by using the maximum composite sample concentration from the discrete sediment samples..." This does not make sense. There were no discrete samples..

Page 10: 3rd paragraph: Treatment of barium is inconsistent through this report. It was not used in Table 2 to calculate PECs-HQ but it was used in Table 3 to calculate HQs for aquatic – feeding birds.

Page 10: 3rd paragraph: The text says that atrazine is a chemical with low toxicity. How do the authors reconcile the 0.0003 mg/kg SQAG-TEC values; it is the lowest concentration of TEC for the compounds detected.

Page 11: 3.3.1 Does USFWS concur with this position?

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

April 17, 2013

Robert Kukleski
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, Florida 33406

Dear Mr. Kukleski:

The U.S. Fish and Wildlife Service (Service) has reviewed the document entitled "Phase II Environmental Site Assessment for the A-2 Flow Equalization Basin, Palm Beach County, Florida," prepared by Professional Service Industries, Incorporated (PSI). This report summarizes sampling results for the approximately 14,408 acre Talisman property.

Previous due diligence assessments were performed on the A-2 Flow Equalization Basin (FEB) parcels prior to the creation of the current "Protocol for Assessment, Remediation, and Post-Remediation. Monitoring for Environmental Contaminants on Everglades Restoration Projects", therefore a reduced sampling density of 10 percent was agreed to prior to the current assessment of previously cultivated areas in the project footprint. All point source concerns within the A-2 FEB were previously assessed and remediated as necessary. A total of 30, fifty acre grids were sampled using composite samples. Analytical results were compared to the Florida Department of Environmental Protection Sediment Quality Assessment Guidelines (SQAG) and the Florida Administrative Code Soil Cleanup Target Levels (SCTL).

Results

Barium concentrations (69 to 118 mg/kg) exceeded the SQAG threshold effect concentration (20 mg/kg) and probable effect concentration (PEC) (60 mg/kg) in all of the samples. Copper (53 to 110 mg/kg) was detected at concentrations that exceeded the recommended interim screening level for protection of the Everglade snail kite (*Rostrhamus sociabilis plumbeus*) (85 mg/kg) in eight of the samples collected. The calculated 95 percent upper confidence level (UCL) of the mean copper concentrations (83.1 mg/kg) was below 85 mg/kg. The metals chromium, mercury, and selenium exceeded the SCTL for leaching to surface water in several of the sample locations. The herbicides 2,4-D, metribuzin, phorate, and atrazine were detected at some locations with concentrations above the SCTL for leaching to surface water or ground water. Atrazine (27 to 3,500 µg/kg) was relatively widespread, with detections at 16 of the sampling locations above the SQAG threshold effect concentration (TEC) (0.30 µg/kg). The pesticide dieldrin was detected above the SQAG TEC (1.9 µg/kg) in four samples, ranging from 2.7 to 5.1 µg/kg. Atrazine and dieldrin were also analyzed with the synthetic precipitation leaching procedure (SPLP). Atrazine was detected in SPLP extract at concentrations above the Florida Administrative Code (FAC) groundwater cleanup target level (GCTL) and the FAC

Surface water Cleanup Target Level (SwCTL). The detection limits for the dieldrin SPLP extracts were above the SwCTL.

Copper concentrations within the A-2 FEB did show some exceedances above the recommended interim screening level, but sitewide they are calculated to be below 85 mg/kg. In addition, the total organic carbon (TOC) content of the soils at the proposed A-2 FEB are high (20-50 percent) and will act to decrease the bioavailability of copper. The recommended interim screening level was generally established for sandy soils with roughly 1 percent TOC. To verify that copper does not present a risk to snail kites, PSI recommended a sampling program at the start-up of the A-2 FEB to monitor copper concentrations in surface water, periphyton, and any apple snails that may establish onsite. To address the exceedances of 2,4-D, atrazine, metribuzin, phorate, dieldrin, chromium, mercury, and selenium above the SCTL for leaching to surface water PSI recommended sampling surface water after start-up operations at the A-2 FEB.

Summary and Recommendations

After reviewing the analytical data, the Service concurs that the detected contaminant concentrations are unlikely to pose risk to Service trust resources at the proposed A-2 FEB. We agree that the proposed monitoring for copper is necessary to verify predictions of reduced copper bioavailability due to the high TOC. While the detected levels of barium could potentially impact the benthic community, it is unlikely that they would pose risk to federally listed species.

The Service agrees that an agrochemical best management practices (BMP) plan is appropriate to address the use of agrochemicals, if the property is used for agricultural purposes prior to project construction. We strongly recommend restricting any further use of copper and discontinuing use of atrazine a minimum of one year prior to project construction. If agrochemicals are applied during the interim use, then further sampling may be necessary to ensure that agrochemical concentrations are below thresholds for ecological risk.

Thank you for the opportunity to provide comments regarding the assessment in the A-2 FEB project area. If you have any questions, please contact Emily Bauer at 772-469-4335.

Sincerely yours,

for Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc: electronic only

Corps, West Palm Beach, Florida (Tori White)
Service, Vero Beach, Florida (Sharon Kocis, Steve Mortellaro)
PSI, Tampa, Florida (Stephen Long)

DEPARTMENT OF ENVIRONMENTAL PROTECTION

MEMORANDUM

TO: Joe Lurix, Air/Waste/WF Program Administrator
FROM: William Rueckert, Environmental Manager, Waste Compliance Assistance & Enforcement Section
DATE: April 4, 2013
SUBJECT: Phase II Environmental Site Assessment, A-2 Flow Equalization Basin, Palm Beach County; Site No. COM_157258 (Talisman); Tract Numbers: D7100-044; -047; -066; -067; -104; -139; -141; and D7200-005.

As requested by the Department's Office of Ecosystem Projects in Tallahassee, I have reviewed the document prepared for the South Florida Water Management District (District) by Professional Service Industries, Inc. (PSI) dated March 25, 2013 (received April 1, 2013) *Phase II Environmental Site Assessment, A-2 Flow Equalization Basin (Report), Palm Beach County, Florida.* The Department's review was performed following the "Protocol for Assessment, Remediation and Post Remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects" known as the White Paper. The Waste Compliance Assistance & Enforcement Section has the following comments:

1. Based on the information and representations as presented, this Report adequately addresses the concerns of the Department's Waste Compliance Assistance & Enforcement Section with further discussion below. Therefore, the property addressed in this Report should be capable of being utilized for the intended end use as a flow equalization basin.

2. Start Up Operations - the Department concurs that during the start up operation a one-time surface water and sediment sampling event should be performed. This sampling event should be performed at the 30- or 60-day period from inundation. **In addition,** after one year of operations, an additional surface water sampling event should be performed. Sample location, minimum of three, determinations should be based upon the highest concentrations of the listed parameters presented in this Report. The Department suggests three locations with the highest copper concentrations for the metals analyses. For example, sample collection should be in the vicinity of Comp-1, Comp-16, and Comp-30.

Sample locations, minimum of three, for the pesticide and herbicide analyses should be in the areas of Comp-9, Comp-18, and Comp-28. The following parameters should be laboratory analyzed: pesticides and herbicides (2,4-D; atrazine; metribuzin; phorate) and metals (barium, chromium, copper, mercury and selenium).

3. Arsenic is not suggested for additional analyses but these soils should not be transported off site for uncontrolled disposal. As presented in Section 6.2, Recommendations, a soil management plan should be developed for project construction to ensure proper handling and disposal of the soils.

4. Also as presented in Section 6.2 of the Report, an agrochemical best management practices plan should be instituted during the continued use of agrochemicals on the property.

If you have any questions, feel free to contact William Rueckert at (561) 681-6679 or at William.Rueckert@dep.state.fl.us.

cc: (RPPS_Comp@dep.state.fl.us)

130267

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

June 14, 2013

Mr. David S. Hobbie
Deputy District Engineer
Programs and Project Management Division
U.S. Army Corps of Engineers
701 San Marco Boulevard
Jacksonville, FL 32207-8175

Dear Mr. Hobbie:

Subject: Request for Inclusion of a Section Entitled "Residual Agricultural Chemicals" within the Central Everglades Planning Project 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 Central Everglades Planning Project (CEPP) Final Integrated Project Implementation Report and Environmental Impact Statement. 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.

SFWMD has provided information to the Jacksonville District to fulfill the applicable requirements set forth in Paragraph 4 of the policy guidance for the CEPP and will work with the Jacksonville District to complete this section in the Final Integrated Project Implementation Report and Environmental Impact Statement.

Sincerely,

Temperince Morgan

Temperince Morgan
Director
Office Everglades Policy and Coordination

TM/pv

c: Eric Bush, USACE
Howard Gonzales, USACE
Kimberley 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

From: Kukleski, Robert
To: Gued, Lisa R SAJ
Cc: robert_frakes@fws.gov; Emily Bauer; Shafer, Mark D SAJ; "william.rueckert@dep.state.fl.us"; "Steve Long"; "andrew.cadle@psiusa.com"; "Joe Allen"; Davis, Murika R SAJ; Irfan, Muhammad SAJ; Taplin, Kimberley A SAJ; Taylor, Robert; Morrison, Matthew; Warner, Paul; Cooper, Abner; Thourot, Scott; Teets, Thomas M; Palmer, Ray; Bassell, Richard; Bergstrom, Jayne; Virgil, Richard; Loehrlein, Vincent; Kivett, Jeff; Mitnik, John
Subject: Response To Additional USACOE Comments; Phase II Environmental Assessment (Addendum #1); Screening Level Ecological Risk Assessment; A-2 Flow Equalization Basin Project; Former Talisman Sugar Corporation Property (Tract No. D7 100-104)
Date: Friday, June 14, 2013 11:02:32 AM

Lisa:

The South Florida Water Management District (SFWMD, or "the District") is submitting this response to address your requests for clarification on the Phase II Environmental Site Assessment (ESA) for the A-2 Flow Equalization Basin (FEB) that were received via e-mail on May 21, 2013; the comments were issued in response to the Phase II ESA - Addendum #1. We have provided each of your comments in italics below, followed by our response:

1. With respect to the FDEP letter, which standards will be used to evaluate the target compound water concentrations (if any) in the FEB after inundation?

Response: The FDEP concurrence letter, which was previously provided for the Phase II ESA did not specify which standards would be applied to evaluate target compound concentrations in the surface water in the A-2 Flow Equalization Basin (FEB) after inundation. However, the District is not permitting the FEB as a treatment works; and, therefore, the surface water standards for Class III surface water bodies, which are contained in Chapter 62-302, Florida Administrative Code (FAC) would apply.

2. With respect to the FDEP letter, what would be the repercussions if any of the targets exceeded the standards?

Response: The FDEP concurrence letter did not specify the repercussions for any target compounds that might exceed the surface water quality standards during the operation of the FEB. However, exceedences of the water quality standards for this FEB would be treated no differently than exceedences for any other constructed water body or reservoir that is operated by the District. When an exceedence is detected and confirmed through follow-up testing, a corrective action plan would be developed to reduce the chemical concentrations to below the applicable criteria. The District commonly employs adaptive management strategies to meet water quality standards, and the operation of the FEB might need to be altered to meet the water quality standards.

3. With respect to the USFWS letter, what concentrations of copper found in surface water, periphyton and apple snails after FEB inundation would be a cause for concern?

Response: As you are aware, SFWMD, USFWS, FDEP and USACOE are currently participating in a joint Copper Working Group to further our understanding of the fate and transport and potential ecological effects of copper in the Everglades environment. As part of this effort, we have jointly sponsored several studies which are currently underway to evaluate copper bioaccumulation, toxicity, desorption, and other important parameters that significantly impact the potential risks associated with exposure of the Everglades snail kite, and other species to copper in sediments. We believe that it is premature to set goals for allowable concentrations of copper in periphyton and apple snails at this time, but we will be in a better position to jointly set these goals after completion of these studies within the next 12-18 months, and prior to FEB construction. With regard to copper in surface water, the Class III surface water standard for copper would apply, and this value is hardness dependent.

4. With respect to the USFWS letter, what would be the consequences if copper concentrations exceeded the level of concern?

Response: Similar to the FDEP concurrence letter, the USFWS concurrence letter does not identify the consequences if the copper concentrations within the FEB exceeded the level of concern during operation. The District will utilize adaptive management techniques to address any exceedences of copper in surface water, periphyton, or snail tissue.

5. With respect to the USFWS letter, does the SFWMD agree with restricting further use of copper at the site and discontinuing use of atrazine a minimum of one year prior to project construction?

Response: The District does agree with the USFWS recommendation to restrict copper applications and to require the leasee to discontinue atrazine use a minimum of one year prior to project completion. It has been very common for the District to prepare and adopt agricultural chemical Best Management Practices (BMP) Plans which are implemented during interim use to prevent further degradation of a property prior to construction.

6. With respect to the USFWS letter, it says that "If agrochemicals are applied during the interim use, then further sampling may be necessary to ensure that agrochemical concentrations are below thresholds for ecological risk". Please confirm that SFWMD is still planning on leasing the land for the A-2 and agrochemicals will be applied. Please clarify what further sampling would be necessary to ensure that agrochemical concentrations are below threshold for ecological risk.

Response: The current lease on the property varies, with some components of the property leased until 2015 and others until 2019. The portions leased until 2019 can also be extended beyond that timeframe if the Project is not ready for construction. The District intends to allow continued farming on the property, subject to the proposed BMP restrictions, during the interim use period. Upon termination of the lease, the SFWMD Environmental Science Unit (ESU) will conduct an Exit Assessment on the property. The Exit Assessment typically involves a thorough reconnaissance of the property to identify any evidence of spills that may have occurred during the lease period (e.g., dead vegetation, staining, odors), or new chemical sources (e.g., mix/load areas, tanks, etc.) with a high potential for spills. A governmental database search is also typically performed to identify any reported spills or environmental violations that have been reported on the property during the lease period.

If any potential point sources are identified, soil and groundwater samples would typically be collected from these areas. The District would also typically perform re-sampling within the cultivated fields at a few grid locations to verify current conditions. During this re-sampling, we collect samples from previously sampled grids for comparison of current conditions with the Phase II ESA results. We typically perform re-sampling at 5-10% of the previously sampled grids. SFWMD will submit a workplan for any Exit Assessment sampling to FDEP and USFWS to obtain concurrence prior to conducting the additional work.

We trust that these responses will be satisfactory to address the USACOE's concerns regarding the report. If you have any additional questions, please do not hesitate to contact me at (561)686-8800, ext. 3337.

We value your opinion. Please take a few minutes to share your comments on the service you received from the District by clicking on this link
<http://my.sfwmd.gov/portal/page/portal/pg_grp_surveysystem/survey%20ext?pid=1653> .

H.3 Comprehensive Everglades Ecosystem Restoration Plan Environmental Risk Assessment Protocol Documents

ANNEX H

PART 3

CERP ENVIRONMENTAL RISK ASSESSMENT PROTOCOL DOCUMENTS

1) Whitepaper to Address Florida DEP Remaining Concerns about the Ecological Risk Assessment (ERA) Protocol
   Prepared by
   Joseph Allen, Mark Lewis, Ph.D., and Shahrokh Rouhani, Ph.D., P.E.
   NewFields Companies, LLC

2) 3/14/08 FINAL VERSION
   ATTACHMENT 1, PROTOCOL FOR ASSESSMENT, REMEDIATION AND POST-REMEDIATION MONITORING FOR ENVIRONMENTAL CONTAMINANTS ON EVERGLADES RESTORATION PROJECTS

Whitepaper to Address Florida DEP Remaining Concerns about the Ecological Risk Assessment (ERA) Protocol

Prepared by
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NewFields Companies, LLC

Prepared for
South Florida Water Management District

October 15, 2007

1.0 INTRODUCTION

The South Florida Water Management District (SFWMD) routinely acquires large agricultural tracts for incorporation into water storage and water quality improvement projects. Many of these tracts have residual chemicals present in the soil associated with routine agrochemical application during the period of agricultural use. In order to characterize the level of chemical impacts on these tracts, SFWMD and its land acquisition contractors have utilized a protocol for sampling and subsequent risk assessment ("the protocol") of these properties which was developed by the United States Fish and Wildlife Service (USFWS) in cooperation with SFWMD. This protocol has been in use for a number of years and has been revised occasionally to reflect lessons learned through the assessment process. The intent of the protocol is to ensure that the sampling density and methodology is consistent between project objectives and is sufficient to adequately characterize these properties with regard to chemical impacts and potential future use. As the protocol states (USFWS, 2004, page 1):

"Many of these lands proposed for acquisition will support functioning water reservoirs (storm water treatment areas, Aquifer Storage and Recovery detention reservoirs, and storage reservoirs) designed to impound a wide range of water capacities and depths over long periods of time. Additionally, many of these reservoirs will cover large expanses of several thousand acres, establishing local and regional aquatic ecosystems as well as providing foraging habitat for waterfowl and other aquatic wildlife. Without appropriate risk management and attention to design alternatives, the subsequent release of these pesticides and trace metals into CERP [the Comprehensive Everglades Restoration Plan] *wetlands, reservoirs, and conveyances will provide exposure pathways to the regional fish and wildlife communities in south Florida."*

Ultimately, the data collected using the USFWS protocol are utilized in performing ecological risk assessments (ERA) and in the decision making process as to whether the land is suitable for the proposed water quality projects, or whether remedial actions are required to protect the receptors that may utilize the habitat created by the proposed water quality improvement project.

This document has been prepared in response to concerns raised by the Florida Department of Environmental Protection (FDEP) regarding the ERA guidance. In recent months, FDEP has provided comments on environmental reports for tracts within the BBCW and C-111 projects, and other SFWMD projects. On October 20, 2006 FDEP provided SFWMD with a list of comments and concerns related to the ERA guidance. A meeting to discuss these comments was held on November 3, 2006 with technical experts representing FDEP, USFWS and SFWMD with the primary goal of addressing FDEPs concerns regarding the ERA guidance and associated sampling protocols. These comments, including the SFWMD responses to the comments were provided at the November 3, 2006 meeting. A round of comments based on the SFWMD responses was provided to SFWMD on February 26, 2007 by FDEP.

To address the above FDEP comments, a draft version of this document was submitted to FDEP on July 9, 2007, which was followed by a joint FDEP/SFWMD meeting on July 12, 2007. Discussions during this meeting indicated that the submitted draft document satisfactorily addressed most of the concerns raised by FDEP. A final round of comments, highlighting the remaining concerns, was provided to SFWMD on September 9, 2007 by FDEP. This document has been revised to address these comments.

2.0 OUTLINE OF THE ECOLOGICAL RISK ASSESSMENT GUIDANCE

The ERA guidance outlines a multi-phased approach toward determining the presence or absence of hazardous materials and the potential for ecological risk associated with their presence. The assessment steps provided in the ERA guidance are as follows:

- An initial Phase I Environmental Site Assessment ("ESA") is performed according to American Society of Testing and Materials ("ASTM") Standard Practice E1527-00 with the goal of identifying the presence or likely presence of any hazardous substance of petroleum products on the property.
    - The Phase I ESA includes a thorough site inspection, review of historical aerial photographs, land use records, and review of pertinent environmental databases, as well as onsite personnel interviews. Information acquired via the Phase I ESA is used to determine the necessity for a Phase II ESA.
    - If the Phase I ESA indicates the presence of contamination or that the potential for contamination exists, a Phase II ESA is initiated that includes coordination with the USFWS.
- A Phase II ESA is used to identify sources and locations of contamination, specifically contaminants of potential concern (both human health and ecological), and provide recommendations for additional sampling, testing or risk assessment; and corresponding corrective actions.
    - The Phase II ESA is focused on potential point sources at the property along with additional limited sampling within canals or agricultural fields.
    - Data are used to conduct a screening-level ERA (SLERA) using available benchmarks, such as the Florida Sediment Quality Assessment Guidelines (SQAGs) and/or surface water quality standards and assessment of risk to USFWS trust species.

- The ERA guidance recommends risk assessment protocols for further risk-based evaluation should the results of the SLERA indicate that risks may be elevated at the site.

3.0 OUTLINE OF THE PHASE II SAMPLING PROTOCOL

The sampling protocol for Phase II ESAs provides data for risk assessment purposes in both potential point source areas and within current or former agricultural areas. The media sampled may include soils, sediments, groundwater and/or surface water (if present).

- Phase II ESA sampling is generally focused on facilities (current and/or former) and potential point sources on the property.
  - Discrete samples are collected from all potential source areas identified during the site inspection or historical review conducted as part of the Phase I ESA and may include: pesticide mixing and loading areas, storage sheds, vehicle turn-arounds, airstrips, cattle dip tanks, pumping stations and burn areas.
  - Sediment and surface water data are collected from canals at the site.

- Phase II sampling also includes the collection of data from the current or former agricultural areas at the property following a standard protocol. The collected data in the former agricultural areas are intended to provide representative average concentrations over the specified grids for risk assessment purposes. The proposed sampling protocol does not recommend the use of grid-wide values, especially grid composite data, to delineate and/or evaluate extents or magnitudes of potential hot spots.

  - On small properties (< 500 acres), discrete samples are collected at regular intervals across the property with a density of at least one sample per 10 to 20 acres with a minimum of 10 samples.
  - On large properties (> 500 acres), a composite sampling protocol is instituted based on 50-acre grid cells.
    - On very large properties, a previously determined number of grids are randomly selected for sampling.
    - On smaller properties (e.g. < 1000 acres) an attempt is made to sample all grids.
      - 50-acre grids are stratified by agricultural use.
      - Grids are divided into ten 5-acre plots.
      - A discrete random sample is collected from each 5-acre plot.
      - Samples are composited from all discrete samples within the 50-acre grid.
      - A second aliquot from each 5-acre grid sample is typically archived for future analysis.
      - Copper is analyzed in all 5-acre discrete samples.

4.0 RISK MANAGEMENT GOALS AND GUIDING PRINCIPLES FOR THE CERP LAND ACQUISITION AND ASSESSMENT.

Risk Management Goals (RMGs) are an important part of assessing risk (EPA 1998). The RMGs for an ERA form the basis of the sampling design and process by which risks are assessed. The RMGs implicit in CERP guiding documents and ERA risk assessment and management process are as follows:

- The overall purpose of CERP is to manage ecosystem nutrient loading and hydrology.
- The CERP process recognizes that agricultural chemicals, and the risk of adverse effects from them cannot be completely removed (i.e., cannot manage to NO Risk).
- The benefits realized from reclamation of wetland and hydrologic function through CERP outweighs risk of adverse effects from residual agricultural chemicals.
- Risks to USFWS trust species are managed to avoid unacceptable adverse effects on "individual" basis rather than on a population basis.
- Ecological function from other aquatic receptors (benthos and fish) is protected on populations and community basis, some effect is tolerated if ecosystem function is protected.
- Risks and ecological function are assessed and managed on a landscape scale rather than on the smaller scale typically encountered on a regulated industrial or commercial cleanup site.
- The ability to assess ecotoxic risk is limited by available resources (time and money).

The ERA process design is based on the primary RMGs of protecting Trust wildlife species, and ecological function on a landscape scale. The process for assessing benthic effects is based on this underlying principle in that:

- The Assessment Endpoint for the benthic community is based on function of the community as a whole ecosystem occupying the landscape. Functions of benthos include nutrient cycling (including organic carbon) and to provide important prey base for the aquatic food web. These functions are generally scaled over large, landscape levels rather than at small scales and can tolerate small-scale disturbances provided that the majority of the community remains viable. The overall impact on function should be related to the degree to which the system is affected.

- The system level effects from direct sediment toxicity to benthos (or anything else), if they occur, do not extend beyond the boundaries of the affected portion of the site (whereas bioaccumulation effects can affect area and resources beyond contaminated spot).
  - As a result, a relatively small portion of an area may be severely affected, without affecting function in the system.
  - Conversely, a large area with relatively small level of effects can have significant system effects because a proportionately larger fraction of the system is affected.

- The RMGs relate to restoring ecosystem function and protecting Trust wildlife species. For benthos and other ecological functions, this typically applies to landscape scales of the project areas. As a result, the ERA assessment goal for benthos is geared toward detecting large areas of even small effects, possibly sacrificing resolution of proportionately small areas of higher impact. This is consistent with the goals cited in the USFWS/SFWMD Guidance. This is driven, in part, by limited resources (time and money) to investigate such large tracts.

5.0 ADDRESSING FDEP KEY CONCERNS AND RECOMMENDATIONS

As noted, FDEP provided a series of comments about various aspects of the sampling protocol. Some of these comments were satisfactorily addressed by SFWMD. The remaining FDEP comments can be grouped into the following key concerns:

- Reliability of composite samples proposed in large property investigations;
- Random selection of grids for composite sampling and analysis in very large properties;
- Analysis of resulting composite data in ERA decisions;
- Sufficiency of collected data in agricultural areas of the investigated properties;
- The use of copper Threshold Effect Concentrations (TECs), Probable Effect Concentrations (PECs) and the interim benchmark for the protection of the Everglades snail kite.
- The overall protectiveness of the process for benthic receptors (i.e. the aquatic community).
- The use of bioaccumulation and toxicity testing studies.
- Additional analysis for heavy metals.
- Canal sediment sampling.
- Fish tissue sampling.

The following sections address the above concerns and provide recommendations where appropriate.

5.1 Discrete Sample Compositing

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 hotspots. Composite sampling is a compromise, under which large numbers of discrete samples are collected, but composited prior to laboratory analyses. As early as the 1980s, the United States Environmental Protection Agency (EPA) recognized the utility of composite sampling in large site investigations (e.g. EPA, 1989, Section 6.6).

The main advantage of composite sampling is its expanded spatial coverage, which is achieved without the ensuing increase in analytical costs. The proposed composite samples, which are unbiased and representative samples of their constituent aliquots, have the following characteristics:

- Composite samples yield unbiased and representative estimates of average concentrations over exposure areas that have ecologically relevant scales for large properties. For example, comparison of an individual composite sample to appropriate ecological benchmarks allows an appropriate remedial decision concerning the entire 50-acre grid.

- For the aquatic community endpoint, site-wide averages are an appropriate scale. Composite samples directly provide estimates of exposure and potential risk to the entire aquatic community that may colonize the site.

- For the USFWS trust species, risks to individuals are more important than risks to the population due to their threatened or endangered status. This sampling protocol allows for average concentrations to be measured directly over areas that may encompass the entire foraging range or only a portion of the foraging range depending on the species being evaluated.

The primary disadvantage of composite samples is the likelihood of masking hotspots 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.

The protocol attempts to minimize the above disadvantage by including rules according to which all discrete aliquot samples associated with an exceeding composite sample should be analyzed individually. As noted, recent adjustments to the protocol have also called for the analysis of the archived discrete aliquot samples from adjacent grids.

The above protocol rule addresses the false negative problem associated with elevated composite samples. The question that remains is the problem of false negatives among non-exceeding composites. For this purpose, available data can be used to quantify such likelihoods. For example, consider the discrete and composite copper concentrations from 37 50-acre grids from various sites that have been sampled under the Phase II ESA protocol, as listed in Table 1. Figure 1 shows the range of variability of discrete aliquot samples associated with each composite. The issue is whether these exceeding discrete values are ecologically significant.

The probability of an aliquot exceeding a benchmark in a given grid can be computed as the ratio of the number of exceeding discrete aliquots in that grid over its total number of aliquots. Using the above copper data, Table 2 lists the aliquot exceedance rates in individual grids based on the three copper benchmark levels routinely used in the SLERAs of 85 ppm (USFWS Interim Benchmark for the Everglades Snail Kite), 31.6 ppm (TEC), and 150 ppm (PEC). On average, the aliquot exceedance in individual grids increases with decreasing ecological benchmarks and increasing composite values.

To address FDEP's concern about false negatives associated with non-exceeding composite samples, a supplementary step can be added to the protocol. For this purpose, a subset of non-exceeding grids is randomly selected, in which all discrete aliquots are laboratory analyzed. These discrete results are then added to discrete aliquot data produced for exceeding grids. 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 non-exceeding grids but not greater than 10.

For each grid, the aliquot exceedance rate is computed based on the appropriate ecological benchmarks. The resulting rates are then listed according to the ascending order of their corresponding composite values, as listed in Table 2. Using these results, then the average aliquot exceedance rates are computed in the ascending grids (i.e., all grids having a composite value equal or less than the given grid). Such results allows the analyst to identify the composite concentration beyond which ascending average aliquot exceedance rates is greater than a pre-determined level, *e.g.* 5%. This composite threshold value is then considered as the area-specific trigger level. The trigger values for the example copper dataset based on the above three ecological benchmarks are listed in Table 2.

Consistent with the FDEP's recommendation, the final area-specific trigger levels must meet the following criteria: (1) trigger levels shall be determined on a chemical- and area-specific basis; and 2) if the empirically derived trigger level exceeds the chemical-specific PEC (or PEC equivalent) benchmark then the benchmark shall be used as the trigger level.

Upon the above determination, all grids associated with composite concentrations in excess of the trigger level either will be remediated in their entirety, or their discrete samples will be laboratory analyzed for all contaminants of concern and investigated in a manner similar to other previously analyzed discrete samples. This supplementary step: (a) enhances the conservative basis of the protocol, (b) reduces the chances of false negatives consistent with area-specific results, and (c) avoids reliance of arbitrary trigger levels, such as 1/10 of a benchmark.

As the final comments of FDEP indicate, although the above approach reduces the likelihood of false negatives, it does not eliminate the chances of such occurrences. The question that immediately arises is whether the proposed approach leaves unreasonable data gaps regarding undetected hot spots. For this purpose, the following must be considered:

- The majority of hot spots are likely to occur within grids associated with composite concentrations in excess of trigger values. Therefore, although such hot spots may go undetected individually, they will be addressed collectively through proposed grid-wide remediations or further investigation.

- Under the proposed approach, the chances of missing isolated hot spots in non-exceeding grids, *i.e.* grids with composite concentrations less than trigger values, will be maintained below a pre-determined level, *e.g.* 5%. Given the fact that non-exceeding grids cover only parts of the area, the cumulative extent of undetected, isolated hot spots on an area-wide basis will always remain below the pre-determined level.

- The cumulative extent of undetected, isolated hotspots is further reduced by the fact that in the revised approach, based on the FDEP's recommendation, trigger values are ensured to remain at or below their corresponding benchmark criteria, i.e. the final chances of missing isolated hot spots in non-exceeding grids will always be at or below the pre-determined level.

- Regardless of sampling density, any field measurement entails the likelihood of a false negative. As EPA guidance (1989, page 2-1) states the question is: "*How can you balance the two sets of possibilities: the chance that the site is contaminated even when the sampling shows attainment of the cleanup standard, and the chance of contamination when the majority of samples taken show the site to be clean? The answer is to evaluate the potential magnitude of these two errors and balance them using the statistical strategies described in* [EPA (1989)]." This is exactly how SFWMD approached the problem and addressed it in accordance with EPA Guidance (EPA, 1989).

Considering the above, SFWMD concludes that the proposed sampling protocol provides a balanced approach, which maintains the chances of false negatives at a reasonable level. Language addressing FDEP's concerns regarding the accumulation of risk based on unidentified, small hot spots will be included as an uncertainty in all future risk assessments.

5.2 Random Selection of Grids

As noted, the protocol prescribes random selection of a pre-determined number of 50-acre grids for composite sampling and analysis in very large properties (>1000 acres). FDEP raised concerns about the fact that such random selections may lead to data gaps and uneven sampling of the property resulting in under-representation of large portions of the property.

Theoretically, the homogeneity of the delineated properties mitigates concerns about potential gaps and under-representations. In fact, the ERA Phase I investigation is primarily focused on ensuring the homogeneity of the investigated properties by excluding potential hotspots and point sources. The chance, however, exists that random selection of grids may leave certain zones of a property under-represented.

To address the above concern SFWMD proposes to divide very large properties into super-grids, each consisting of about 25 50-acre grids, and then randomly select a pre-determined number of grids from each super-grid. This stratified random sampling, which is consistent with EPA Guidance (EPA, 1989, Section 6.5.2.2), addresses the coverage issue, while preserving the unbiased nature of the sampling process, without undue increases in the overall cost of the sampling or analysis effort.

5.3 Analysis of Composite Data

FDEP has raised a number of comments concerning the use of composite data in remedial computations and decisions, specifically with regards to maximum and the upper confidence level of the mean (UCL) computations. Comments indicate that the main concerns stem from the apparent treatment of composite values, which are physical averages of a finite number of aliquots, as discrete values.

Any sample is representative of a given volume. The use of discrete and composite data is predicated on the following fundamental requirements that are already imbedded in the protocol, including:

- Samples representative of different volumes shall not be mixed in any statistical computations. For example, the UCL of the mean concentration over an area cannot be calculated based on a mixture of composite and discrete samples.

- Estimates, such as mean or maximum concentration, computed based on composite or discrete samples, shall be considered as representative of the volumetric base of their constituent sample data.

- ERA decisions must be made based on sample data that have volumetric bases consistent with the given decision.

The computational procedures in the protocol are based on strict separation of composite and discrete samples. These procedures fully recognize the fact that composite data generally have lower standard deviations when compared to discrete datasets. However, many statistical procedures have self correcting mechanism to account for such differences. For example, discrete data are usually more numerous than composite data, *e.g.* Table 1. However, when calculating the UCL, the higher standard deviation of the discrete aliquot copper data is compensated by their larger sample size. As a result, UCLs of the mean based on both discrete and composite data would yield nearly similar results. As listed in Table 3, in the example dataset, although discrete aliquots have a higher standard deviation, due to their much larger number, yield a lower UCL when compared to the one calculated based on composite data.

Such self correcting mechanism does not exist for composite sample statistics. For example, on average, the maximum composite concentration in a given property is bound to be less than the maximum discrete concentrations. For example, see Table 3. Use of such sample statistics in an ERA decision is appropriate, if only the volumetric base of the composite data are considered as consistent with the underlying assumptions of the given decision.

5.4 Sufficiency of Composite Data

FDEP has raised concerns about the potential insufficiency of composite datasets for characterizing large properties. In statistical terms, large sample sizes are required for characterization of highly variable contaminants (see EPA, 1989, Box 6.10, page 6-14). The protocol pursues procedures to ensure the homogeneity of the delineated properties. Implicit in this approach is the low level of variability among the contaminants of concern within the delineated area. However, definitive confirmation of the data adequacy occurs upon the completion of the sampling effort when UCL of the mean over the entire area is computed.

Given the unbiased and representative nature of composite samples, if the computed UCL is less than ecological benchmarks, then consistent with EPA guidance (EPA, 1989, Section 6.4.3), the property as a whole can be considered as clean and the sample size can be viewed as adequate. In contrast, if the resulting composite data display high variability, then the computed UCL may exceed ecological benchmarks, even when the computed mean is low. Under such a condition, the sample size can be viewed as inadequate for determining the clean status of the property.

If data inadequacy is determined, specific alternative can be pursued, including: (a) additional grid sampling; or (b) segregating grids that cause elevated standard deviations and repeat the process for each part separately. The segregation of composite data into statistically homogeneous subsets can be accomplished using techniques, such as the probability plot analysis (DON, 2002).

The above post-sampling analyses not only provide appropriate data for ERA decisions, but also confirm the sufficiency of the data to reach the appropriate decision.

5.5 The Use of Copper Benchmarks

Comments from FDEP have indicated concern over the application of the TEC and PEC copper benchmarks along with the interim benchmark for the protection of the Everglades snail kite. The comments have suggested that the snail kite benchmark appears to supersede all other values in risk assessment conclusions and risk management decisions.

Current SFWMD practice is to analyze all discrete 5-acre grid subcells from sampled 50-acre grid cells for copper. As a result, copper is evaluated in all current SLERAs conducted at citrus farms on a discrete sample basis only. This is an example of a protocol change made in response to agency (USFWS) comments.

In practice, all copper data are screened against the TEC. If the maximum concentration (grid composite or discrete sample) exceeds the TEC, the copper distribution is further evaluated by identifying the (discrete) grid cells in which the TEC or the PEC is exceeded. The results are presented in reports. Copper concentrations in all samples are also compared to the 85-ppm snail kite benchmark and the locations exceeding this value are identified.

Based on the results of the SLERA, risk managers at SFWMD make decisions on corrective actions and/or decisions to do more extensive ecological risk analysis, including toxicity testing, bioaccumulation testing, and elutriate testing as appropriate to the chemicals and receptors identified in the Phase II analysis.

Remediation for copper is usually based on exceedance of the snail kite screening value (85 ppm). Toxicity test results used for development of the SQAGs indicate that the 85-ppm value is protective of benthos. The snail kite value is approximately 57% of the copper PEC (150 mg/Kg). Although specific data for copper are not available for review, FDEP (2003) indicates that an average PEC-quotient (PEC-Q) less than 0.5 (50%) for all chemicals combined corresponds to less than 20% toxicity in laboratory tests (See Attachment A, Table 4.10). This also applies to PEC-Q for combined metals (see Table 2 in USEPA 2000). This percentage is within the range corresponding to identification of TECs (See Attachment A, Table 4.8). Therefore, site management decisions made to protect snail kites based on this value appear to be protective of benthic invertebrates.

5.6 Overall Protectiveness of the ERA Process for the Aquatic Community

Comments received from FDEP have indicated that the use of the PEC value for screening purposes is not acceptable and have suggested the use of the PEC divided by a safety factor (i.e., 1/10 of the PEC) for use in the SLERA. FDEP comments also suggest that risk from combinations of chemicals (i.e., cumulative risks) are not adequately represented, and that sediment toxicity testing should be used to assess this aspect of risk to benthos.

SFWMD disagrees that 1/10 PEC should be used as a screening value. In response to past comments from FDEP and USFWS, the ERA screening process that is implemented is more conservative than described in the guidance and essentially equivalent to what FDEP has suggested. The process described above for copper is also applied to all other chemicals detected at each site. All chemical results are first screened against the TEC. For properties smaller than 500 acres this means that each 5-acre parcel is screened. For larger properties, this includes 50-acre grid composite samples. All screening results are presented in the ERA reports.

FDEP (2003) recommends using a TEC as a screening level, below which adverse effects on benthics is considered unlikely. For most organic chemicals, the TEC is less than 20% of the PEC, and for many important insecticides, less than 10% (Table 4). For metals, the ratio is higher, but still protective based on the RMGs described in previous sections. Therefore, the level of conservatism implied by screening against the TEC is near that requested for composite samples in FDEP's comment.

To address the issue of a cumulative risk to benthos from multiple chemicals, SFWMD proposes adding the PEC-quotient (PEC-Q) method to the screening process (FDEP 2003). Based on data presented by FDEP (2003), the SFWMD proposes to use a mean PEC-Q of 0.5 as a screening level. Samples from the Southeastern US with mean PEC-Q values less than 0.5 exhibited detectable toxicity in less than 20% of samples (See Attachment A, Table 4.10). FDEP guidance relies upon TECs as screening levels, and TECs typically represent concentrations at which 15-30% of toxicity tests show positive results (See

Attachment A, Table 4.8). Therefore, a PEC-Q corresponding to equivalent toxicity would offer similar protection.

Results could be used to determine whether corrective actions can be used to reach acceptable conditions. If corrective action decisions cannot be made on the basis of the above, then an expanded ERA will be performed for the site. The scope for the expanded ERAs is dependent upon results of the SLERA, and on site-specific conditions and data needs. In the past, the expanded risk assessments have included toxicity testing to varying degrees. Use of toxicity testing as part of an expanded ERA may be considered. SFWMD proposes that standard testing procedures be used to maintain consistency.

5.7 Bioaccumulation and Toxicity Testing Studies

In cases where expanded ERAs are necessary, additional data are required that allow the ERA to move beyond the typical SLERA stage. The USFWS/SFWMD guidance document provides some examples of the types of testing that could be done as part of an expanded ERA. Comments received from FDEP have provided additional suggestions.

In current practice, the use of expanded ERAs has been minimal. The Phase I/Phase II ESA process associated with the acquisition process requires relatively quick turn-around in the initial 'screening' stages. On a project-specific basis, long-term investigations (*e.g.*, long-term bioaccumulation testing) are not feasible in the initial stages. SFWMD practice has been to make conservative decisions on corrective actions to expedite process.

Expanded ERAs have been conducted under USFWS oversight in cases where decisions on corrective actions are not possible based on screening assessments. Such assessments have included bioaccumulation and toxicity testing. Study designs have been based on EPA and ASTM standard methods.

SFWMD is willing to combine data from past bioaccumulation and toxicity testing exercises to glean trends in bioaccumulation rates, and to support the development of South Florida benchmarks based on toxicity test results. Results can be used to help guide use of toxicity tests and bioaccumulation testing in the future.

SFWMD is also willing to consider research, or use of non-standard methods on a separate path. However, schedule and budget constraints in the Phase I/II process must be considered. The SFWMD agrees that additional types of data may be valuable as part of an expanded ERA and that consultation with FDEP can be beneficial to the successful completion of an expanded ERA.

5.8 Additional Analysis for Heavy Metals

The FDEP has requested that the SFWMD consider routinely analyzing soil, sediment, and groundwater samples for metals such as cadmium, chromium, boron, vanadium, nickel, and zinc because these heavy metals may be present in pesticides.

The SFWMD already routinely analyzes samples for cadmium and chromium, as part of the eight Resource Conservation and Recovery Act (RCRA) metals suite. However, these metals have not typically been detected at concentrations to raise any human health or ecological concerns.

A detailed evaluation of agrochemical application is typically conducted as part of the Phase I environmental site assessment (ESA) portion of the CERP ERA process. This evaluation includes interviews with the property manager regarding the type, quantity, timing, and method of application of agrochemicals. The evaluation also typically includes a review of material safety data sheets (MSDS) for chemicals which are handled by the property manager. Based on the SFWMD's experience, the chemicals cited by FDEP as potential components of pesticides have not been noted on any reviewed MSDS. In the event that any of these metals were noted in the MSDS, the analytical suite for the Phase II ESA would be expanded to include these chemicals. The SFWMD does not believe that routine analyses for these metals are warranted. Therefore, the SFWMD proposes to conduct these analyses on a case by case basis, as warranted by the Phase I ESA results.

5.9 Canal Sediment Sampling

The FDEP has suggested expanding the sampling of sediments in site canals as a potential screening tool for the CERP ERA protocol. While limited canal sediment sampling is typically performed as a component of the ERA protocol, the SFWMD's experience indicates that expanded canal sediment sampling is not likely to be an effective screening tool. Currently, canal sediment sampling is typically limited to potential point source areas where run-off of agrochemicals into the canals appears likely. A limited number of canal sediment samples are also typically collected in areas where canals converge or in other areas which the sampler believes would most likely be impacted.

One of the major concerns with using canal sediment sampling as a screening tool is the high potential for false negatives due to the fact that most agricultural canals are dredged on a routine basis. In many cases, the SFWMD has found a complete lack of sediments for sampling, or the chemicals of concern in the site soils have been banned for many years (e.g., DDT) and the canals have been dredged multiple times since the last application.

Additionally, since very few canals originate and terminate on the same property, it is very difficult to conclude whether the sediments in the canal originated on-site or off-site. The presence of absence of a chemical in the canal sediments appears to be a poor predictor of whether the chemical will be detected in the site soils.

Lastly, the presence of contaminants in canal sediments would probably be a minor contributor to ecological risk on agricultural properties after they are converted to water storage or treatment areas. The relatively low contribution to the overall ecological risk is also associated with several factors related to the typical construction characteristics of these projects.

(1) Most of the canals within the areas proposed for flooding are backfilled during construction to promote sheet flow across the storage areas. The backfilling of the canals would eliminate the exposure pathway to contaminated canal for ecological risk.
(2) The canals generally represent a very small percentage of the overall footprint of the eventual project areas, so they do not represent a significant portion of total habitat area when compared to the project scale.
(3) Existing conditions in many remaining canals would typically not be preferred habitat for wading birds and other sensitive receptors due to steep banks that prevent shallow water areas needed for emergent vegetation and that are preferred by wading birds.

If canal segments are to be included in project plans as part of the deepwater refugia, then samples will be collected from segments that are to remain. However, these segments cannot be identified during the Phase I/II process because detailed designs are not available.

5.10 Fish Tissue Sampling

The FDEP has suggested the collection of fish tissue samples from existing canals on agricultural properties as a screening mechanism for evaluating cumulative ecological risk. The SFWMD acknowledges that fish tissue analysis may be an appropriate tool in post-construction monitoring and adaptive management of the CERP projects. However, pre-construction sampling of fish within existing canals would not be an effective tool in making decisions about corrective actions or evaluating post construction conditions.

Foremost, it must be acknowledged that most of the canals on these agricultural properties cross many properties. Both the surface water and fish in these canals move freely between sites. While the home range of smaller fish may be solely within the subject property boundaries, the fish are exposed to water, sediment, and possibly food sources that enter the subject property from upgradient areas. As a result, it would not be possible to infer that any accumulation of agrochemicals in fish tissue is associated with the subject property.

The construction of the CERP projects typically involves significant alteration of the surface water hydrology and habitat on these agricultural sites. Therefore, post-construction conditions are likely to be vastly different from pre-construction conditions. It is likely that most of the existing fauna on these properties would be excluded from the proposed water storage areas due to significant alteration of the habitat during and after the construction stage. For example, most existing fish in the site canals would move off-site during the draining and filling of on-site canals and other disruptive construction activities.

The SFWMD has limited experience that indicates that fish tissue may not be a reliable indicator of sources of contamination in sediments. On one particular site, no significant concentrations of toxaphene were detected in fish tissue samples collected from existing canals where high toxaphene concentrations were present in the soils of the adjacent property. Additionally, the interpretation of the data is likely to require iterative sampling and negotiating access to off-site properties in order to determine whether the source of any identified fish tissue burdens are related to on-site or off-site sources. Such a process is not likely to fit into schedule available during the property acquisition process.

Fish tissue samples collected on a project-wide basis may be good indicators of contaminants that may have the potential to cause risk following construction of the project. Such information could be used to focus on the contaminant types (and associated land uses) that are important to manage or control through design and management of the reservoirs and STAs. However, such samples do not appear to be a useful tool in the relatively narrowly focused decisions associated with the property acquisition Phase I/II process.

6.0SUMMARY

The ecological risk assessment protocol designed and utilized by SFWMD and USFWS represents a defensible and adequate approach to making informed risk management decisions regarding the purchase of property to be utilized in various SFWMD projects.

This document was prepared in order to address several concerns regarding the protocol that have been raised by FDEP. These concerns have been grouped into ten (10) categories and the conclusions reached in each for each of these topics following discussions with FDEP are as follows:

- Reliability of composite samples proposed in large property investigations.

- An area and chemical-specific trigger value that is equal or less than the PEC benchmark (or PEC equivalent benchmark) will be calculated and used to indicate grids requiring discrete sample analysis.

- Random selection of grids for composite sampling and analysis in very large properties.
  - On very large properties, using a 'super-grid' system, blocks of 50-acre grid cells will be created and a random subset of those grids will be sampled in a stratified random sampling design to ensure more uniform sample coverage.

- Analysis of resulting composite data in ERA decisions.
  - Statistical calculations will not mix composite and discreet data and estimates of the mean will be noted as being calculated on a volumetric basis.

- Sufficiency of collected data in agricultural areas of the investigated properties.
  - Additional data may be collected if the non-point source dataset is deemed to be statistically inadequate.
  - Discrete samples will continue to be collected at all known point-source locations

- The use of copper Threshold Effect Concentrations (TECs), Probable Effect Concentrations (PECs) and the interim benchmark for the protection of the Everglades snail kite.
  - A review of the toxicological data used to calculate the TEC and PEC indicates that the interim benchmark for the Everglades snail kite is expected to approximate the benthic toxicity predicted by the TEC and is adequately protective of the aquatic community.

- The overall protectiveness of the process for benthic receptors (i.e. the aquatic community).
  - The PEC-Q approach recommended in the FDEP sediment benchmark guidance document will be utilized as another line-of-evidence in assessing risk to the aquatic community.

- The use of bioaccumulation and toxicity testing studies.
  - Where expanded ERAs are required, SFWMD will consider the use of bioaccumulation studies using both standard and non-standard protocols on a project-specific basis.

- Additional analysis for heavy metals.
  - SFWMD will consider the analysis of heavy metals not included in the standard Phase II investigation on a case-by-case basis if the Phase I investigation indicates their potential presence.

- Canal sediment sampling.
    - If canal segments are to be included in project plans as part of the deepwater refugia, then samples will be collected from segments that are to remain but not as part of the property acquisition Phase I/II process.

- Fish tissue sampling.
    - Fish tissue samples do not appear to be a useful tool in the relatively narrowly focused decisions associated with the property acquisition Phase I/II process; however, their collection will be considered on a project-wide basis.

7.0 REFERENCES

Department of Navy (DON), *"Guidance for Environmental Background Analysis, Volume I: Soil, NFESC User's Guide,"* UG-2049-ENV, April 2002.

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United States Environmental Protection Agency (EPA). *"Prediction of sediment toxicity using consensus-based freshwater sediment quality guidelines."* Prepared by USGS for USEPA. EPA 905/R-00/007. 2000.

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Tables

Table 1. Examples of Aliquot and Composite Copper Data

Area	Grid ID	Grid Number	Aliquot ID	Copper (Aliquot)	Unit	Qualifier	Copper (Composite)	Unit
AG Property	A1	1	A1-1	79	mg/Kg dw		95	mg/Kg dw
AG Property	A1	1	A1-2	200	mg/Kg dw	*	95	mg/Kg dw
AG Property	A1	1	A1-3	50	mg/Kg dw		95	mg/Kg dw
AG Property	A1	1	A1-4	120	mg/Kg dw	*	95	mg/Kg dw
AG Property	A1	1	A1-5	56	mg/Kg dw		95	mg/Kg dw
AG Property	A1	1	A1-6	84	mg/Kg dw		95	mg/Kg dw
AG Property	A1	1	A1-7	74	mg/Kg dw		95	mg/Kg dw
AG Property	A1	1	A1-8	230	mg/Kg dw	*	95	mg/Kg dw
AG Property	A1	1	A1-9	43	mg/Kg dw		95	mg/Kg dw
AG Property	A1	1	A1-10	52	mg/Kg dw		95	mg/Kg dw
AG Property	A2	2	A2-1	37	mg/Kg dw		86	mg/Kg dw
AG Property	A2	2	A2-2	55	mg/Kg dw		86	mg/Kg dw
AG Property	A2	2	A2-3	71	mg/Kg dw		86	mg/Kg dw
AG Property	A2	2	A2-4	85	mg/Kg dw		86	mg/Kg dw
AG Property	A2	2	A2-5	37	mg/Kg dw		86	mg/Kg dw
AG Property	A2	2	A2-6	17	mg/Kg dw		86	mg/Kg dw
AG Property	A2	2	A2-7	2	mg/Kg dw		86	mg/Kg dw
AG Property	A2	2	A2-8	81	mg/Kg dw		86	mg/Kg dw
AG Property	A2	2	A2-9	22	mg/Kg dw		86	mg/Kg dw
AG Property	A2	2	A2-10	36	mg/Kg dw		86	mg/Kg dw
AG Property	A3	3	A3-1	100	mg/Kg dw		90	mg/Kg dw
AG Property	A3	3	A3-2	9	mg/Kg dw		90	mg/Kg dw
AG Property	A3	3	A3-3	73	mg/Kg dw		90	mg/Kg dw
AG Property	A3	3	A3-4	13	mg/Kg dw		90	mg/Kg dw
AG Property	A3	3	A3-5	180	mg/Kg dw	*	90	mg/Kg dw
AG Property	A3	3	A3-6	48	mg/Kg dw		90	mg/Kg dw
AG Property	A3	3	A3-7	5.5	mg/Kg dw		90	mg/Kg dw
AG Property	A3	3	A3-8	53	mg/Kg dw		90	mg/Kg dw
AG Property	A3	3	A3-9	23	mg/Kg dw		90	mg/Kg dw
AG Property	A3	3	A3-10	37	mg/Kg dw		90	mg/Kg dw
AG Property	A4	4	A4-1	120	mg/Kg dw	*	97	mg/Kg dw
AG Property	A4	4	A4-2	190	mg/Kg dw	*	97	mg/Kg dw
AG Property	A4	4	A4-3	25	mg/Kg dw		97	mg/Kg dw
AG Property	A4	4	A4-4	130	mg/Kg dw	*	97	mg/Kg dw
AG Property	A4	4	A4-5	77	mg/Kg dw		97	mg/Kg dw
AG Property	A4	4	A4-6	28	mg/Kg dw		97	mg/Kg dw
AG Property	A4	4	A4-7	50	mg/Kg dw		97	mg/Kg dw
AG Property	A4	4	A4-8	91	mg/Kg dw		97	mg/Kg dw
AG Property	A4	4	A4-9	32	mg/Kg dw		97	mg/Kg dw
AG Property	A4	4	A4-10	45	mg/Kg dw		97	mg/Kg dw
AG Property	A5	5	A5-1	99	mg/Kg dw		120	mg/Kg dw
AG Property	A5	5	A5-2	30	mg/Kg dw		120	mg/Kg dw
AG Property	A5	5	A5-3	150	mg/Kg dw	*	120	mg/Kg dw
AG Property	A5	5	A5-4	26	mg/Kg dw		120	mg/Kg dw
AG Property	A5	5	A5-5	180	mg/Kg dw	*	120	mg/Kg dw
AG Property	A5	5	A5-6	63	mg/Kg dw		120	mg/Kg dw
AG Property	A5	5	A5-7	370	mg/Kg dw	*	120	mg/Kg dw
AG Property	A5	5	A5-8	50	mg/Kg dw		120	mg/Kg dw

Table 1. Examples of Aliquot and Composite Copper Data

Area	Grid ID	Grid Number	Aliquot ID	Copper (Aliquot)	Unit	Qualifier	Copper (Composite)	Unit
AG Property	A5	5	A5-9	19	mg/Kg dw		120	mg/Kg dw
AG Property	A5	5	A5-10	45	mg/Kg dw		120	mg/Kg dw
Biscayne Bay CW	S1	6	S1-A	45.1	mg/kg		20.9	mg/kg
Biscayne Bay CW	S1	6	S1-B	8.13	mg/kg		20.9	mg/kg
Biscayne Bay CW	S1	6	S1-C	12.3	mg/kg		20.9	mg/kg
Biscayne Bay CW	S1	6	S1-D	9.07	mg/kg		20.9	mg/kg
Biscayne Bay CW	S1	6	S1-E	5.97	mg/kg		20.9	mg/kg
Biscayne Bay CW	S1	6	S1-F	5.88	mg/kg		20.9	mg/kg
Biscayne Bay CW	S1	6	S1-G	20.8	mg/kg		20.9	mg/kg
Biscayne Bay CW	S1	6	S1-H	2.9	mg/kg		20.9	mg/kg
Biscayne Bay CW	S1	6	S1-I	13.7	mg/kg		20.9	mg/kg
Biscayne Bay CW	S1	6	S1-J	11.8	mg/kg		20.9	mg/kg
Biscayne Bay CW	S2	7	S2-A	6.66	mg/kg		7.35	mg/kg
Biscayne Bay CW	S2	7	S2-B	12	mg/kg		7.35	mg/kg
Biscayne Bay CW	S2	7	S2-C	7.42	mg/kg		7.35	mg/kg
Biscayne Bay CW	S2	7	S2-D	6.13	mg/kg		7.35	mg/kg
Biscayne Bay CW	S2	7	S2-E	4.36	mg/kg		7.35	mg/kg
Biscayne Bay CW	S2	7	S2-F	17	mg/kg		7.35	mg/kg
Biscayne Bay CW	S2	7	S2-G	11.3	mg/kg		7.35	mg/kg
Biscayne Bay CW	S3	8	S3-A	9.6	mg/kg		6.68	mg/kg
Biscayne Bay CW	S3	8	S3-B	7.33	mg/kg		6.68	mg/kg
Biscayne Bay CW	S3	8	S3-C	15.5	mg/kg		6.68	mg/kg
Biscayne Bay CW	S3	8	S3-D	12.9	mg/kg		6.68	mg/kg
Biscayne Bay CW	S3	8	S3-E	5.81	mg/kg		6.68	mg/kg
Biscayne Bay CW	S3	8	S3-F	3.45	mg/kg		6.68	mg/kg
Biscayne Bay CW	S3	8	S3-G	6.21	mg/kg		6.68	mg/kg
Biscayne Bay CW	S3	8	S3-H	19.3	mg/kg		6.68	mg/kg
Biscayne Bay CW	S3	8	S3-I	18.2	mg/kg		6.68	mg/kg
Biscayne Bay CW	S3	8	S3-J	16	mg/kg		6.68	mg/kg
Biscayne Bay CW	S4	9	S4-A	6.08	mg/kg		4.18	mg/kg
Biscayne Bay CW	S4	9	S4-B	5.64	mg/kg		4.18	mg/kg
Biscayne Bay CW	S4	9	S4-C	4.97	mg/kg		4.18	mg/kg
Biscayne Bay CW	S4	9	S4-D	3.15	mg/kg		4.18	mg/kg
Biscayne Bay CW	S4	9	S4-E	3.12	mg/kg		4.18	mg/kg
Biscayne Bay CW	S4	9	S4-F	2.99	mg/kg		4.18	mg/kg
Biscayne Bay CW	S4	9	S4-G	4.24	mg/kg		4.18	mg/kg
Biscayne Bay CW	S4	9	S4-H	13.1	mg/kg		4.18	mg/kg
Biscayne Bay CW	S4	9	S4-I	13.6	mg/kg		4.18	mg/kg
Biscayne Bay CW	S4	9	S4-J	13.5	mg/kg		4.18	mg/kg
Biscayne Bay CW	S5	10	S5-A	15.6	mg/kg		4.1	mg/kg
Biscayne Bay CW	S5	10	S5-B	21.8	mg/kg		4.1	mg/kg
Biscayne Bay CW	S5	10	S5-C	12.8	mg/kg		4.1	mg/kg
Biscayne Bay CW	S5	10	S5-D	6.63	mg/kg		4.1	mg/kg
Biscayne Bay CW	S5	10	S5-E	2.76	mg/kg		4.1	mg/kg
Biscayne Bay CW	S5	10	S5-F	6.12	mg/kg		4.1	mg/kg
Biscayne Bay CW	S5	10	S5-G	4.2	mg/kg		4.1	mg/kg
Biscayne Bay CW	S5	10	S5-H	2.49	mg/kg		4.1	mg/kg
Biscayne Bay CW	S5	10	S5-I	2.24	mg/kg		4.1	mg/kg

Table 1. Examples of Aliquot and Composite Copper Data

Area	Grid ID	Grid Number	Aliquot ID	Copper (Aliquot)	Unit	Qualifier	Copper (Composite)	Unit
Biscayne Bay CW	S5	10	S5-J	2.66	mg/kg		4.1	mg/kg
Biscayne Bay CW	S6	11	S6-A	9.78	mg/kg		5.29	mg/kg
Biscayne Bay CW	S6	11	S6-B	9.81	mg/kg		5.29	mg/kg
Biscayne Bay CW	S6	11	S6-C	8.26	mg/kg		5.29	mg/kg
Biscayne Bay CW	S6	11	S6-D	16.2	mg/kg		5.29	mg/kg
Biscayne Bay CW	S6	11	S6-E	2.51	mg/kg		5.29	mg/kg
Biscayne Bay CW	S6	11	S6-F	22.3	mg/kg		5.29	mg/kg
Biscayne Bay CW	S6	11	S6-G	3.02	mg/kg		5.29	mg/kg
Biscayne Bay CW	S6	11	S6-H	6.01	mg/kg		5.29	mg/kg
Biscayne Bay CW	S6	11	S6-I	2.16	mg/kg		5.29	mg/kg
Biscayne Bay CW	S6	11	S6-J	2.45	mg/kg		5.29	mg/kg
Biscayne Bay CW	S7	12	S7-A	27	mg/kg		21.8	mg/kg
Biscayne Bay CW	S7	12	S7-B	29.4	mg/kg		21.8	mg/kg
Biscayne Bay CW	S7	12	S7-C	25.3	mg/kg		21.8	mg/kg
Biscayne Bay CW	S7	12	S7-D	18.8	mg/kg		21.8	mg/kg
Biscayne Bay CW	S7	12	S7-E	26.1	mg/kg		21.8	mg/kg
Biscayne Bay CW	S7	12	S7-F	24.3	mg/kg		21.8	mg/kg
Biscayne Bay CW	S7	12	S7-G	23	mg/kg		21.8	mg/kg
Biscayne Bay CW	S7	12	S7-H	23.2	mg/kg		21.8	mg/kg
Biscayne Bay CW	S7	12	S7-I	20.7	mg/kg		21.8	mg/kg
Biscayne Bay CW	S7	12	S7-J	29.2	mg/kg		21.8	mg/kg
Biscayne Bay CW	S8	13	S8-A	27.2	mg/kg		17.6	mg/kg
Biscayne Bay CW	S8	13	S8-B	35	mg/kg		17.6	mg/kg
Biscayne Bay CW	S8	13	S8-C	3.46	mg/kg		17.6	mg/kg
Biscayne Bay CW	S8	13	S8-D	17	mg/kg		17.6	mg/kg
Biscayne Bay CW	S8	13	S8-E	15.5	mg/kg		17.6	mg/kg
Biscayne Bay CW	S8	13	S8-F	14.6	mg/kg		17.6	mg/kg
Biscayne Bay CW	S8	13	S8-G	15	mg/kg		17.6	mg/kg
Biscayne Bay CW	S9	14	S9-A	53.6	mg/kg		28.3	mg/kg
Biscayne Bay CW	S9	14	S9-B	36.6	mg/kg		28.3	mg/kg
Biscayne Bay CW	S9	14	S9-C	30	mg/kg		28.3	mg/kg
Biscayne Bay CW	S9	14	S9-D	23.6	mg/kg		28.3	mg/kg
Biscayne Bay CW	S9	14	S9-E	29.3	mg/kg		28.3	mg/kg
Biscayne Bay CW	S9	14	S9-F	21.8	mg/kg		28.3	mg/kg
Biscayne Bay CW	S9	14	S9-G	42.1	mg/kg		28.3	mg/kg
Biscayne Bay CW	S9	14	S9-H	28.2	mg/kg		28.3	mg/kg
Biscayne Bay CW	S9	14	S9-I	57.4	mg/kg		28.3	mg/kg
Biscayne Bay CW	S9	14	S9-J	57.1	mg/kg		28.3	mg/kg
Biscayne Bay CW	S10	15	S10-A	82.7	mg/kg		7.6	mg/kg
Biscayne Bay CW	S10	15	S10-B	4.57	mg/kg		7.6	mg/kg
Biscayne Bay CW	S10	15	S10-C	10.4	mg/kg		7.6	mg/kg
Biscayne Bay CW	S10	15	S10-D	2.83	mg/kg		7.6	mg/kg
Biscayne Bay CW	S10	15	S10-E	3.81	mg/kg		7.6	mg/kg
Biscayne Bay CW	S10	15	S10-F	6.61	mg/kg		7.6	mg/kg
Biscayne Bay CW	S10	15	S10-G	15.4	mg/kg		7.6	mg/kg
Biscayne Bay CW	S10	15	S10-H	5.92	mg/kg		7.6	mg/kg
Biscayne Bay CW	S10	15	S10-I	5.34	mg/kg		7.6	mg/kg
Biscayne Bay CW	S10	15	S10-J	7.33	mg/kg		7.6	mg/kg

Table 1. Examples of Aliquot and Composite Copper Data

Area	Grid ID	Grid Number	Aliquot ID	Copper (Aliquot)	Unit	Qualifier	Copper (Composite)	Unit
Biscayne Bay CW	S11	16	S11-A	14	mg/kg		10.5	mg/kg
Biscayne Bay CW	S11	16	S11-B	9.32	mg/kg		10.5	mg/kg
Biscayne Bay CW	S11	16	S11-C	8.71	mg/kg		10.5	mg/kg
Biscayne Bay CW	S11	16	S11-D	8.62	mg/kg		10.5	mg/kg
Biscayne Bay CW	S11	16	S11-E	7.69	mg/kg		10.5	mg/kg
Biscayne Bay CW	S11	16	S11-F	9.01	mg/kg		10.5	mg/kg
Biscayne Bay CW	S11	16	S11-G	12	mg/kg		10.5	mg/kg
Biscayne Bay CW	S11	16	S11-H	6.9	mg/kg		10.5	mg/kg
Biscayne Bay CW	S12	17	S12-A	4.75	mg/kg		4.95	mg/kg
Biscayne Bay CW	S12	17	S12-B	4.1	mg/kg		4.95	mg/kg
Biscayne Bay CW	S12	17	S12-C	19.5	mg/kg		4.95	mg/kg
Biscayne Bay CW	S12	17	S12-D	5.36	mg/kg		4.95	mg/kg
Biscayne Bay CW	S12	17	S12-E	5.02	mg/kg		4.95	mg/kg
Biscayne Bay CW	S12	17	S12-F	4.38	mg/kg		4.95	mg/kg
Biscayne Bay CW	S12	17	S12-G	6.35	mg/kg		4.95	mg/kg
Biscayne Bay CW	S12	17	S12-H	3.24	mg/kg		4.95	mg/kg
Biscayne Bay CW	S12	17	S12-I	11.3	mg/kg		4.95	mg/kg
Biscayne Bay CW	S12	17	S12-J	9.65	mg/kg		4.95	mg/kg
Biscayne Bay CW	S13	18	S13-A	4.1	mg/kg		4.89	mg/kg
Biscayne Bay CW	S13	18	S13-B	4.33	mg/kg		4.89	mg/kg
Biscayne Bay CW	S13	18	S13-C	6.2	mg/kg		4.89	mg/kg
Biscayne Bay CW	S13	18	S13-D	3.82	mg/kg		4.89	mg/kg
Biscayne Bay CW	S13	18	S13-E	6.42	mg/kg		4.89	mg/kg
Biscayne Bay CW	S13	18	S13-F	6.81	mg/kg		4.89	mg/kg
Biscayne Bay CW	S13	18	S13-G	4.72	mg/kg		4.89	mg/kg
Biscayne Bay CW	S13	18	S13-H	3.23	mg/kg		4.89	mg/kg
Biscayne Bay CW	S13	18	S13-I	5.4	mg/kg		4.89	mg/kg
Biscayne Bay CW	S13	18	S13-J	26	mg/kg		4.89	mg/kg
Biscayne Bay CW	S14	19	S14-A	3.46	mg/kg		4.71	mg/kg
Biscayne Bay CW	S14	19	S14-B	4.71	mg/kg		4.71	mg/kg
Biscayne Bay CW	S14	19	S14-C	4.65	mg/kg		4.71	mg/kg
Biscayne Bay CW	S14	19	S14-D	4.23	mg/kg		4.71	mg/kg
Biscayne Bay CW	S14	19	S14-E	4	mg/kg		4.71	mg/kg
Biscayne Bay CW	S14	19	S14-F	4.43	mg/kg		4.71	mg/kg
Biscayne Bay CW	S14	19	S14-G	3.96	mg/kg		4.71	mg/kg
Biscayne Bay CW	S14	19	S14-H	4.32	mg/kg		4.71	mg/kg
Biscayne Bay CW	S14	19	S14-I	3.69	mg/kg		4.71	mg/kg
Biscayne Bay CW	S14	19	S14-J	4.59	mg/kg		4.71	mg/kg
Biscayne Bay CW	S15	20	S15-A	4.06	mg/kg		4.36	mg/kg
Biscayne Bay CW	S15	20	S15-B	4.4	mg/kg		4.36	mg/kg
Biscayne Bay CW	S15	20	S15-C	4.69	mg/kg		4.36	mg/kg
Biscayne Bay CW	S15	20	S15-D	4.59	mg/kg		4.36	mg/kg
Biscayne Bay CW	S15	20	S15-E	4.6	mg/kg		4.36	mg/kg
Biscayne Bay CW	S15	20	S15-F	4.24	mg/kg		4.36	mg/kg
Biscayne Bay CW	S15	20	S15-G	4.12	mg/kg		4.36	mg/kg
Biscayne Bay CW	S15	20	S15-H	3.85	mg/kg		4.36	mg/kg
Biscayne Bay CW	S15	20	S15-I	4.39	mg/kg		4.36	mg/kg
Biscayne Bay CW	S15	20	S15-J	4.02	mg/kg		4.36	mg/kg

Table 1. Examples of Aliquot and Composite Copper Data

Area	Grid ID	Grid Number	Aliquot ID	Copper (Aliquot)	Unit	Qualifier	Copper (Composite)	Unit
Biscayne Bay CW	S16	21	S16-A	3.41	mg/kg		3.16	mg/kg
Biscayne Bay CW	S16	21	S16-B	3.8	mg/kg		3.16	mg/kg
Biscayne Bay CW	S16	21	S16-C	3.64	mg/kg		3.16	mg/kg
Biscayne Bay CW	S16	21	S16-D	4.01	mg/kg		3.16	mg/kg
Biscayne Bay CW	S16	21	S16-E	3.08	mg/kg		3.16	mg/kg
Biscayne Bay CW	S16	21	S16-F	4.1	mg/kg		3.16	mg/kg
Biscayne Bay CW	S16	21	S16-G	2.58	mg/kg		3.16	mg/kg
Biscayne Bay CW	S16	21	S16-H	2.54	mg/kg	U	3.16	mg/kg
Biscayne Bay CW	S16	21	S16-I	10.1	mg/kg		3.16	mg/kg
Biscayne Bay CW	S16	21	S16-J	2.82	mg/kg		3.16	mg/kg
Biscayne Bay CW	S17	22	S17-A	2.5	mg/kg	U	4.36	mg/kg
Biscayne Bay CW	S17	22	S17-B	2.62	mg/kg	U	4.36	mg/kg
Biscayne Bay CW	S17	22	S17-C	3.44	mg/kg		4.36	mg/kg
Biscayne Bay CW	S17	22	S17-D	2.23	mg/kg	U	4.36	mg/kg
Biscayne Bay CW	S17	22	S17-E	3.53	mg/kg		4.36	mg/kg
Biscayne Bay CW	S17	22	S17-F	3.5	mg/kg		4.36	mg/kg
Biscayne Bay CW	S17	22	S17-G	5.12	mg/kg		4.36	mg/kg
Biscayne Bay CW	S17	22	S17-H	5.5	mg/kg		4.36	mg/kg
Biscayne Bay CW	S17	22	S17-I	5.11	mg/kg		4.36	mg/kg
Biscayne Bay CW	S17	22	S17-J	4.59	mg/kg		4.36	mg/kg
Biscayne Bay CW	S18	23	S18-A	3.72	mg/kg		4.27	mg/kg
Biscayne Bay CW	S18	23	S18-B	4.31	mg/kg		4.27	mg/kg
Biscayne Bay CW	S18	23	S18-C	5.2	mg/kg		4.27	mg/kg
Biscayne Bay CW	S18	23	S18-D	4.61	mg/kg		4.27	mg/kg
Biscayne Bay CW	S18	23	S18-E	4.75	mg/kg		4.27	mg/kg
Biscayne Bay CW	S18	23	S18-F	4.7	mg/kg		4.27	mg/kg
Biscayne Bay CW	S18	23	S18-G	4.46	mg/kg		4.27	mg/kg
Biscayne Bay CW	S18	23	S18-H	4.88	mg/kg		4.27	mg/kg
Biscayne Bay CW	S18	23	S18-I	4.48	mg/kg		4.27	mg/kg
Biscayne Bay CW	S18	23	S18-J	4.42	mg/kg		4.27	mg/kg
Biscayne Bay CW	S19	24	S19-A	4.61	mg/kg		4.41	mg/kg
Biscayne Bay CW	S19	24	S19-B	5.08	mg/kg		4.41	mg/kg
Biscayne Bay CW	S19	24	S19-C	5	mg/kg		4.41	mg/kg
Biscayne Bay CW	S19	24	S19-D	4.72	mg/kg		4.41	mg/kg
Biscayne Bay CW	S19	24	S19-E	5.21	mg/kg		4.41	mg/kg
Biscayne Bay CW	S19	24	S19-F	5.03	mg/kg		4.41	mg/kg
Biscayne Bay CW	S19	24	S19-G	5.36	mg/kg		4.41	mg/kg
Biscayne Bay CW	S19	24	S19-H	5.55	mg/kg		4.41	mg/kg
Biscayne Bay CW	S19	24	S19-I	5	mg/kg		4.41	mg/kg
Biscayne Bay CW	S19	24	S19-J	4.33	mg/kg		4.41	mg/kg
Conley	C2	25	C2-1	120	mg/Kg dw	V	96	mg/Kg dw
Conley	C2	25	C2-2	11	mg/Kg dw	V	96	mg/Kg dw
Conley	C2	25	C2-3	78	mg/Kg dw	V	96	mg/Kg dw
Conley	C2	25	C2-4	220	mg/Kg dw	V	96	mg/Kg dw
Conley	C2	25	C2-5	110	mg/Kg dw	V	96	mg/Kg dw
Conley	C2	25	C2-6	180	mg/Kg dw	V	96	mg/Kg dw
Conley	C2	25	C2-7	64	mg/Kg dw	V	96	mg/Kg dw
Conley	C2	25	C2-8	180	mg/Kg dw	V	96	mg/Kg dw

Table 1. Examples of Aliquot and Composite Copper Data

Area	Grid ID	Grid Number	Aliquot ID	Copper (Aliquot)	Unit	Qualifier	Copper (Composite)	Unit
Conley	C2	25	C2-9	57	mg/Kg dw	V	96	mg/Kg dw
Conley	C2	25	C2-10	52	mg/Kg dw	V	96	mg/Kg dw
Conley	C4	26	C4-1	93	mg/Kg dw	V	87	mg/Kg dw
Conley	C4	26	C4-2	81	mg/Kg dw	V	87	mg/Kg dw
Conley	C4	26	C4-3	90	mg/Kg dw	V	87	mg/Kg dw
Conley	C4	26	C4-4	75	mg/Kg dw	V	87	mg/Kg dw
Conley	C4	26	C4-5	69	mg/Kg dw	V	87	mg/Kg dw
Conley	C4	26	C4-6	48	mg/Kg dw	V	87	mg/Kg dw
Conley	C4	26	C4-7	40	mg/Kg dw	V	87	mg/Kg dw
Conley	C4	26	C4-8	31	mg/Kg dw	V	87	mg/Kg dw
Conley	C4	26	C4-9	75	mg/Kg dw	V	87	mg/Kg dw
Conley	C4	26	C4-10	51	mg/Kg dw	V	87	mg/Kg dw
Graves	25GC	27	36G	98	mg/kg		110	mg/kg
Graves	25GC	27	32G	68	mg/kg		110	mg/kg
Graves	25GC	27	28G	270	mg/kg		110	mg/kg
Graves	25GC	27	33G	89	mg/kg		110	mg/kg
Graves	25GC	27	29G	98	mg/kg		110	mg/kg
Graves	25GC	27	25G	160	mg/kg		110	mg/kg
Graves	25GC	27	26G	190	mg/kg		110	mg/kg
Graves	25GC	27	30G	120	mg/kg		110	mg/kg
Graves	25GC	27	34G	98	mg/kg		110	mg/kg
Graves	25GC	27	35G	55	mg/kg		110	mg/kg
Graves	25GC	27	31G	83	mg/kg		110	mg/kg
Graves	25GC	27	27G	190	mg/kg		110	mg/kg
L31 N	046	28	046-A	100	mg/kg		160	mg/kg
L31 N	046	28	046-B	190	mg/kg		160	mg/kg
L31 N	046	28	046-C	500	mg/kg		160	mg/kg
L31 N	046	28	046-D	420	mg/kg		160	mg/kg
L31 N	046	28	046-E	180	mg/kg		160	mg/kg
L31 N	046	28	046-F	130	mg/kg		160	mg/kg
L31 N	046	28	046-G	210	mg/kg		160	mg/kg
L31 N	046	28	046-H	130	mg/kg		160	mg/kg
L31 N	046	28	046-I	130	mg/kg		160	mg/kg
L31 N	046	28	046-J	87	mg/kg		160	mg/kg
MacArthur	M22	29	13M	39	mg/kg		100	mg/kg
MacArthur	M22	29	14M	83	mg/kg		100	mg/kg
MacArthur	M22	29	15M	39	mg/kg		100	mg/kg
MacArthur	M22	29	16M	84	mg/kg		100	mg/kg
MacArthur	M22	29	17M	99	mg/kg		100	mg/kg
MacArthur	M22	29	18M	56	mg/kg		100	mg/kg
MacArthur	M22	29	19M	48	mg/kg		100	mg/kg
MacArthur	M22	29	20M	49	mg/kg		100	mg/kg
MacArthur	M22	29	21M	52	mg/kg		100	mg/kg
MacArthur	M22	29	22M	37	mg/kg		100	mg/kg
MacArthur	M23	30	23M	120	mg/kg		120	mg/kg
MacArthur	M23	30	24M	130	mg/kg		120	mg/kg
MacArthur	M23	30	25M	130	mg/kg		120	mg/kg
MacArthur	M23	30	26M	51	mg/kg		120	mg/kg

Table 1. Examples of Aliquot and Composite Copper Data

Area	Grid ID	Grid Number	Aliquot ID	Copper (Aliquot)	Unit	Qualifier	Copper (Composite)	Unit
MacArthur	M23	30	27M	130	mg/kg		120	mg/kg
MacArthur	M23	30	28M	74	mg/kg		120	mg/kg
MacArthur	M23	30	29M	83	mg/kg		120	mg/kg
MacArthur	M23	30	30M	52	mg/kg		120	mg/kg
MacArthur	M23	30	31M	73	mg/kg		120	mg/kg
MacArthur	M23	30	32M	180	mg/kg		120	mg/kg
MacArthur	M55	31	53M	42	mg/kg		60	mg/kg
MacArthur	M55	31	54M	29	mg/kg		60	mg/kg
MacArthur	M55	31	55M	55	mg/kg		60	mg/kg
MacArthur	M55	31	56M	49	mg/kg		60	mg/kg
MacArthur	M55	31	57M	58	mg/kg		60	mg/kg
MacArthur	M55	31	58M	47	mg/kg		60	mg/kg
MacArthur	M55	31	59M	36	mg/kg		60	mg/kg
MacArthur	M55	31	60M	30	mg/kg		60	mg/kg
MacArthur	M55	31	61M	13	mg/kg		60	mg/kg
MacArthur	M55	31	62M	35	mg/kg		60	mg/kg
MacArthur	M117	32	113M	31	mg/kg		100	mg/kg
MacArthur	M117	32	114M	57	mg/kg		100	mg/kg
MacArthur	M117	32	115M	320	mg/kg		100	mg/kg
MacArthur	M117	32	116M	53	mg/kg		100	mg/kg
MacArthur	M117	32	117M	18	mg/kg		100	mg/kg
MacArthur	M117	32	118M	31	mg/kg		100	mg/kg
MacArthur	M117	32	119M	75	mg/kg		100	mg/kg
MacArthur	M117	32	120M	140	mg/kg		100	mg/kg
MacArthur	M117	32	121M	100	mg/kg		100	mg/kg
MacArthur	M117	32	122M	34	mg/kg		100	mg/kg
Marcott	M1	33	M1-1	15	mg/Kg dw	V	120	mg/Kg dw
Marcott	M1	33	M1-2	100	mg/Kg dw	V	120	mg/Kg dw
Marcott	M1	33	M1-3	99	mg/Kg dw	V	120	mg/Kg dw
Marcott	M1	33	M1-4	130	mg/Kg dw	V	120	mg/Kg dw
Marcott	M1	33	M1-5	150	mg/Kg dw	V	120	mg/Kg dw
Marcott	M1	33	M1-6	25	mg/Kg dw	V	120	mg/Kg dw
Marcott	M1	33	M1-7	51	mg/Kg dw	V	120	mg/Kg dw
Marcott	M1	33	M1-8	46	mg/Kg dw	V	120	mg/Kg dw
Marcott	M1	33	M1-9	57	mg/Kg dw	V	120	mg/Kg dw
Marcott	M1	33	M1-10	65	mg/Kg dw		120	mg/Kg dw
Marcott	M2	34	M2-1	45	mg/Kg dw		89	mg/Kg dw
Marcott	M2	34	M2-2	33	mg/Kg dw		89	mg/Kg dw
Marcott	M2	34	M2-3	66	mg/Kg dw		89	mg/Kg dw
Marcott	M2	34	M2-4	56	mg/Kg dw		89	mg/Kg dw
Marcott	M2	34	M2-5	45	mg/Kg dw		89	mg/Kg dw
Marcott	M2	34	M2-6	15	mg/Kg dw		89	mg/Kg dw
Marcott	M2	34	M2-7	14	mg/Kg dw		89	mg/Kg dw
Marcott	M2	34	M2-8	48	mg/Kg dw		89	mg/Kg dw
Marcott	M2	34	M2-9	16	mg/Kg dw		89	mg/Kg dw
Marcott	M2	34	M2-10	29	mg/Kg dw		89	mg/Kg dw
Marcott	M3	35	M3-1	57	mg/Kg dw		86	mg/Kg dw
Marcott	M3	35	M3-2	88	mg/Kg dw		86	mg/Kg dw

Table 1. Examples of Aliquot and Composite Copper Data

Area	Grid ID	Grid Number	Aliquot ID	Copper (Aliquot)	Unit	Qualifier	Copper (Composite)	Unit
Marcott	M3	35	M3-3	33	mg/Kg dw		86	mg/Kg dw
Marcott	M3	35	M3-4	60	mg/Kg dw		86	mg/Kg dw
Marcott	M3	35	M3-5	21	mg/Kg dw		86	mg/Kg dw
Marcott	M3	35	M3-6	51	mg/Kg dw		86	mg/Kg dw
Marcott	M3	35	M3-7	43	mg/Kg dw	V	86	mg/Kg dw
Marcott	M3	35	M3-8	98	mg/Kg dw	V	86	mg/Kg dw
Marcott	M3	35	M3-9	45	mg/Kg dw	V	86	mg/Kg dw
Marcott	M3	35	M3-10	24	mg/Kg dw	V	86	mg/Kg dw
Marcott	M4	36	M4-1	59	mg/Kg dw	V	210	mg/Kg dw
Marcott	M4	36	M4-2	1.2	mg/Kg dw	V	210	mg/Kg dw
Marcott	M4	36	M4-3	96	mg/Kg dw	V	210	mg/Kg dw
Marcott	M4	36	M4-4	4	mg/Kg dw	V	210	mg/Kg dw
Marcott	M4	36	M4-5	22	mg/Kg dw	V	210	mg/Kg dw
Marcott	M4	36	M4-6	19	mg/Kg dw	V	210	mg/Kg dw
Marcott	M4	36	M4-7	18	mg/Kg dw	V	210	mg/Kg dw
Marcott	M4	36	M4-8	80	mg/Kg dw	V	210	mg/Kg dw
Marcott	M4	36	M4-9	23	mg/Kg dw	V	210	mg/Kg dw
Marcott	M4	36	M4-10	31	mg/Kg dw	V	210	mg/Kg dw
Tetley	TC	37	1T	36	mg/kg		40	mg/kg
Tetley	TC	37	3T	54	mg/kg		40	mg/kg
Tetley	TC	37	5T	24	mg/kg		40	mg/kg
Tetley	TC	37	7T	21	mg/kg		40	mg/kg
Tetley	TC	37	9T	23	mg/kg		40	mg/kg
Tetley	TC	37	10T	85	mg/kg		40	mg/kg
Tetley	TC	37	11T	24	mg/kg		40	mg/kg
Tetley	TC	37	12T	42	mg/kg		40	mg/kg

Table 2. Determination of Copper Trigger Levels Using Different Ecological Benchmarks

Benchmark	Rate of Aliquots Exceeding Benchmark					
	85 ppm		TEC (31.6 ppm)		PEC (149 ppm)	
Copper (Composite in ppm)	Individual Grid Rate	Ascending Grid Average	Individual Grid Rate	Ascending Grid Average	Individual Grid Rate	Ascending Grid Average
3.16	0%	0%	0%	0%	0%	0%
4.1	0%	0%	0%	0%	0%	0%
4.18	0%	0%	0%	0%	0%	0%
4.27	0%	0%	0%	0%	0%	0%
4.36	0%	0%	0%	0%	0%	0%
4.36	0%	0%	0%	0%	0%	0%
4.41	0%	0%	0%	0%	0%	0%
4.71	0%	0%	0%	0%	0%	0%
4.89	0%	0%	0%	0%	0%	0%
4.95	0%	0%	0%	0%	0%	0%
5.29	0%	0%	0%	0%	0%	0%
6.68	0%	0%	0%	0%	0%	0%
7.35	0%	0%	0%	0%	0%	0%
7.6	0%	0%	10%	1%	0%	0%
10.5	0%	0%	0%	1%	0%	0%
17.6	0%	0%	14%	2%	0%	0%
20.9	0%	0%	10%	2%	0%	0%
21.8	0%	0%	0%	2%	0%	0%
28.3	0%	0%	50%	4%	0%	0%
40	0%	0%	50%	7%	0%	0%
60	0%	0%	70%	10%	0%	0%
86	0%	0%	70%	12%	0%	0%
86	20%	1%	80%	15%	0%	0%
87	20%	2%	90%	19%	0%	0%
89	0%	2%	60%	20%	0%	0%
90	20%	2%	60%	22%	10%	0%
95	30%	3%	100%	25%	20%	1%
96	50%	5%	90%	27%	30%	2%
97	40%	6%	80%	29%	10%	2%
100	30%	7%	70%	30%	10%	3%
100	10%	7%	100%	32%	0%	3%
110	75%	9%	100%	35%	33%	4%
120	40%	10%	70%	36%	30%	4%
120	40%	11%	80%	37%	10%	5%
120	50%	12%	100%	39%	10%	5%
160	100%	15%	100%	40%	50%	6%
210	10%	14%	30%	40%	0%	6%
Lower Bound of Trigger Level	**95**		**28.3**		**120**	

Note: Composite values corresponding to the highlighted cells define the bounds of the trigger value for the given benchmark based on a cutoff exceedance rate of 5%

Table 3. Descriptive Statistics of Aliquot and Composite Copper Data

Parameters	Aliquot	Composite
Count	362	37
Minimum	1.2	3.2
Maximum	500.0	210.0
Mean	44.7	55.0
Std. Deviation	61.6	54.5
Std. Error	3.2	9.0
95%UCL of Mean	50.0	70.1

Table 4
Florida SQAGs and TEC/PEC Ratio

from: Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. FDEP 2003

Chemical	TEC	PEC	TEC/PEC
Arsenic	9.8	33	0.3
Barium	20	60	0.33
Beryllium	NG	NG	--
Boron	NG	NG	--
Cadmium	1	5	0.2
Chromium	43	110	0.39
Cobalt	50	NG	--
Copper	32	150	0.21
Lead	36	130	0.28
Mercury	0.18	1.1	0.16
Nickel	23	49	0.47
Silver	1	2.2	0.45
Strontium	NG	NG	--
Titanium	NG	NG	--
Zinc	120	460	0.26
Zircon	NG	NG	--
Acenaphthene	6.7	89	0.08
Acenaphthylene	5.9	130	0.05
Anthracene	57	850	0.07
Fluorene	77	540	0.14
Naphthalene	180	560	0.32
Phenanthrene	200	1200	0.17
Benz[a]anthracene	110	1100	0.1
Benzo(a)pyrene	150	1500	0.1
Chrysene	170	1300	0.13
Dibenz[a,h]anthracene	33	140	0.24
Fluoranthene	420	2200	0.19
Pyrene	200	1500	0.13
Total PAHs	1600	23000	0.07
Total PCBs	60	680	0.09
Hexachlorobenzene (HCB)	20	240	0.08
Hexachlorobutadiene (HCBD)	55	550	0.1
Bis(2-ethylhexyl)phthalate	180	2600	0.07
Dimethyl Phthalate	NG	NG	--
Diethyl Phthalate	630	NG	--
Di-n-butyl Phthalate	NG	43	--
Chlordane	3.2	18	0.18
Dieldrin	1.9	62	0.03
Sum DDD	4.9	28	0.18
Sum DDE	3.2	31	0.1
Sum DDT	4.2	63	0.07
Total DDTs	5.3	570	0.01
Endrin	2.2	210	0.01

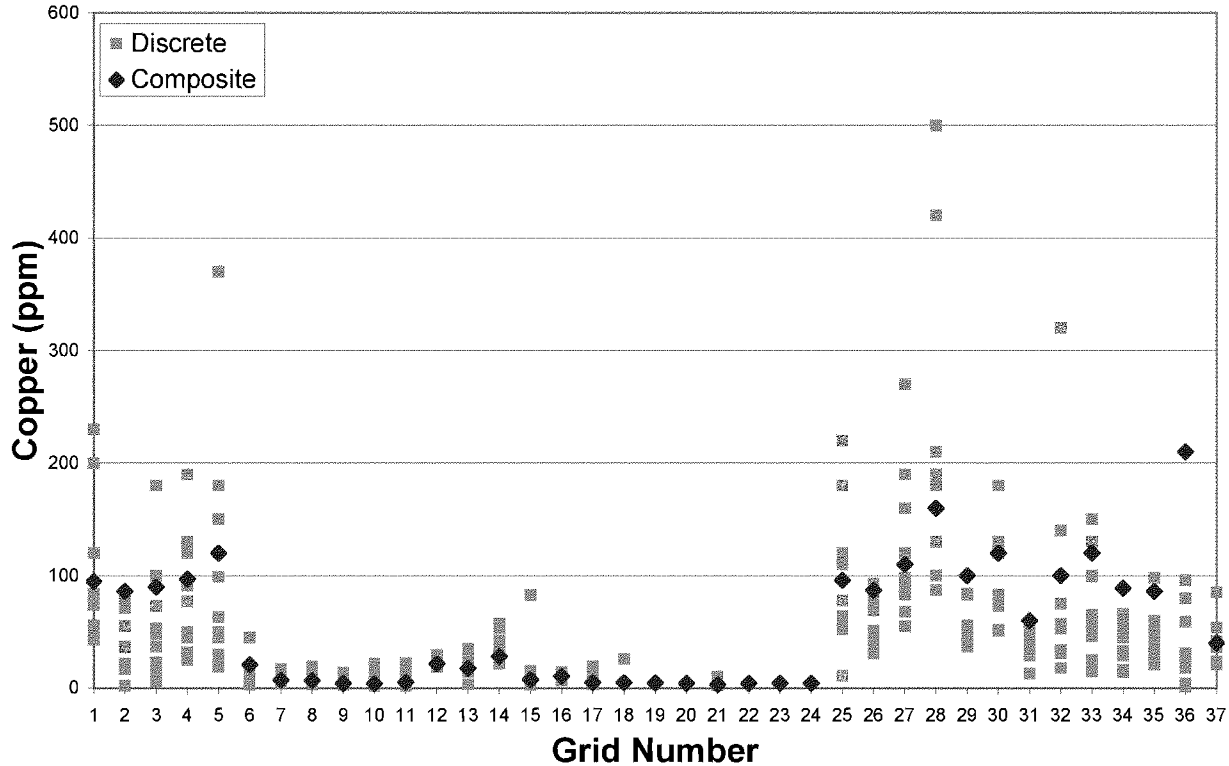
Table 4
Florida SQAGs and TEC/PEC Ratio

from: Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. FDEP 2003

Chemical	TEC	PEC	TEC/PEC
Heptachlor Epoxide	2.5	16	0.16
Lindane	2.4	5	0.48
Azinphos-ethyl	0.018	NG	--
Azinphos-methyl	0.062	NG	--
Diazinon	0.38	NG	--
Ethion	NG	NG	--
Malathion	0.67	NG	--
Methidathion	NG	NG	--
Phosmet	NG	NG	--
Phosphamidon	NG	NG	--
Phoxim	0.06	NG	--
Pyrazophos	0.015	NG	--

Figures

Figure 1. Examples of Composite and Discrete Aliquot Copper Data



Attachment A
Exerpted Tables from:

Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. (FDEP 2003)

Table 4.8. Incidence of toxicity within ranges of contaminant concentrations defined by the sediment quality guidelines (SQGs; from MacDonald *et al.* 2000a)

Substance	Number of Samples Evaluated	Incidence of Toxicity (number of samples in parenthesis)		
		≤TEC	TEC-PEC	>PEC
Metals				
Arsenic	150	25.9% (15 of 58)	57.6% (38 of 66)	76.9% (20 of 26)
Cadmium	347	19.6% (20 of 102)	44.6% (29 of 65)	93.7% (118 of 126)
Chromium	347	28% (37 of 132)	64.4% (38 of 59)	91.7% (100 of 109)
Copper	347	17.7% (28 of 158)	64.0% (48 of 75)	91.8% (101 of 110)
Lead	347	18.4% (28 of 152)	53.6% (37 of 69)	89.6% (112 of 125)
Mercury	79	65.7% (23 of 35)	70.0% (28 of 40)	100% (4 of 4)
Nickel	347	27.7% (51 of 184)	62.7% (32 of 51)	90.6% (87 of 96)
Zinc	347	18.4% (30 of 163)	60.9% (39 of 64)	90.0% (108 of 120)
Polycyclic Aromatic Hydrocarbons (PAHs)				
Anthracene	129	17.3% (13 of 75)	92.9% (26 of 28)	100% (13 of 13)
Fluorene	129	29% (27 of 93)	85.7% (12 of 14)	100% (13 of 13)
Naphthalene	139	24.7% (21 of 85)	94.1% (16 of 17)	92.3% (24 of 26)
Phenanthrene	139	17.7% (14 of 79)	88.2% (30 of 34)	100% (25 of 25)
Benz[a]anthracene	139	17.1% (13 of 76)	70% (14 of 20)	100% (20 of 20)
Benzo(a)pyrene	139	18.5% (15 of 81)	75.7% (28 of 37)	100% (24 of 24)
Chrysene	139	20% (16 of 80)	68.1% (32 of 47)	95.8% (23 of 24)
Fluoranthene	139	25% (24 of 96)	82.5% (33 of 40)	100% (15 of 15)
Pyrene	139	20.5% (16 of 78)	63.0% (29 of 46)	96.4% (27 of 28)
Total PAHs	167	18.5% (15 of 81)	65.1% (43 of 66)	100% (20 of 20)
Polychlorinated Biphenyls (PCBs)				
Total PCBs	120	11.1% (3 of 27)	31.0% (9 of 29)	82.3% (42 of 51)
Organochlorine Pesticides				
Chlordane	193	14.9% (15 of 101)	75.0% (15 of 20)	73.0% (27 of 37)
Dieldrin	180	16.5% (18 of 109)	95.2% (20 of 21)	100% (10 of 10)
Sum DDD	168	19.8% (20 of 101)	33.3% (1 of 3)	83.3% (5 of 6)
Sum DDE	180	18.1% (19 of 105)	33.3% (1 of 3)	96.7% (29 of 30)
Sum DDT	96	23% (23 of 100)	0.0% (0 of 1)	91.7% (11 of 12)
Total DDT	110	17.4% (16 of 92)	100% (23 of 23)	100% (10 of 10)
Endrin	170	29.4% (37 of 126)	40.0% (4 of 10)	NA% (0 of 0)
Heptachlor Epoxide	138	17.8% (16 of 90)	85.0% (17 of 20)	37.5% (3 of 8)
Lindane	180	28.1% (34 of 121)	65.9% (29 of 44)	82.4% (14 of 17)

NA = not applicable; TEC = threshold effect concentration; PEC = probable effect concentration.

Table 4.10. Incidence of sediment toxicity within ranges of meau PEC-Qs for sediments from Florida and elsewhere in the southeastern portion of the United States.

Toxicity Test - Endpoint	n	Avg mean Q	Incidence of Toxicity (number of samples in parentheses)					
			<0.1	0.1 to <0.5	0.5 to <1.0	1.0 to <5.0	≥1.0	≥5.0
10-d *Hyalella azteca* survival	522	0.379	13% (15 of 116)	15% (51 of 339)	30% (14 of 46)	33% (6 of 18)	38% (8 of 21)	67% (2 of 3)
10-d *Hyalella azteca* survival or growth	522	0.379	13% (15 of 116)	16% (54 of 339)	37% (17 of 46)	39% (7 of 18)	48% (10 of 21)	100% (3 of 3)
28-42-d *Hyalella azteca* survival	174	0.549	8% (4 of 53)	13% (11 of 87)	43% (10 of 23)	38% (3 of 8)	45% (5 of 11)	67% (2 of 3)
28-42-d *Hyalella azteca* survival or growth	174	0.549	13% (7 of 53)	24% (21 of 87)	52% (12 of 23)	38% (3 of 8)	45% (5 of 11)	67% (2 of 3)
10-d *Chironomus tentans* survival	133	0.391	19% (5 of 26)	7% (7 of 94)	0% (0 of 9)	0% (0 of 3)	0% (0 of 4)	0% (0 of 1)
10-d *Chironomus tentans* survival or growth	133	0.391	23% (6 of 26)	9% (8 of 94)	33% (3 of 9)	67% (2 of 3)	75% (3 of 4)	100% (1 of 1)
Overall Toxicity	643	0.381	18% (27 of 150)	18% (73 of 406)	43% (26 of 61)	36% (8 of 22)	42% (11 of 26)	75% (3 of 4)

n = number of samples; PEC-Q = probable effects concentration quotient.

3/14/08 FINAL VERSION

ATTACHMENT 1

PROTOCOL FOR ASSESSMENT, REMEDIATION AND POST-REMEDIATION MONITORING FOR ENVIRONMENTAL CONTAMINANTS ON EVERGLADES RESTORATION PROJECTS

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

[1] Hot spots are referred to isolated areas of elevated contaminant concentrations.

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.

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 pre-determined 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 remedial 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 Army Corps of Engineers, 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.

ANNEX I

SEA LEVEL CHANGE ASSESSMENT FOR CENTRAL EVERGLADES PLANNING PROJECT

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I EVALUATION OF THE EFFECT OF SEA LEVEL CHANGE ON THE CEPP

I.1 INTRODUCTION

Per the guidance found in EC 1165-2-121, this paper provides a discussion of the effects of sea level change on the project area as well as on the restoration benefits anticipated to result from the implementation of the Central Everglades Planning Project (CEPP). The CEPP study area is shown in **Figure I-1**. Within the study area, the land elevation is relatively geologically static so this analysis of sea level change impacts covers only scenarios that include rising sea level conditions. The CEPP purpose is to improve the quantity, quality, timing, and distribution of water flows to the central Everglades (WCA 3 and ENP) while decreasing the magnitude and frequency of flows to the northern coastal estuaries (St. Lucie and Caloosahatchee estuaries via the C-43 and C-44). **Figure I-2** shows the project components for the tentatively selected plan (Alternative 4R). The Project will increase water delivery quantities past Tamiami Trail while maintaining water deliveries to the east of the L30 and L31-N canals necessary to maintain existing levels and quality of water supply for Miami-Dade County and Biscayne Bay and decreasing water delivery via the C-43 and C-44 to improve the ecological conditions of the St. Lucie and Caloosahatchee Estuaries. Elevations in the project area range from approximately +6.0 – 0.0 feet NAVD88 with the lowest elevations in the south and along the coastline. The low elevations mean that the project area will be impacted by future sea level rise (SLR) which is projected to be 2 to 6 ft over the next 100 years.

The ecosystem restoration benefits for this project are associated with the decreased frequency and magnitude of freshwater releases to the St. Lucie and Caloosahatchee Estuaries and the rehydration of freshwater wetlands and reduced salinity conditions in nearshore areas of Florida Bay downstream of Taylor and Shark River Sloughs.

I.2 PROJECT AREA ECOLOGICAL SETTING

Portions of the project that are subject to potential impact from SLR are the Northern Estuaries which are located east and west of the Lake Okeechobee and the Everglades Wetlands / Nearshore. A short discussion of the valued ecological components located in these areas and how they are expected to be affected by SLR follows below.

I.2.1 Northern Estuaries

Historically, freshwater flowed as sheetflow south from Lake Okeechobee, through the central part of the state to the estuaries. Water management activities in the past several decades have changed the magnitude, distribution, and timing of sheetflow throughout the Everglades landscape. In the north, water management changes have resulted in an increased magnitude and a change in the timing and distribution of flows to the northern estuaries (greater volume discharges during the wet season from a point source). Restoring historic flow volumes and timing to the northern estuaries will reestablish a salinity range most favorable to juvenile marine fish, shellfish, oysters and submerged aquatic vegetation (SAV) by reducing high volume and minimum discharge events to the estuary.

The effect of SLR on CEPP wetland and estuarine habitat will vary depending upon the location and elevation of the effected lands. In the northern estuaries, habitat coverage is represented by the area encompassing the preferred water depths (0.8-2.8 m) for the desired restored submerged aquatic vegetation species *Halodule wrightii* (Kenworthy and Fonseca 1996; Steward et al. 2005). **Figure I-3** and **Figure I-4** show oyster and sea grass habitat within selected portions of the St. Lucie and Caloosahatchee Estuaries.

Based on the topography and the existing infrastructure, inland impacts from SLR to the northern estuaries will be primarily restricted to increased water depths and saline conditions in the estuaries and canal systems, as the majority of the coastline is built out and protected by seawalls and other hardened structures. Light limitation is commonly the principal factor controlling the distribution of seagrass in the Northern Estuaries. Thus, seagrass beds typically terminate at a deep water edge where light is not sufficient to support photosynthesis. This deep water boundary or maximum depth limit can be quantified based on monitoring (Steward et al. 2005). As the Northern Estuaries deepen in response to rising sea level, the deep water edge of seagrass habitat throughout the basin will migrate upslope. In response to sea level rise, the relative depth of the deep water edge in each sub-basin or segment will not change. Suitable SAV habitat in the northern estuaries is expected to contract with SLR as the hardened shoreline restricts inward movement of the coastline and the creation of new suitable estuarine habitat. The result is increased water depths beyond the preferred range for the desired restored submerged aquatic vegetation species, *Halodule wrightii*. Habitat loss may be even higher in areas of the basin impaired by persistent pollutant loading and poor water quality.

Sea level rise during the next century will increase the exchange and circulation of Atlantic Ocean water with waters in the Caloosahatchee Estuary, Indian River Lagoon and the St. Lucie Estuary. The effect of this would be a more saline condition overall and a shift in salinity ranges and their location within the estuary. This shift could affect the location and health of most of the flora and fauna in the estuary including freshwater SAV, oysters, benthic communities and shoreline vegetation. In the Caloosahatchee River Estuary, a one dimensional hydraulic analysis was completed to determine the potential effects of sea level rise on the salinity distribution in the estuary (Hanks and Fitz 2005). The hydraulic analysis indicated that under current management strategies, a 0.9 m rise in mean sea level could result in a 4.5 psu increase at the regulatory compliance monitoring location at Ft. Myers which is 18 kilometers upstream of the mouth of the river at San Carlos Bay. Total inflow to the estuary would need to be increased from 14.2 m^3/s to 22.9 m^3/s or approximately 50 percent in order to meet current regulations. Additionally, a 0.9 m rise in sea level could reduce the rate of salinity reduction in the estuary under high freshwater flow conditions from 0.50 psu/day to 0.28 psu/day, with no observable effect on the rate of salinity increase under no flow conditions (Hanks and Fitz 2005).

Salinities and canal stages are also expected to increase in the St. Lucie and Caloosahatchee waterways (C-44, and C43 canals), increasing the probability of urban flooding and saltwater intrusion. On the other hand, the adverse effects of large freshwater releases from Lake Okeechobee to the northern estuaries that reduce salinities below the targets will be dampened to some extent by SLR.

I.2.2 Everglades Wetlands/Nearshore

Sea level rise will affect the southern end of the project area from approximately Tamiami Trail south to Florida Bay. The effect of SLR on CEPP Everglades wetland and estuarine habitat will vary depending upon the location and elevation of the affected lands. SLR will cause saltwater to intrude into groundwater, damaging existing natural vegetation communities, drinking water supplies, etc. Hardened structures, buildout and sea walls will slow but not stop intrusion through highly porous bedrock. **Figure I-5** shows freshwater wetland habitat zones and indicator regions used to evaluate CEPP project benefits. Sea level rise over the next 50 years is not expected to affect habitat zones north of Tamiami Trail making ENP-N the northern most freshwater wetland habitat expected to be affected by SLR. The ENP-N, ENP-S, ENP-SE zones include both freshwater wetland habitat and saltwater wetland habitat. In general, the saltwater wetland habitat within these zones is considered to be the area encompassing the mean high water (0 – 2') as an estimation of the mangrove zone. Freshwater wetland habitat is considered to be wetlands not subject to inundation under mean tide level (MTL) conditions. **Figure I-6** shows the saltwater wetland habitat zones as well as the nearshore habitat zones used to estimate project benefits in this area. Since the project is not expected to substantially affect existing water supply for Miami-Dade County and salinity conditions in nearshore areas of Biscayne Bay, the SLR impact analysis for estuarine habitat is limited to Florida Bay.

Changes in hydrology in the south end of the project area have resulted in the reduction of freshwater volume and duration of flows resulting in shortened wetland hydroperiods, reduced freshwater pooling along the sawgrass/mangrove ecotone, and disrupted sheetflow. The decreased fresh surface and ground water volumes and distribution through Taylor and Shark River Sloughs and the Lower East Coast to Florida Bay, the Lower Southwest Coast, and Biscayne Bay have resulted in a shift from the historic mesohaline conditions to hypersaline conditions in several nearshore areas. The CEPP project is intended to reverse some of these anthropogenic impacts by providing additional flows into northern Everglades National Park to rehydrate freshwater wetlands and enhance nearshore habitat. Restoring pre-drainage volume, distribution, and duration to the south will prolong the pooling of freshwater and increase volume and duration of freshwater to the estuaries (Davis et al. 2005). This increased volume and duration will decrease salinity in Florida Bay and the Lower Southwest Coast, driving the seagrass community and trophic web toward the pre-drainage condition (Rudnick et al. 2005). Maintenance of existing flow volumes and adjustments to timing and distribution to the Lower East Coast under CEPP is intended to result in the maintenance of existing ecological conditions in Biscayne Bay and quantity and quality of water available for Miami-Dade County water supply.

Based on the topography and the existing infrastructure, inland impacts related to SLR over the next 50 years will likely be limited within the southern portion of the Everglades landscape. The lack of hardened structures and/or natural topographic flow barriers along the southern coastal wetlands adjacent to Florida Bay and the Lower Southwest Coast will allow for largely unimpeded intrusion of saline waters inland as a function of SLR. It is anticipated the white zone habitat and mangrove forest will move north into the sawgrass habitat areas and the salt water front in the groundwater will move inland. Nearshore shallow estuarine habitat that is targeted for salinity improvement by this project will slowly move inland as MSL comes up. Peat soils may decompose and disappear as saltwater intrudes into the former freshwater grammanoid marsh areas magnifying the inland impacts of SLR and degrading water quality conditions in Florida Bay and the Lower Southwest Coast.

Many tidal creeks have already disappeared in coastal wetlands as a result of sedimentation and reduced flows. Restoring freshwater flows through the estuary will help maintain open watercourses; however, sea level rise is expected to modify the patterns of connectivity through coastal wetlands and create increased sediment loads (Davis et al. 2005). In addition to SLR, climate change may result in more extreme weather events. Increased temperatures and possible decreased rainfall will likely reduce peat accumulation rates, increase peat loss, and increase the susceptibility of freshwater wetlands to SLR. If SLR is accompanied by an increase in tropical storm intensity and frequency, the rate of soil accumulation may increase and partially offset higher MSL conditions. For example, Hurricane Wilma resulted in approximately 5 cm accumulation of sediment deposits in the mangrove zones in 2005 (Whelan, 2009).

Under higher rates of SLR, the increase in groundwater stages and surface water depths will result in a loss of flood protection for the southern portions of the project area. Increased salinity in the groundwater will result in water quality impacts to public and private water supply along the coastal portions of the project area. Changes to the open/close operating criteria at canal structures in the C-111 basin and others may be instituted as water managers attempt to counteract the effects of SLR on flood protection and salinity control. With no change to water management operations, agricultural lands north of the Everglades National Park panhandle will likely be abandoned and revert to freshwater wetland habitat since farming is likely to be uneconomical in the face of increased flooding and water quality issues.

Given the gentle slope of Taylor and Shark River Sloughs and other areas of the southern glades, SLR is expected to result in the translocation of estuarine nursery habitat northward as MSL increases. Man-made boundaries such as a levee or canal will limit the northward movement of the estuarine environment. Under the lower to moderate SLR projections, it is possible that SLR will actually provide a greater area of estuarine habitat than that presently. This depends upon how long it will take for former freshwater wetland habitat to become viable estuarine habitat. Factors affecting habitat transition include local scale topography, future changes to the landscape resulting from peat soil decomposition, storm event related sediment deposition, and changes to water quality.

I.3 SLR IMPACT ANALYSIS

Corps planning guidance (EC 1165-2-211) calls for evaluating the effects of SLR under multiple scenarios. The multiple scenarios recommended include analysis of sea level rise at low, intermediate and high levels at 20, 50, and 100 years following the completion of project construction. The historic sea level rise as measured at the NOAA Key West tide station is 2.24 mm/yr. Sea level rise has been calculated by the Jacksonville District for the low, intermediate and high scenarios at 5 year intervals per EC 1165-2-212 guidance using the Corps Sea-Level Change Curve Calculator (http://www.corpsclimate.us/ccaceslcurves.cfm). The results of the SLR projections are shown graphically in **Figure I-7**. To assess the impact of SLR on project benefits which are computed under the assumption that 2022 is the initial year of project operations. Estimates of SLR from 1992 going forward and the net SLR with 2022 as the initial year of project operation are summarized in **Table I-1** for the 20 year, 50 year, and 100 year epochs. The net sea level rise going forward at 20, 50, and 100 years are estimated by using the SLR projection curves to subtract the sea level rise that has or will occur between 1992 and 2022. At the low end defined by the historic trend, the expected increased sea level is approximately 0.75 ft over the next 100 years. At the high end, the expected SLR over the next 100 years is 6.7 ft. Note that the Corps climate change guidance does not address change beyond 2100 so estimates of sea level change at 2122 should be used with caution.

I.3.1 Methodology for Assessing Impacts to Project Benefits

The ecological benefits associated with this project are the enhancement of northern estuarine freshwater flow conditions, extension of freshwater wetland hydroperiod, and the improvement (reduction) or maintenance of salinity conditions in the nearshore areas in Florida Bay and downstream of Taylor and Shark River Sloughs. **Table I-2** shows the estimate habitat function (in acres) for the existing condition baseline (ECB) and the net habitat improvement (acres of lift) for the future without condition (FWO) and the with-project condition, Alternative 4R2 (ALT4R2). In this table, the ecological benefit zones that are likely to be impacted by sea level rise are highlighted in pink, yellow and orange. The pink highlighted benefit zones are northern estuary habitat areas that will be subject to sea level rise impacts such as increased salinity and increased depth. These habitat zones are not expected to translocate because of shoreline hardening and natural topographic conditions. The yellow highlight benefit zones are freshwater wetland habitat areas where sea level rise is expected to reduce the area of functional freshwater wetlands due to changes in salinity, increased depth, and loss of peat soils. The orange highlighted benefits zones are those Florida Bay nearshore estuarine habitat zones that are expected to migrate inland as a result of sea level rise due to changes in salinity and increased depth. While the habitat benefits for Florida Bay are expected to be impacted by SLR, they were assumed to be constant in this analysis. In other words, for this analysis loss of estuarine benefits in the Florida Bay zones shown in **Figure I-6** are assumed to be made up by gains in estuarine habitat as freshwater habitat in the ENP-N, ENP-S, ENP-SE zones convert to saltwater habitat. Habitat zones north of Tamiami Trail which acts as a partial barrier are assumed to be unaffected by SLR in this analysis so the benefits estimated for these areas (Water Conservation Areas 1, 2, 3) are not adjusted for SLR impacts. Overall, approximately 50% of the expected project benefits are assumed to be either not impacted by SLR because they will occur in areas not subject to SLR or they are estuarine benefits located in Florida Bay and are expected to not diminish as additional upland areas convert from freshwater to saline habitat.

Table I-1. Total and Net Sea Level Change at Three Epochs for Historic, Intermediate, and High Rate Projections.

		Total Sea Level Change Relative to 1992 Base Epoch Year (Key West Tidal Gauge)			Net Sea Level Change from 2022 Project Start Date		
Time Epoch	Date	Low Projection (Based on Historic Rate at Key West)	Intermediate (Based on NRC Curve I)	High (Based on NRC Curve III)	Low Projection (Based on Historic Rate at Key West)	Intermediate (Based on NRC Curve I)	High (Based on NRC Curve III)
		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
0	2022	0.22	0.30	0.55			
20	2042	0.36	0.58	1.29	0.14	0.28	0.7
50	2072	0.58	1.15	2.95	0.36	0.85	2.4
100	2122	0.94	2.44	7.2	0.72	2.1	6.7

Table I-2. Estimated Habitat function (in acres) for ECB and Net Habitat Lift for FWO and ALT 4R2

		Change from ECB Condition	
Project Region (Zone)	**ECB**	**FWO**	**ALT4R2**
Caloosahatchee Estuary (CE-1)	2839	31231	36199
St Lucie Estuary (SE-1)	2099	300	6148
Total Northern Estuaries	4938	31531	42347
Northeast WCA 3A (3A-NE)	44451	-14817	46921
WCA 3A Miami Canal (3A-MC)	32847	-5474	21899
Northwest WCA 3A (3A-NW)	30970	-704	23228
Central WCA 3A (3A-C)	108414	-2745	2745
Southern WCA 3A (3A-S)	69247	-824	-824
WCA 3B (3B)	55697	-6855	3428
Northern ENP (ENP-N)	57557	-2503	41290
Southern ENP (ENP-S)	124068	2386	45332
Southeast ENP (ENP-SE)	79711	1351	4053
Total Greater Everglades	602962	-30185	188072
Florida Bay West (FB-W)	23693	-3159	17375
Florida Bay Central (FB-C)	9,025	-820	5744
Florida Bay South (FB-S)	16614	-1955	11727
Florida Bay East Central (FB-EC)	21984	-1759	12311
Florida Bay North Bay (FB-NB)	2154	-126	507
Florida Bay East (FB-E)	9440	-755	378
Total Florida Bay	82910	-8574	48042
Total All Regions	690810	-7,228	278461

The evaluation of the project benefits included an estimate of the timeline in which habitat lift would be realized over the project life span. **Table I-3** shows the percent of benefits achieved from year zero through year 100 for the project as estimated for the three habitat regions (northern estuaries, freshwater wetlands, southern estuary). Since benefits increase over time and SLR impacts also increase over time, a histogram of benefits typically has a rising limb followed by falling limb as SLR impacts accrue. Using this timeline for benefit accrual, the 50-year average project benefits are 227,262 habitat units which is about 84 percent of the expected net project benefits of 271,931 habitat units shown in **Table I-2**.

Changes to the area of freshwater wetland were used as an indicator of how these freshwater wetland benefits are likely to be impacted by SLR. To assist in the evaluation of the likely effects of sea level rise on project benefits, the areas where benefits are expected to occur were projected onto flood prediction maps generated under different mean tide level (MTL) conditions. For this assessment, Florida Bay bathymetric data were projected onto the NAVD88 datum using the National Oceanic and Atmospheric Administration (NOAA) VDatum software program. This software is designed to convert different horizontal/vertical references into a common reference level which is necessary when creating maps that incorporate both terrestrial and bathymetric data. A more conservative approach to this analysis would be to use Mean Higher High Water (MHHW) rather than MTL as the reference since ecological systems are affected by changes in salinity which are strongly influenced by MHHW. This was not done because the analysis considered full and immediate loss of peat soils as a conservative estimate of the extent of inland impact. In reality it may take several decades for peat soils to completely collapse.

The mapping of the likely freshwater wetland and estuarine benefit zones were created using difference mapping techniques for the ALT4R2 scenario overlaid with SLR projections of 0', +1', +2', +3', +4' and +5'. For the Everglades Freshwater wetlands (ENP-N, ENP-S, ENP-SE), the total area suitable for freshwater habitat was estimated using the GIS projection of mean tidal level (MTL) at 1 ft increments of sea level rise and topography developed from top of peat survey data or top of rock survey data. Freshwater wetland habitat area loss was then estimated by taking the difference between the existing freshwater wetland habitat function acreage and the projected habitat function acreage for each SLR scenario and time point. Two estimates for each timeframe (20, 50, and 100 years) and SLR scenario (Historic, Intermediate, High rate) were evaluated. One estimate, denoted as "Low", represents expected benefit reduction if peat soils are intact. The other estimate, denoted as "High", represents the expected benefit reduction if peat soils are destroyed by sea level rise related salinity.

The CEPP project will rehydrate portions of the Everglades freshwater wetlands. The additional project provided water will increase groundwater stages and provide more freshwater which should counteract some of the impacts from sea level rise. To determine the maximum reduction in benefit loss due to increased freshwater flows, the net increase in sea level rise was adjusted by subtracting up to 100 percent of the median increase in surface water stage from the estimated increase in sea level rise calculated for the historic, intermediate, and high rate SLR for the 20, 50, and 100 year periods. **Table I-4** shows the median increase in surface water stage for IR129, IR131, and IR133 which are located in ENP-N, ENP-S, and ENP-SE, respectively.

For the northern estuaries SLR benefit impact assessment, the total area suitable for sea grass habitat was estimate for each 1 ft increment of sea level rise using 2.6 to 9.2 feet as the optimum depth range for sea grass. Estimates of benefit loss for the northern estuaries were computed using a ratio of suitable habitat acreage under SLR conditions to suitable habitat acreage without SLR. This methodology does not take into account changes to salinity or light transmittance that both affect sea grass habitat suitability.

Table I-3. Timeline for Achieving Project Benefits by Habitat Region

Percent of Benefits Achieved Over Time						
	Year 5	Year 10	Year 15	Year 20	Year 50	Year 100
Northern Estuaries	0%	50%	75%	100%	100%	100%
Greater Everglades	25%	50%	75%	100%	100%	100%
Florida Bay	17%	33%	50%	75%	100%	100%

Table I-4. Median Change in Surface Water Stage within Everglades Freshwater Wetlands South of Tamiami Trail

Indicator Region	Median Change in Surface Water Stage (ft) for ALT4R2 vs ECB/FWO
	(ft)
IR129 (ENP-N)	0.6
IR131 (ENP-S)	0.25
IR133 (ENP-SE)	-0.2

I.3.2 Estimated Impact to Project Benefits

Table I-5 shows the percent reduction in productive habitat for each zone potentially impacted by salinity. The difference between the "low" and "high" estimates is due to the assumption that the peat soils will remain intact (Low) or the peat soils will be lost and the land elevation will match the top of rock survey (High). The assumption that peat soils will be affected by SLR is critical to the estimation of habitat loss under all three of the sea level rise scenarios and timeframes since it appears that freshwater wetland habitat losses double if peat soils are destroyed by SLR. This is true for all scenarios except the 100 year – high rate scenario where losses of habitat are extensive regardless of whether the peat soils remain or not.

Table I-6 shows the net change in habitat loss due to SLR in comparison to FWO conditions after accounting for changes in the distribution and quantity of freshwater flows that will occur with the CEPP. Specifically, the difference in habitat loss shown in this table is attributable to the assumption that increases or decreases in surface water stages will alter the impact of sea level rise. Since no increase in surface water stages within the Caloosahatchee and St. Lucie Inlet is expected with CEPP, habitat loss for FWO is assumed to be similar to the with-project condition (ALT4R2). For ENP-N, ENP-S, and ENP-SE, the net increase in sea level rise was adjusted based upon the median difference between surface water stages with the project and without the project as determined at the indicator regions shown in **Table I-4**. For the northern everglades wetlands, ALT4R2 is expected to increase the surface water stage by 0.6 ft. For the southern everglades ALT4R2 is expected to increase the surface water stage by 0.25 ft. For the southeastern everglades, ALT4R2 is expected to decrease surface water stages by 0.2 ft. For the ENP-N habitat zone, there is little difference between the FWO and ALT4R2 except under high rate SLR conditions particularly at the 100 year time point. This is largely because the ENP-N habitat zone is expected to be largely un-impacted by SLR except in the distant future or under extreme SLR conditions. The increase in surface water stages under ALT4R2 for the ENP-S habitat zone may reduce freshwater wetland habitat loss by 0 to 14 percent depending upon the SLR scenario, timeframe, and topography assumption. Relative to FWO, ALT4R2 performs best under the historic and intermediate SLR scenarios for ENP-S. The difference between FWO and ALT4R2 under the high rate scenario is no larger than 6 percent which is likely due to the fact that the high rate scenario SLR overwhelms the limited increase in surface water stage under ALT4R2. The decrease in surface water stages under ALT4R2 for the ENP-SE habitat zone may increase freshwater wetland habitat loss by up to 12 percent depending upon the SLR scenario, timeframe, and topography assumption. The increased loss of habitat in ENP-SE under ALT4R2 is the result of reduced flows to Taylor slough relative to FWO conditions.

Table I-5. Range of Habitat Loss for ALT 4R2

	Percent of Available Habitat Lost					
	Historic		Intermediate		High	
	Low	High	Low	High	Low	High
20-year Impact						
Caloosahatchee SAV		1%		2%		7%
St. Lucie Inlet SAV		3%		8%		22%
ENP N Freshwater Wetlands	0%	0%	0%	0%	0%	0%
ENP S Freshwater Wetlands	1%	2%	5%	9%	11%	21%
ENP SE Freshwater Wetlands	9%	20%	12%	27%	21%	49%
50-year Impact						
Caloosahatchee SAV		2%		5%		32%
St. Lucie Inlet SAV		8%		20%		38%
ENP N Freshwater Wetlands	0%	0%	0%	0%	0%	26%
ENP S Freshwater Wetlands	3%	5%	15%	28%	39%	68%
ENP SE Freshwater Wetlands	15%	34%	27%	60%	53%	69%
100-year Impact						
Caloosahatchee SAV		4%		15%		44%
St. Lucie Inlet SAV		15%		28%		58%
ENP N Freshwater Wetlands	0%	0%	0%	14%	58%	100%
ENP S Freshwater Wetlands	14%	26%	41%	66%	100%	100%
ENP SE Freshwater Wetlands	25%	56%	52%	69%	100%	100%

*Low – Estimate computed using top of peat soil topographic survey.

*High – Estimate computed using top of rock topographic survey.

Table I-6. Net Change in Habitat Loss Due to SLR

Change in Habitat Loss Due to the Project (FWO - ALT4R2)						
	Difference in Percent Habitat Lost					
	Historic		Intermediate		High	
	Low	High	Low	High	Low	High
20-year Impact						
Caloosahatchee		0%		0%		0%
St. Lucie Inlet		0%		0%		0%
ENP N Freshwater Wetlands	0%	0%	0%	0%	0%	0%
ENP S Freshwater Wetlands	3%	6%	3%	6%	8%	14%
ENP SE Freshwater Wetlands	-5%	-12%	-5%	-12%	-5%	-12%
50-year Impact						
Caloosahatchee SAV		0%		0%		0%
St. Lucie Inlet SAV		0%		0%		0%
ENP N Freshwater Wetlands	0%	0%	0%	0%	0%	14%
ENP S Freshwater Wetlands	8%	15%	10%	18%	4%	4%
ENP SE Freshwater Wetlands	-6%	-13%	-6%	-11%	-5%	-1%
100-year Impact						
Caloosahatchee SAV		0%		0%		0%
St. Lucie Inlet SAV		0%		0%		0%
ENP N Freshwater Wetlands	0%	0%	0%	24%	14%	0%
ENP S Freshwater Wetlands	8%	15%	0%	6%	0%	0%
ENP SE Freshwater Wetlands	-6%	-13%	-5%	-1%	0%	0%

Table I-7 shows the estimated total project habitat units for the 20, 50, and 100 year timeframes under the three SLR scenarios as well as the 50-year average net benefits for each scenario for ALT4R2. Results are shown for the "Top of Rock" and "Top of Peat" topographic survey assumptions as well as with-hydrologic adjustment and without-hydrologic adjustment. **Table I-8** shows the percent of total habitat lost at 20, 50, and 100 years under the scenario that additional ALT4R2 CEPP flows counteract SLR impacts and that all of the peat soils within the MTL affected area are lost. In terms of total habitat units, the SLR scenario assumptions result in a maximum of 8 percent reduction in total habitat units at the 20-year timeframe, 22 percent difference in habitat units at the 50-year timeframe, and up to 39 percent difference in habitat units at the 100-year timeframe. However from **Table I-7**, the 50-year average net project habitat lift does not vary more than a couple percent across any of the SLR rate scenarios or due to the assumptions for peat soils or project related hydrology. The net project habitat lift shown in **Figure I-8** indicates very little reduction in lift for the historic and intermediate SLR scenarios at year 50 and a reduction in Year 50 lift for the High Rate Scenario of approximately eight percent when compared to the no SLR scenario. However, in total habitat terms (**Figure I-9**), the High Rate Scenario indicates 22 percent reduction of the habitat units at Year 50 when compared to the no-SLR scenario. The impact of SLR on net benefits is less than that of total habitat units because SLR impacts will affect FWO habitat conditions in a fashion similar to the with-project condition.

As a simplification, this analysis assumed no gain or loss in estuarine habitat due to uncertainty in the rate at which former freshwater wetland acreage converts to functional estuarine habitat. Within the approximately 470,000 acres of Florida Bay considered in the CEPP benefit analysis, approximately 200,000 acres of the bay are less than 2 ft deep with approximately 100,000 of those acres less than 1 ft deep. **Table I-9** shows the available estuarine acreage defined as areas inundated up to 2 ft will greater for the first two feet of sea level rise; however, the functionality of this additional estuarine habitat will depend upon the rate at which the freshwater wetlands convert. With three or more feet of sea level rise, the available habitat is less than the acreage at present meeting the 0 to 2 ft depth criteria. Based on the three SLR scenarios (Historic, Intermediate, Low), an additional two feet of SLR is likely to occur between 50 and approximately 200 years into the future.

Figure I-10 shows that total habitat function is higher with CEPP in place under any SLR scenario and timeframe when compared to the FWO condition. The ability of the CEPP project to provide higher habitat functionality when compared to the FWO is a result of two factors: 1) the peak habitat functionality with CEPP is significantly greater than the FWO condition which means that proportional loss due to SLR affects both the CEPP and FWO conditions fairly equally, and 2) increased freshwater flows with CEPP reduce the loss of freshwater habitat within Everglades National Park that would occur under the FWO condition.

Table I-7. Estimated Habitat Units (in acres) at 20, 50, and 100 Year Timeframes and 50-yr Avg Net Habitat Benefits for Three SLR Rate Scenarios for ALT4R2.

No Sea Level Rise					
	Total Habitat Units				Average
Scenario	ECB	20 YR	50 YR	100 YR	Net
TOP/ No Stage Adjustment	690,810	957,261	969,271	969,271	225,535
Historic Rate of Sea Level Rise					
	Total Habitat Units				Average
Scenario	ECB	20 YR	50 YR	100 YR	Net
TOP / No Stage Adjustment	690,810	946,913	941,561	913,237	222,932
TOR / No Stage Adjustment		937,316	915,771	861,058	220,880
TOP / 50% Stage Adjustment		947,327	946,186	917,916	224,536
TOR / 50% Stage Adjustment		937,179	923,378	868,754	223,099
TOP / Full Stage Adjustment		947,741	950,811	922,595	226,140
TOR / Full Stage Adjustment		937,032	930,966	876,449	225,312
Intermediate Rate of Sea Level Rise					
	Total Habitat Units				Average
Scenario	ECB	20 YR	50 YR	100 YR	Net
TOP / No Stage Adjustment	690,810	936,823	905,602	852,141	220,146
TOR / No Stage Adjustment		918,231	846,825	745,348	215,708
TOP / 50% Stage Adjustment		937,238	911,042	850,065	222,003
TOR / 50% Stage Adjustment		918,102	855,774	761,080	218,344
TOP / Full Stage Adjustment		937,652	916,805	847,861	223,960
TOR / Full Stage Adjustment		917,955	867,652	777,786	221,887
High Rate Sea Level Rise					
	Total Habitat Units				Average
Scenario	ECB	20 YR	50 YR	100 YR	Net
TOP / No Stage Adjustment	690,810	906,777	841,237	622,771	214,915
TOR / No Stage Adjustment		861,795	734,394	595,216	202,910
TOP / 50% Stage Adjustment		911,079	842,743	622,771	217,431
TOR / 50% Stage Adjustment		868,871	743,866	595,216	208,848
TOP / Full Stage Adjustment		915,382	843,739	636,458	219,790
TOR / Full Stage Adjustment		875,948	754,584	595,216	215,172

Table I-8. Percent Total Habitat Loss at 20, 50, and 100 Years, Assuming Top of Rock, and Full Stage Adjustment for ALT4R2.

Percent Total Habitat Lost Due to SLR			
Sea Level Rise Scenario	20 YR	50 YR	100 YR
Historic SLR	2%	4%	10%
Intermediate SLR	4%	10%	20%
High Rate SLR	8%	22%	39%

Table I-9. Change in Everglades Estuarine Habitat Due to Sea Level Rise for ALT4R2.

Change in Estuarine Habitat						
		Increase in Sea Level Rise (ft)				
		0	1	2	3	5
		Acres of Estuarine Habitat Meeting Depth Criteria				
Southern ENP (ENP-S)						
	0 to 2 ft deep	4,035	34,912	58,694	53,354	2,100
	> 2 ft deep	-	191	4,035	72,972	85,299
Southeast ENP (ENP-SE)						
	0 to 2 ft deep	9,241	72,119	87,318	50,197	83,700
	> 2 ft deep	345	853	9,636	35,102	126,326
Existing Florida Bay Habitat						
	0 to 1 ft deep	71,970	-			
	1 to 2 ft deep	31,152	71,970			
	> 2 ft deep	287,164	318,316	390,286	390,286	390,286
Total Estuarine Habitat						
	0 to 2 ft deep	116,398	179,001	146,012	103,551	85,800
	> 2 ft deep	345	73,014	13,671	108,074	211,625

I.3.3 Discussion

The estimation of benefit loss for the Everglades is based on the GIS mapping analysis presented in **Figure I-11** through **Figure I-14**. In these figures for the 1 ft and 2 ft SLR scenarios, the grey area represents the probable limits of the freshwater habitat, the light blue areas are transitional wetlands with some impact from increased salinity, and the dark blue area represents areas that are greater than 2 ft deep and likely to be fully estuarine habitat. The maps with complete peat loss show that SLR impacts will extend inland several miles particularly in Shark River Slough which presently has thick peat soils.

Loss in freshwater wetland benefits to ENP-S and ENP-SE will occur in the southern portions of the regions as increased salinity causes a shift from freshwater vegetation to saline tolerant vegetation.

These newly created saltwater wetland habitat will result in the expansion of the Florida Bay North, West, Central, East-Central, and East estuarine zones. Benefit gain in the Florida Bay zone is dependent on the rate of landscape transformation from a mangrove/gramminoid marsh community to a nearshore estuarine environment and may not be completely realized 20 years post-saltwater inundation. This results of this analysis assumed that estuarine habitat remains constant over the period of the analysis though Table 9 shows that available estuarine habitat area will increase given up two feet of SLR. This additional estuarine acreage is not counted in the benefits assessment because it is difficult to predict how quickly and to what extent it will be functional. Given the gentle slope of the topography of Taylor Slough and Shark River Slough and the lack of man-made barriers such as levees or canals, it is unlikely that mesohaline and oligohaline nearshore areas will be completely eliminated by SLR under any scenario in 20 years. However, with high SLR projections in excess of 2 ft there will be a reduction in the 0 to 2 ft estuarine habitat and thus less available area where salinity conditions may be optimal for some mesohaline and oligohaline species. This analysis also does not account for the potential reduction in the severity and duration of hypersaline conditions in Joe Bay, Barnes Sound, Manatee Bay, and Florida Bay proper that results from increased exchange of bay water with ocean water.

Figure I-15 through **Figure I-18** show potential aquatic vegetation habitat under 0 ft and 2 ft of SLR. These maps show much greater potential SAV coverage than the existing aquatic vegetation coverage maps (**Figure I-3** and **Figure I-4**). This difference is likely due to the water quality and substrate limitations that are not explicitly considered in the analysis methodology used to develop the potential SAV habitat maps.

I.4 UNCERTAINTY DISCUSSION

As with the predictions of future rates of SLR, there is uncertainty in the estimation of effects to project related ecosystem benefits due to the accuracy and reliability of the datasets used in this analysis. Two elevation scenarios were used to evaluate SLR impacts to the Everglades: existing topography, and a topographic change due to the degradation and collapse of the existing peat soils in the southern portion of the Project. This based on the understanding that saltwater interactions with peat soils can cause them to collapse resulting in a decrease in elevation allowing for greater spatial impacts inland from SLR. These topographic datasets are known to be accurate to within plus or minus 0.5 ft. In addition to these sources of topographic uncertainty, the benefitted area mapping is based upon the Glades-LECSA Regional Simulation model output that has a surface water stage prediction accuracy estimated at 0.5 ft.

The analysis assumed that Tamiami Trail and the L-29 levee will serve as a barrier to SLR impacts within WCA-3A/B at least the next 100 years. This assumption is reasonable for the historic and intermediate SLR scenarios. Under the high SLR rate scenario, impacts to WCA-3A/B are likely to occur within the next 50 to 100 years, particularly if project features such as the degradation of L-29 levee are not modified to prevent saline waters from traveling north of Tamiami Trail.

Estimates of benefit loss for the Caloosahatchee and St. Lucie waters are based upon the change to the total area with depth between 2.6 and 9.2 ft deep. Since the existing coverage of SAV is much smaller than the total area with optimum depth, and the analysis does not directly take into account salinity or water quality, it is possible that this analysis under-estimates benefit loss in the Caloosahatchee and St. Lucie basins.

Scientific unknowns also present a significant source of uncertainty in the effects and timing of impacts from SLR. It is unclear how quickly and successfully natural area habitat and species can transition or adapt to the range of potential future conditions anticipated due to ongoing and accelerating global climate change. This analysis assumed that estuarine habitat quantity remained unchanged as sea level increases. Topographic and Bathymetric analysis presented here shows that for moderate SLR of up to two feet, available estuarine acreage increases substantially. However, the functionality of this new estuarine acreage is unknown and it will depend upon factors such as water quality that are not incorporated into this analysis.

The distribution of water between the natural system and the developed areas is assumed to be constant in this analysis in part because water made available for the natural system by CEPP will be reserved as part of the project authorization process. However, increased sea level is likely to cause increased saltwater intrusion into coastal freshwater supply wells fields. In response, urban and agricultural water users may seek to shift water deliveries from the natural system (Everglades National Park) towards eastern portions of Miami-Dade and Broward Counties. The degree to which project water reservations will protect natural system water supplies has not been tested in this manner so it presents a risk to project benefits.

Finally, climate change impacts such as changes in temperatures and rainfall patterns, plus the increasing frequency or intensity of extreme weather events (droughts, floods, storms), will make drought conditions more prevalent and require the addition of additional flood protection measures. Decreased water availability and enhanced flood protection are likely to reduce expected project benefits.

I.5 ADAPTIVE MANAGEMENT

To reduce the risk associated with implementing the project, flexibility in the design and operation of features can be incorporated into the project during the planning phases. Also features planned and operated for one purpose can be repurposed as SLR begins to affect water management needs into the future. For instance, the CEPP project will allow much more water to be sent south from Lake Okeechobee to the Everglades. At present the primary function of this additional water is increased hydroperiod within the Everglades Marsh. As the MTL increases, this additional water will provide a buffer of freshwater that will limit salinity related impacts to freshwater wetland vegetation, reduce peat soil degradation, and impede saltwater intrusion into the groundwater aquifer. At some point, the preservation of freshwater wetland habitat within Everglades National Park may require physical intervention particularly within Shark River Slough. One adaptation plan might be to increase the amount of water sent from Lake Okeechobee south. This would likely require additional congressional authorization to either alter the Herbert Hoover Dike or to provide additional water storage capacity and treatment within the Everglades Agricultural Area. One adaptive manage strategy may be to construct a shallow sand berm across Shark River Slough for the purpose of limiting northward tidal flows into peat soil marsh areas. Another adaptive management strategy to address sea level rise may be to use Tamiami Trail and the L-29 levee as a tidal barrier to prevent saltwater intrusion into WCA-3A/B. This would effectively reverse some of the decompartmentalization work included in the CEPP. To maintain estuarine habitat, some limited human assistance may be very helpful, such as planting mangroves in salinity impacted areas upslope to help tidal ecosystems adapt more successfully to higher rates of sea level rise. The purchase of additional uplands for habitat migration would not likely be proposed as an adaptive measure for this project at least within the Everglades Protective Area since most of the project lands affected by future SLR impacts are already in public ownership.

I.6 CONCLUSION

The effects of sea level rise have been analyzed per (EC 1165-2-212). This analysis looked at the effect of SLR on the benefits predicted for the selected alternative (ALT4R2). The results indicate that within the 50-year planning horizon the average annual net project benefits are likely to be reduced by less than 8 percent in comparison to the projected net annual average project benefits estimated assuming no sea level rise. This relatively moderate decrease in average annual project benefits occurs largely because of closely matching habitat losses under the FWO condition. However, when considering total freshwater wetland habitat, sea level rise will substantially reduce this habitat area. For instance, under the high rate sea level rise scenario, total project area habitat function will be reduced by 8, 21, and 37 percent at the 20, 50, and 100 year timelines, respectively. The total habitat function is significantly higher with CEPP in place under any SLR scenario and timeframe when compared to the FWO condition. The ability of the CEPP project to provide substantially higher habitat functionality when compared to the FWO is partly a result of the increased freshwater flows that reduce the loss of freshwater habitat within Everglades National Park.

There is no doubt that SLR over the last 100 years has impacted Shark River and Taylor Sloughs, the southern glades, and the downstream nearshore estuarine habitat. This is evident by the landward migration of the white zone habitat and the abandonment of farming activities in the extreme southern glades. Water management alterations such as the C-111 and L-32N canals have likely exacerbated the impact of past SLR by substantially reducing surface and groundwater deliveries to Taylor Slough and the southern glades. Relevant ecological literature as well as best professional judgment supports the conclusion that augmenting flows to Shark River and Taylor Slough is critical to maintaining the sawgrass habitat and nearshore estuarine salinity conditions downstream. Given the possibility of peat decomposition caused by landward migration of the salt habitat front, it is critical to the Shark River and Taylor Slough ecosystem that additional freshwater flows are distributed south along Tamiami Trail. Without augmenting Shark River and Taylor Slough flows, it is apparent that the future without project scenario will result in accelerated loss of the functional coastal mangrove ecotone and sawgrass habitat under low and intermediate SLR projections as compared to the selected project scenario.

The most significant uncertainties associated with the SLR impact projections provided here are: 1) the lag time between when freshwater wetlands become substantially impaired due to salinity impacts and when replacement estuarine habitat becomes fully productive, and 2) the degree to which project related water reservations will protect natural system water supplies given SLR related demand from the developed areas.

I.7 REFERENCES

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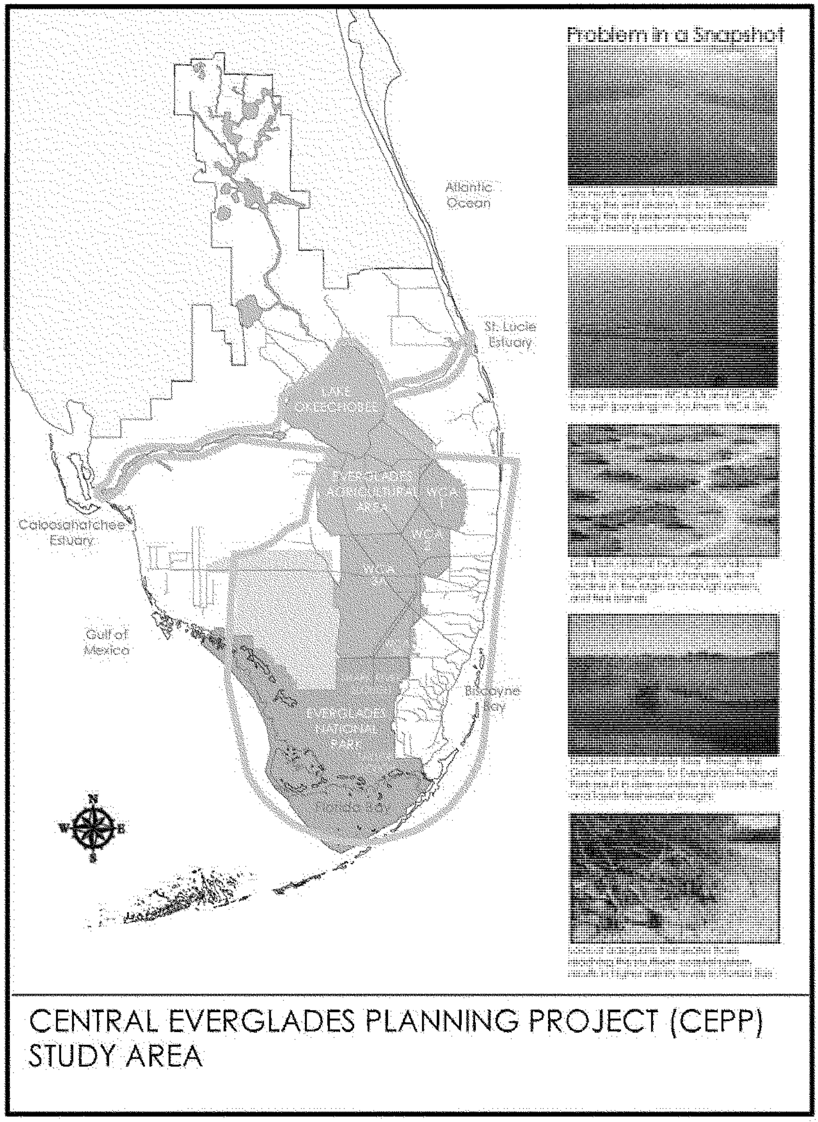

Figure I-1. CEPP Alternative Project Boundaries

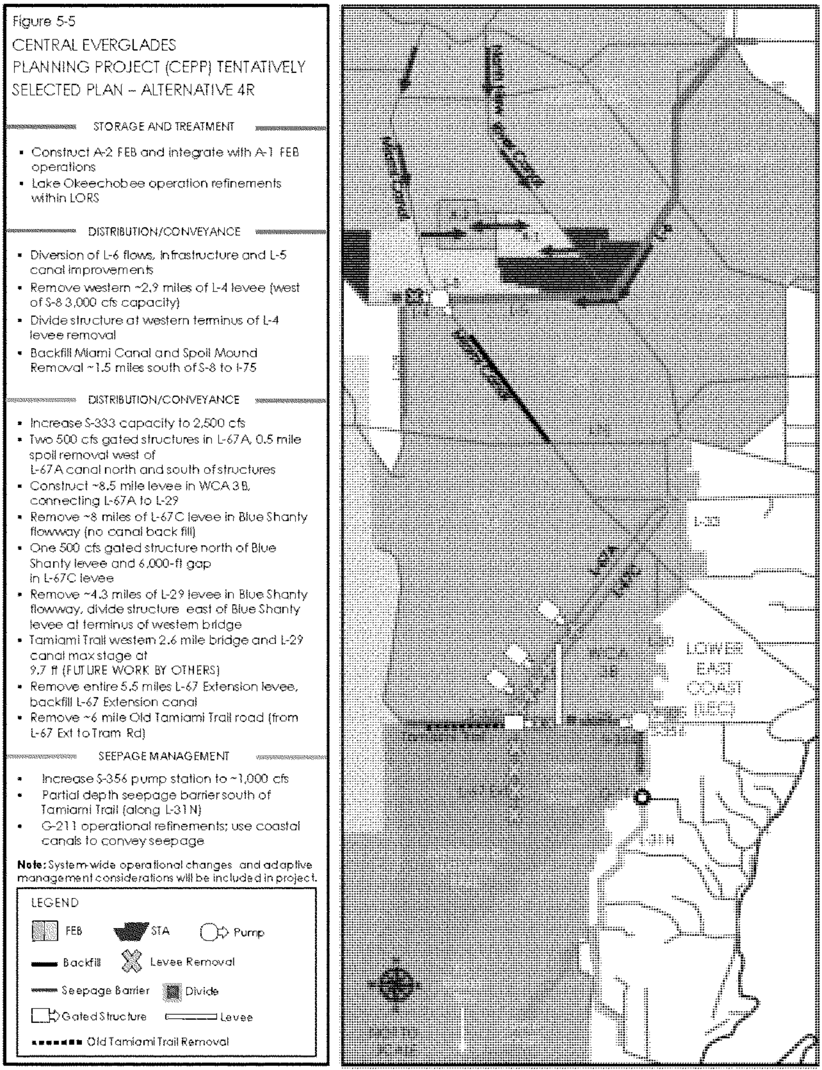

Figure I-2. CEPP Alternative 4R and Alternative 4R2 (Selected Plan) Project Components

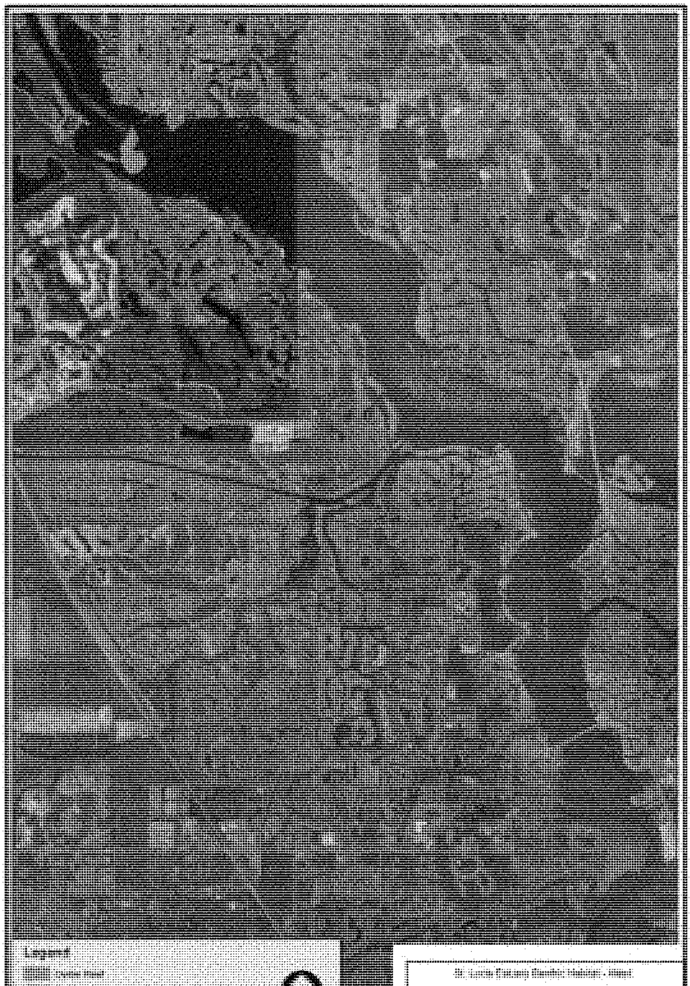

Figure I-3. 2011 Oyster and Seagrass Habitat within the Western Portion of the St. Lucie Estuary

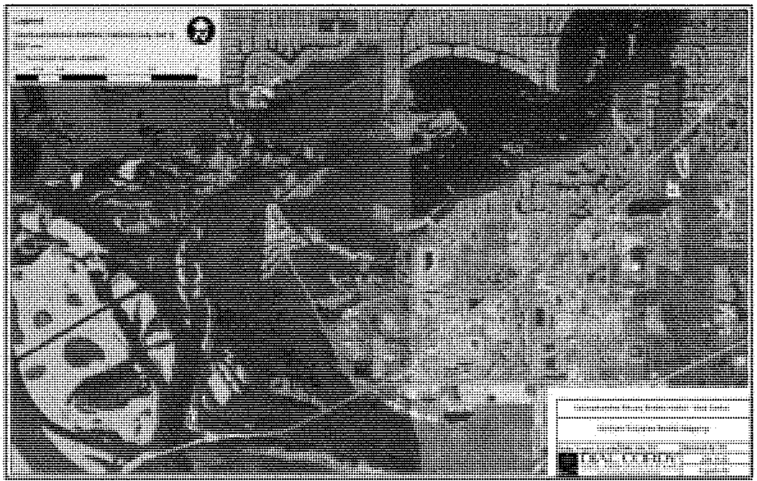

Figure I-4. 2011 Oyster and Seagrass Habitat with the Lower Portion of the Caloosahatchee River Estuary

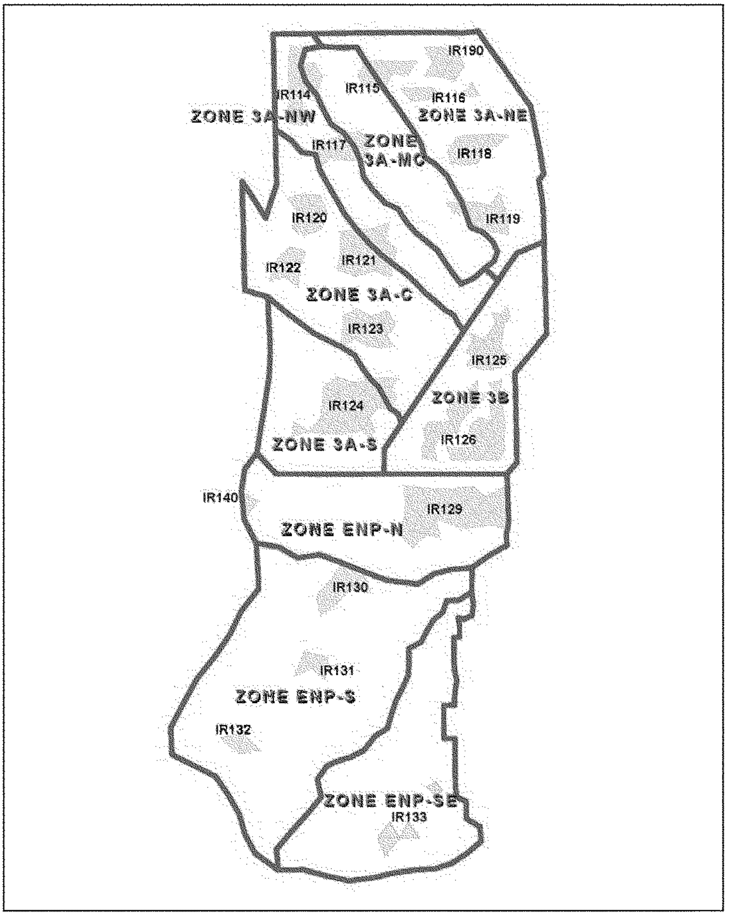

Figure I-5. Freshwater Habitat Zones and Indicator Regions for the CEPP Benefit Evaluation

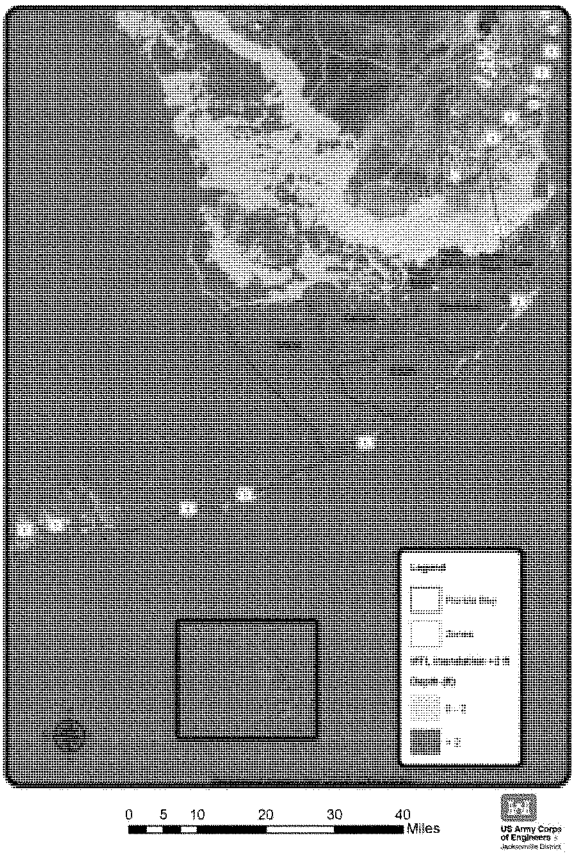

Figure I-6. Existing Conditions Showing CEPP Sub-Regional Boundaries for Nearshore Habitat

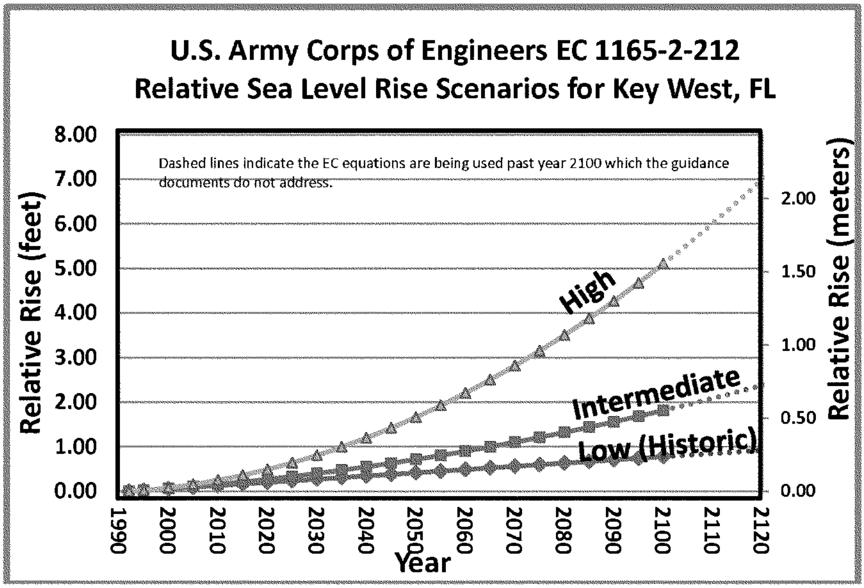

Figure I-7. Projected Sea Level Rise (1922-2113)

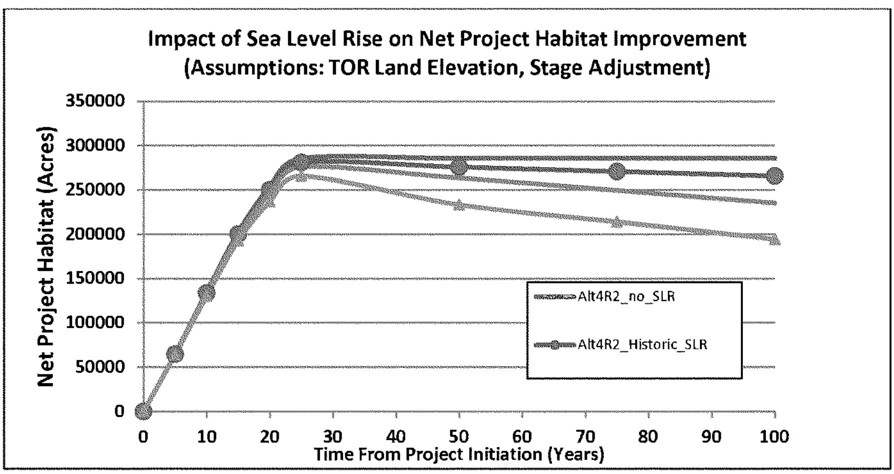

Figure I-8. Net Project Habitat Units for ALT 4R2 Assuming Peat Loss and Project Related Changes to Hydrology

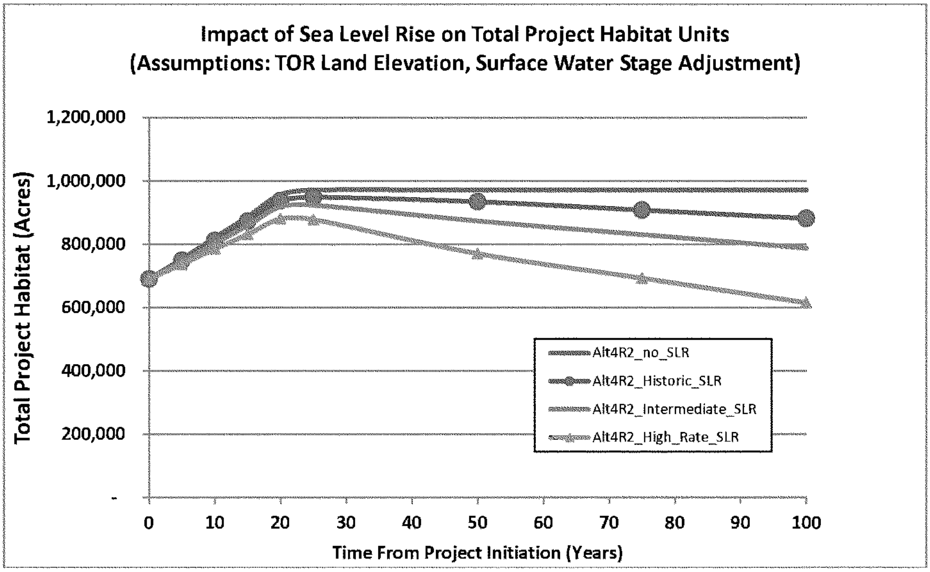

Figure I-9. Total Habitat Units for ALT 4R2 Assuming Peat Loss and Project Related Changes to Hydrology

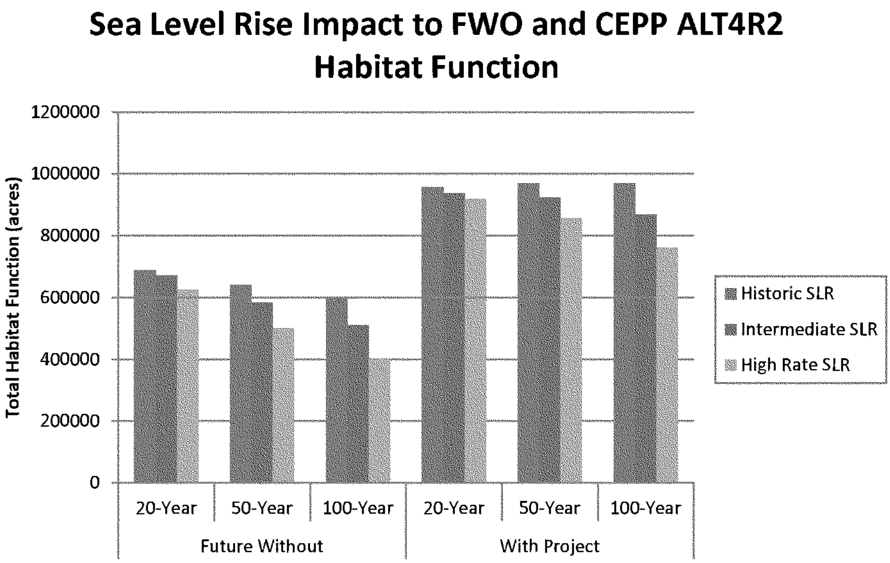

Figure I-10. Total Habitat Function for FWO and CEPP ALT4R2 Conditions As Impacted by Sea Level Rise

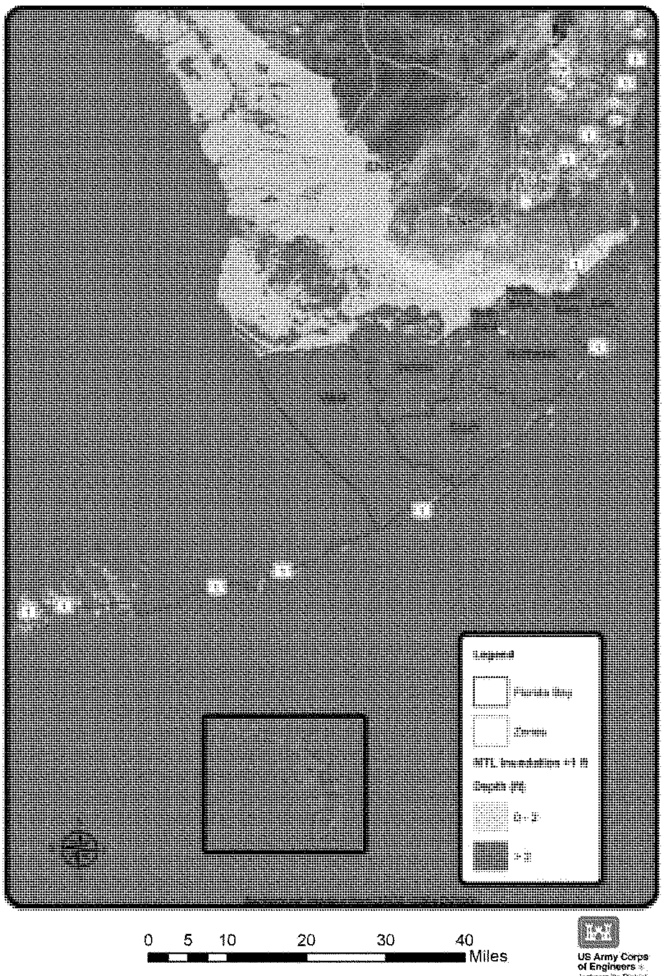

Figure I-11. Alternative 4R with 1' SLR, Assuming Existing Topography for the Southern Portion of the Project

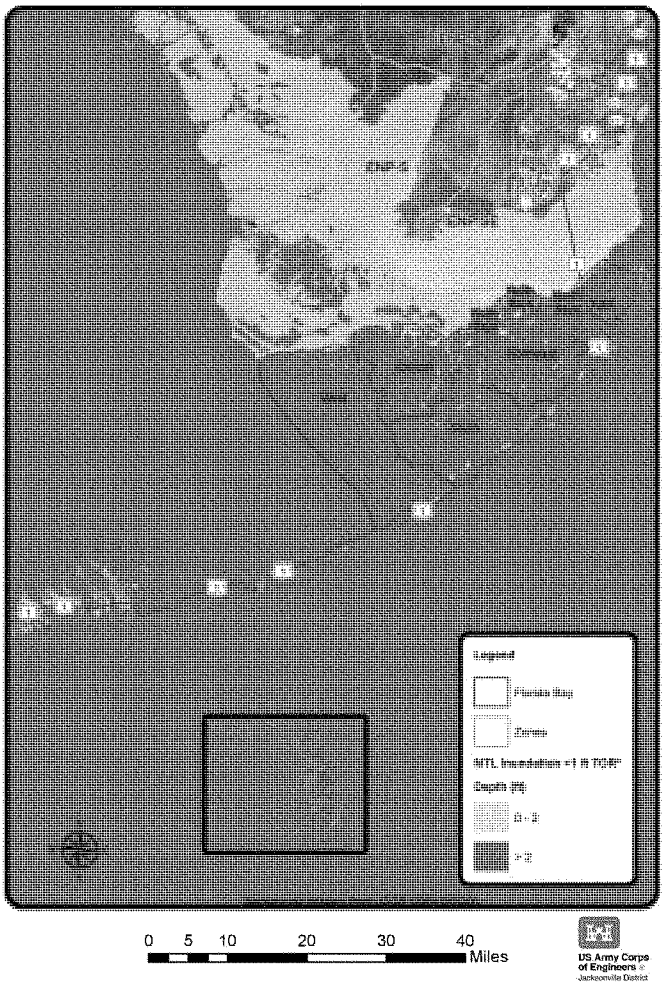

Figure I-12. Alternative 4R with 1' SLR, Assuming Complete Loss of Peat Soils, for the Southern Portion of the Project

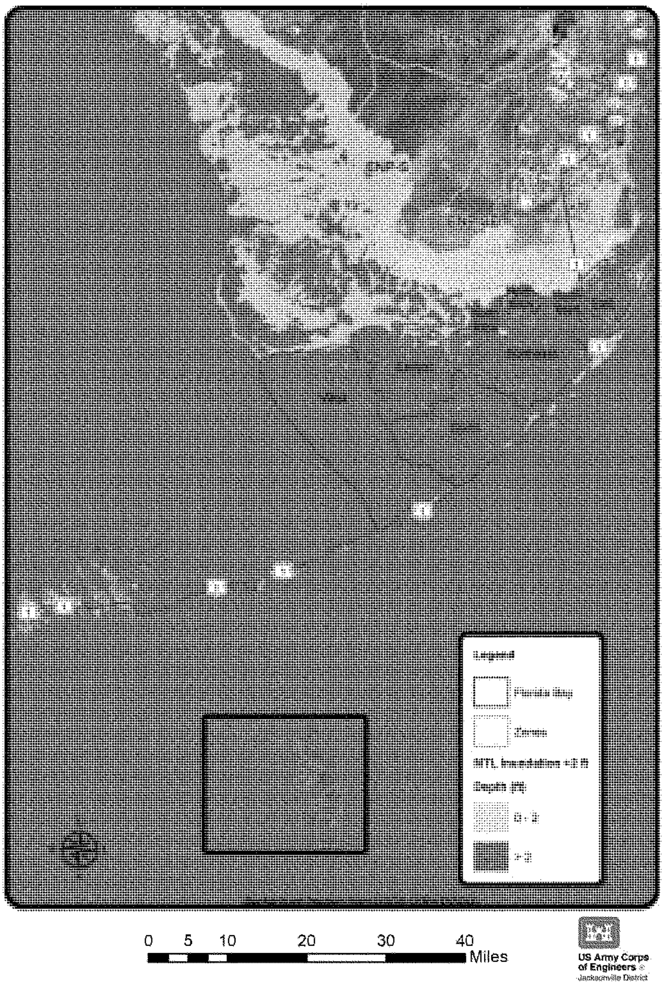

Figure I-13. Alternative 4R with 2' SLR, Assuming Existing Topography, for the Southern Portion of the Project

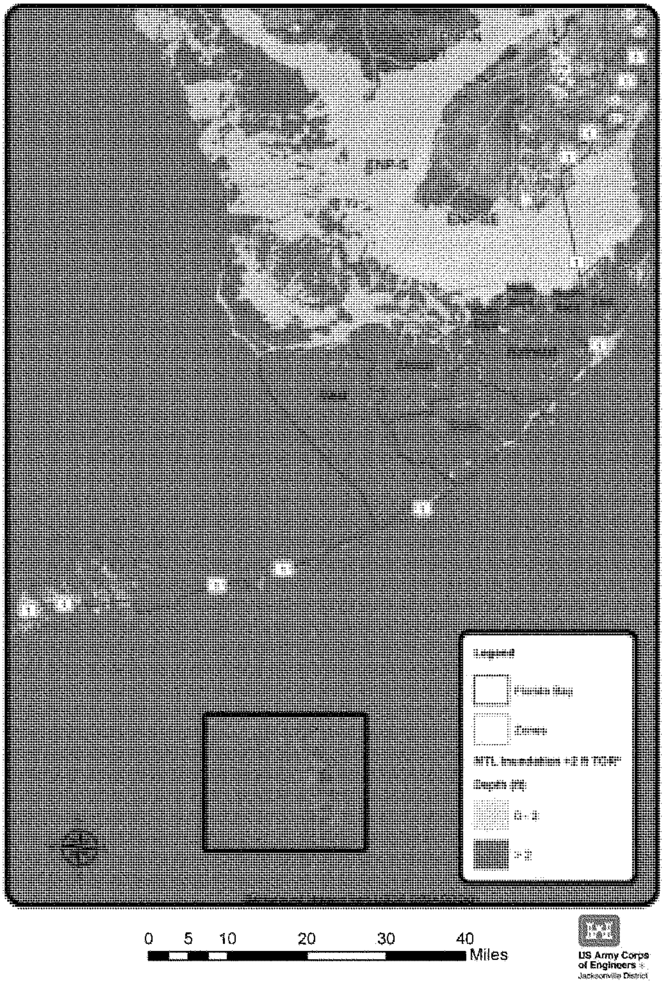

Figure I-14. Alternative 4R with 2' SLR, Assuming Complete Loss of Peat Soils, for the Southern Portion of the Project

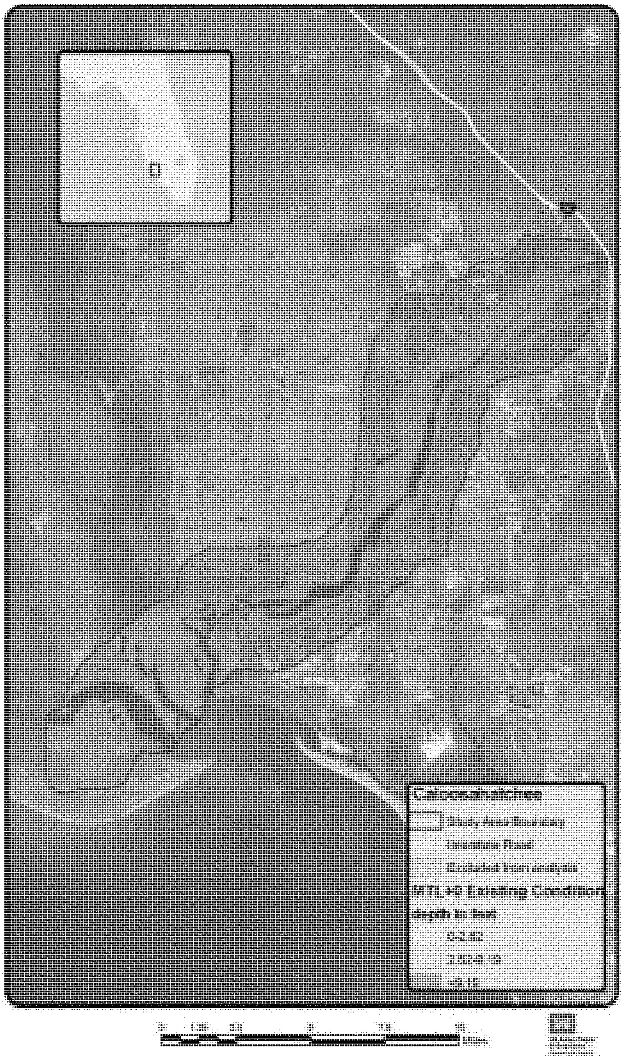

Figure I-15. Potential Submerged Aquatic Vegetation Habitat in Caloosahatchee Estuary with 0 ft of Sea Level Rise

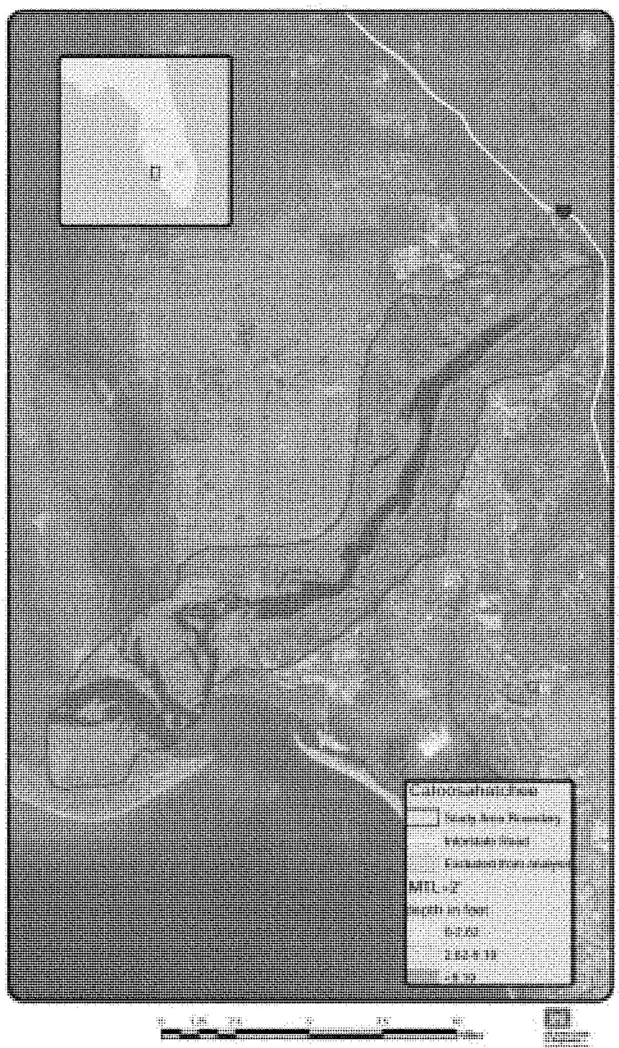

Figure I-16. Potential Submerged Aquatic Vegetation Habitat in Caloosahatchee Estuary with 2 ft of Sea Level Rise

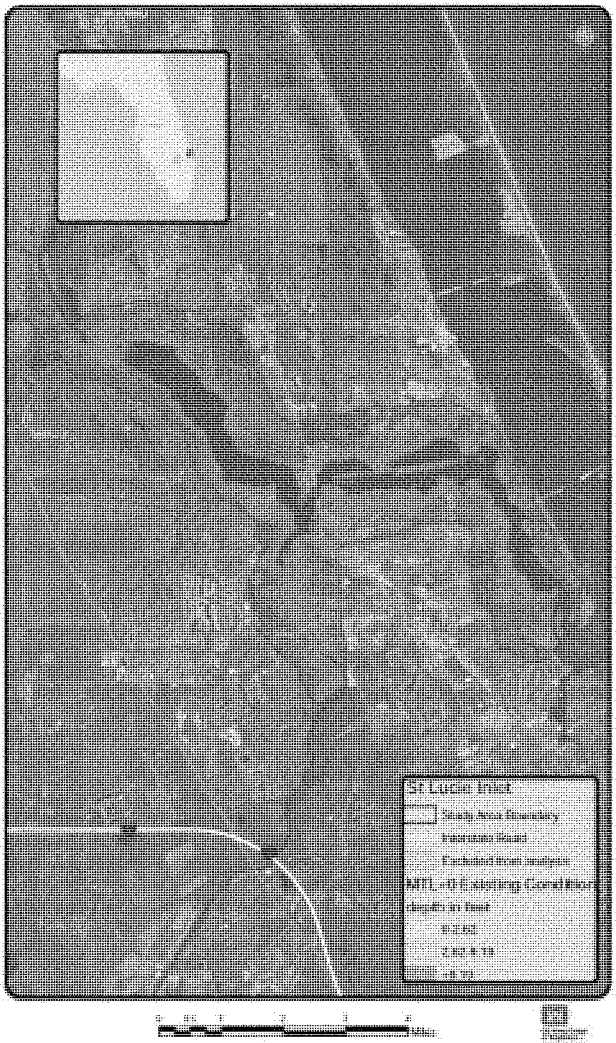

Figure I-17. Potential Submerged Aquatic Vegetation Habitat in St. Lucie Inlet with 0 ft of Sea Level Rise

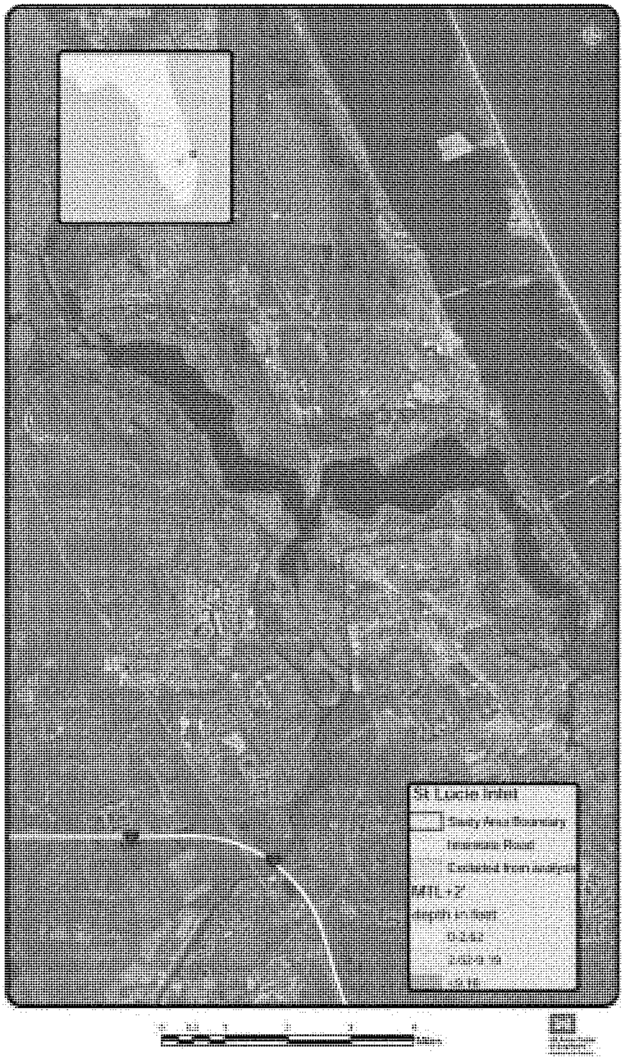

Figure I-18. Potential Submerged Aquatic Vegetation Habitat in St. Lucie Inlet with 2 ft of Sea Level Rise