ANNEX D
MONITORING AND FLORIDA PANTHER MITIGATION PLANS FOR THE LAKE OKEECHOBEE STORAGE RESERVOIR PROJECT

Ecological Monitoring Plan & Adaptive Management Plan

Water Quality Monitoring Plan

Hydrometeorological Monitoring Plan

Florida Panther Mitigation Plan

Table of Contents

List of Tables

List of Figures

D MONITORING PLANS

This annex contains the following monitoring plans:

1. Ecological Monitoring Plan & Adaptive Management Plan
2. Water Quality Monitoring Plan
3. Hydrometeorological Monitoring Plan
4. Florida Panther Mitigation Plan

Part 1: Ecological Monitoring Plan & Adaptive Management Plan

D.1 Introduction to the LOCAR Ecological Monitoring Plan & Adaptive Management Plan

The purpose of the Lake Okeechobee Storage Reservoir Section 203 Study (LOCAR, Project, or Section 203 Study) Ecological Monitoring Plan and Adaptive Management (AM) Plan is to identify the monitoring necessary to inform decision-makers, LOCAR partner agencies, and the public on achieving restoration success.

Ecological Monitoring Plan Background

The Ecological Monitoring Plan focuses on assessing LOCAR meeting Project objectives (per Water Resources Development Act [WRDA] 2016 guidance). The Ecological Monitoring Plan specifies what monitoring is necessary to measure and detect the following across the effects area: benefits of capturing, storing, and redistributing water entering northern Lake Okeechobee to improve lake stage levels for both environmental restoration and water supply purposes, and also improving flows to the Caloosahatchee and St. Lucie Estuaries (collectively referred to in this document as the "Northern Estuaries"). Monitoring of ecosystem responses will capture changes in lake stage and flows into the estuaries that are expected through improvements due to implementation of LOCAR. The majority of monitoring to capture these responses leverages efforts of the CERP RECOVER (REstoration COordination and VERification) System-wide Monitoring and Assessment Plan (MAP), or other agency efforts. The LOCAR Ecological Monitoring Plan will address LOCAR-specific needs through additional Project-level monitoring necessary to fill gaps in ongoing monitoring efforts being leveraged in order to assess project success.

The Ecological Monitoring Plan also contains the monitoring required under the U.S. Fish and Wildlife Service's Final Biological Opinion (BO) for LOCAR, which was provided November 30, 2023. The BO and associated monitoring information for LOCAR is found in **Annex A**, *Fish and Wildlife Coordination Act and Endangered Species Act Compliance*, in the Final Environmental Impact Statement (EIS).

Adaptive Management Plan Background

Complementary to the Ecological Monitoring Plan, the Adaptive Management (AM) Plan for LOCAR will follow the Comprehensive Everglades Restoration Plan (CERP) Guidance Memorandum 56 on the Integration of AM to address project uncertainties (per U.S. Army Corps of Engineers [Corps] Implementation Guidance on Section 1161 of 2016 WRDA; Corps 2017) that may be more specific in their location and/or scale than the overall CERP objectives.

Uncertainty exists in every natural resource management and restoration effort because many ecosystem interactions are often complex and processes not linear. The processes work synergistically and will unfold in a future climate that is likely to be different than the one used when formulating the Recommended Plan.

Per the 2003 Programmatic Regulations, CERP produced guidance for project teams to develop AM plans and integrate AM activities into all phases of a project lifecycle including planning, design, construction, and operations (Corps and SFWMD 2011; RECOVER 2011b). The intent per 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 AM WRDA 2000 authorization and follows the more general 2009 AM guidance from Corps Headquarters on implementing Section 2039 of WRDA 2007.

Adaptive Management Plan Development

The development of the AM Plan is a culmination of input from well-developed Corps planning procedures, extensive scientific and local knowledge developed over decades of experience, and input from the LOCAR Project Team during preconstruction engineering and design (PED).

Conceptual Ecological Model (CEM) are key components of the AM Program described in the Programmatic Regulations for CERP. These important tools help recognize and better understand connections and relationships within ecosystems. CEMs include divers, stressors, and ecological effects and attributes for a given ecosystem and can provide a link between early project planning (e.g., an effective statement of problem, need, opportunity, and constraint) and later evaluation and implementation (Corps, EAB 2006). To guide the LOCAR ecosystem restoration project planning, CEMs from Lake Okeechobee (Havens and Gawlik 2005), Caloosahatchee Estuary (Barnes 2005), and St. Lucie Estuary and Southern Indian River Lagoon (Sime 2005) were utilized to develop and compile a list of uncertainties.

Consistent with Corps planning guidance and CERP AM guidance, uncertainties were screened and prioritized, resulting in a final list of uncertainties. Uncertainties that were screened out can be found in Table D-6. This final list was used to develop strategies, management options, and costs to develop the AM Plan.

Per CERP's AM guidance, the management options included in this AM Plan can be described as the following:

1. Informing LOCAR 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; and
3. LOCAR AM Contingency Options—Monitoring results may suggest a need to implement additional restoration actions, called "management options," pending all required and applicable coordination, policies, and permitting.

Due to the single component (reservoir and corresponding conveyance features, etc.) nature of the LOCAR project, key management options identified to address the uncertainties include adjustments in operations to meet or improve downstream restoration effects, and, as such, implementation of operational adjustments are contained in the Project Operations Manual (POM) (**Annex C,** Draft POM). As a CERP project, the operational plan for the LOCAR project takes into consideration the system responses in achieving restoration in the operational guidance (**Annex C**). Some uncertainties downstream in Lake Okeechobee within the effects area regarding invasive and nuisance species responses have management actions outlined within the Invasive and Nuisance species management plan (**Annex F**). Additional potential future AM measures will be taken into consideration for inclusion in the CERP AM plan when additional CERP components in the system are implemented and a system response indicates the need for adjustment to project components.

D.1.1 Structure of the LOCAR Ecological Monitoring Plan and Adaptive Management Uncertainties and Options

For each LOCAR Project objective, specific attributes and ecological indicators have been identified to measure progress toward success of meeting the objective. Uncertainties for the project were identified through a robust process and subsequently underwent a screening process to determine priority uncertainties. A list of uncertainties screened out can be found in Table D-6. The remaining uncertainties were linked with associated Project objectives and an AM strategy developed following the template found in Table D-1. Tables D-2 and D-3 summarize the ecological monitoring and AM strategies, including (1) AM uncertainty, (2) monitoring attributes, (3) monitoring metrics and frequency, (4) timeframe to detect change, (5) threshold(s) for management action, and (6) management options.

Table D-1. AM Strategies: Template and Definitions.

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.*

Objective or Constraint: *Uncertainties needed to be related to LOCAR 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 LOCAR footprint to which the uncertainty and strategy pertain.*
Associated features: *Structures or measures to which the uncertainty and strategy pertain.*
Driver or uncertainty type: *Not all AM uncertainties and strategies are ecological.*

What is expected to be learned by addressing this uncertainty, that is, how will the project benefit from addressing this uncertainty? *Why the uncertainty needs to be addressed in the project.*

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 the 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, that is., how will the project benefit from knowledge gained about this attribute?**
- **What is the timeframe in which changes to this attribute are expected to be measurable?**
- **Is this attribute complemented by other monitoring programs within and/or outside of the project effects area? If so, provide reference to other monitoring. Note the monitoring paid for by others in the budget spreadsheet.**
- **When during the project lifecycle 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 AM Plan varies in the level of methodology detail provided; in several cases, the details will be formed during detailed design phase. In ALL cases, methodology will be reviewed, updated, and adjusted if needed by agency subject matter experts, before initiation, to best meet the intent of the AM Plan.*

Thresholds that may trigger need for adaptive management action. *Thresholds are a point, range, or limit that signifies when restoration performance is veering away from expectations and is trending toward an unintended outcome. 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 threshold is crossed, which would indicate the need for adaptive management action. The Management Options are suggested paths forward and adjustments that can be made to continue progressing toward achieving objectives and remaining within constraints.*

The AM strategies are summarized in 11x17 pull-out tables after each objective.

AM–adaptive management; LOCAR–Lake Okeechobee Storage Reservoir Section 203 Study

D.1.2 Ecological Monitoring and Adaptive Management Plan Details

For each LOCAR Project objective, specific attributes and ecological indicators have been identified to measure progress toward success of meeting the objective. AM uncertainties that apply to each Project objective are described within the corresponding section.

D.1.2.1 LOCAR Objective 1

Improve quantity, timing, and distribution of flows into Lake Okeechobee to maintain ecologically desired lake stage ranges more often.

This objective has three main components. One is the amount of time Lake Okeechobee remains in the ecologically preferred envelope; another is the amount of time the lake is above the extreme high lake stage and the amount of time the lake is below the extreme low lake stage; the third is the ecological response to lake hydrology.

The nearshore and pelagic regions of Lake Okeechobee are occupied by a number of key ecological communities, which can be used to evaluate the environmental health of the lake as a function of their responses to changing hydrologic conditions. For this objective, two attributes will be monitored: 1) lake stage, and 2) ecological indicators. Lake stage data will be leveraged from existing monitoring networks and the LOCAR Hydrometeorological Monitoring Plan (**Annex D, Part 3**). Much of the ecological indicator data will be leveraged from existing monitoring, as indicated in cost **Table D-4** and **D-5**, but additional monitoring will be required specifically for this project. The field methodology to accomplish this objective will be described in more detail once LOCAR is authorized. Additional monitoring beyond what is described in this Plan may be required and will be determined once LOCAR is authorized or through AM strategies contained herein.

D.1.2.2 Lake Okeechobee Ecological Indicators

LOCAR is expected to benefit floral and faunal communities of Lake Okeechobee by improving the quantity, timing, and distribution of flows into the lake, resulting in more ecologically desired lake stages. These expectations are based on known or assumed relationships of certain indicators to lake stage, based on varying periods of record. For many of the datasets, the period of record includes extreme weather events such as multiple hurricanes and record low lake levels, some of which occurred within 1 to 2 years of each other. While there is ample evidence regarding the effects of extreme lake stages, there is more uncertainty regarding the effects of more stabilized water levels as predicted to occur with LOCAR. How the indicator communities respond will depend on the extent to which the frequency and duration of high lake stages are reduced because of additional water storage constructed in the Lake Okeechobee Watershed. Ecological indicators can represent the overall health of the ecosystem and represent various trophic levels found within the Lake. Chosen ecological indicators for Objective 1 include vascular SAV, EAV, *Chara*, cyanobacteria, birds, and fish. Monitoring for these indicator groups is described within each uncertainty below and within the Table D-2. This ecological monitoring and AM may be further refined during PED prior to construction.

D.1.2.3 Lake Okeechobee Uncertainties

- Will ecological indicators respond to lake changes as expected? (ID#25; LOCAR Objective 1)

- Will fish and wildlife communities benefit from the Project's effect on lake stages or will additional management be needed? (ID#26; LOCAR Objective 1)
- How will new hydrologic regimes affect the occurrence of invasive (native and/or non-native) or undesirable flora and fauna in Lake Okeechobee? (ID#17; LOCAR Objective 1)

D.1.2.4 LOCAR Lake Okeechobee Adaptive Management Strategies

LOCAR AM Uncertainty #25, #26 –Will ecological indicators respond to lake changes as expected? Will fish and wildlife communities benefit from the Project's effect on lake stages or will additional management be needed?

Objective or Constraint: These uncertainties are related to the objective of improving the quantity, timing, and distribution of flows into Lake Okeechobee to maintain ecologically desired lake stage ranges (Objective 1).

Region(s): Lake Okeechobee

Associated Project Features: Deep Reservoir

Driver or Uncertainty Type: Ecological and Operational

What is expected to be learned by addressing this uncertainty (i.e., how will LOCAR benefit from addressing this uncertainty)? The attributes to be measured are representative of ecological conditions on the lake, and how they respond will be used to assess LOCAR's impact to the system. Many ecological indicators will be monitored in the nearshore region, which is the area where changes in lake stages have the most immediate impact (e.g., SAV, EAV, cyanobacteria, phytoplankton, and sportfish (e.g., largemouth bass [*Micropterus salmoides*]). Wading birds, snail kites, and vegetation composition/distribution will be monitored throughout the marsh while fish communities will be assessed in the nearshore and pelagic zones. Specifically, the monitoring of the ecological indicators will assess how stabilization of water levels overall, with consistent reductions in high lake stages, affect Lake Okeechobee's resources, especially in regard to community resilience, for example. Increasing the frequency and reliability of imagery collection and classification will improve the ability to detect change on a lake-wide scale and be critical to discerning Project-related effects from climate or other variability.

Expectations and hypotheses to be tested to address uncertainty, and attribute(s) that will be measured to test each. The expectation to be tested is that maintaining lake stages within ecologically desired ranges more frequently will offset impacts from very minor increases in the frequency of extreme low lake stages. Additionally, the expectation that reducing the frequency of moderate high stages (e.g., over 16 feet [ft] National Geodetic Vertica Datum of 1929 [NGVD29]) will be enough to restore submerged aquatic vegetation habitats at lower elevations after extirpation from storm events. Reference the 2020 RECOVER performance measure for Lake Okeechobee for a definition of the most recent information with respect to ecologically desirable ranges (RECOVER 2020).

Is this attribute complemented by other monitoring programs within and/or outside of the project effects area? If so, provide reference to other monitoring. Note the monitoring paid for by others in the budget spreadsheet. Little new monitoring is proposed in this AM strategy other than annual

aerial/satellite imagery collection and classification for the littoral marsh. However, continuation of many ongoing monitoring efforts conducted by various entities and updating analyses will be key to addressing these uncertainties. Most of the specified ecological indicators are monitored by South Florida Water Management District (SFWMD) including classifying littoral vegetation, when available, while various faunal groups are monitored by the Corps and Florida Fish and Wildlife Conservation Commission (FWC). Thus far, these projects have provided fairly strong evidence for lake stage targets but need to be collected across a wider variety of climate conditions to verify assumptions and refine predicted relationships.

What is the time frame in which changes to this attribute are expected to be measurable? Most of the attributes respond relatively quickly to hydrological changes or the indirect effects of stage variations on water quality parameters. While initial responses may be detected within a year in some cases, correlating those responses to Project implementation would likely take several years and cover a variety of climate conditions.

When during LOCAR's life cycle should this monitoring begin? Monitoring should be implemented concurrent with Project implementation and continue through extreme dry and wet conditions (5 to 10 years) to fully evaluate responses.

Methodology for testing each expectation or hypothesis. Little new monitoring is proposed to address these uncertainties other than classifying annual imagery (aerial or satellite) for the littoral marsh. All the monitoring proposed relies on existing long-term datasets and on maintaining or expanding monitoring programs that are currently running. LOCAR-specific analyses would be needed to determine how Project operations affect various ecological indicators; these are currently being supported by various groups, but if that monitoring is discontinued, LOCAR would need to fill the gaps.

For SAV and EAV mapping procedures, wading-bird foraging surveys, and fish monitoring see the Lake Okeechobee chapter of many South Florida Ecosystem Reports (SFER) (e.g., Zhang and Welch 2018). For information on wading-bird nesting colonies see the annual South Florida Wading Bird Report (SFWBR) (e.g., Cook and Baranski 2018), and for snail kites, see annual demographic reports from University of Florida's snail kite monitoring program (e.g., Fletcher et al. 2015).

Thresholds that may trigger need for AM action: The results for many of the monitoring activities, regardless of whether there was a significant relationship with LOCAR operations, are reported on annually in the SFER and once every 5 years in the RECOVER System Status Report (SSR). Wading bird nesting is reported in the annual South Florida Wading Bird Report (SFWBR) and snail kite nesting in the annual demographic reports from the University of Florida (e.g., Fletcher et al. 2015).

For Uncertainty #25, related to ecological indicators, those will be evaluated separately on an annual basis in the SFER.

Management options that may be chosen based on monitoring results: Should a threshold be crossed that may trigger the need for AM, a primary management option would be to manipulate operations to affect lake stages so that they better align with needs of specific flora or fauna. For example, if operations appear to be having detrimental impacts to a particular group due to high recession rates or high lake stages, reducing those stressors through operations might be feasible via procedural updates to the DPOM (Annex C).

There are also various management actions that could be implemented to reach target vegetation compositions and/or to benefit specific wildlife like wading birds, snail kites, and fish. Further, for harvested species like sportfish, regulatory changes for the fishery could be considered.

LOCAR Uncertainty #17 – How will new hydrologic regimes affect the occurrence of invasive (native and/or non-native) or undesirable flora and fauna in Lake Okeechobee?

Objective or Constraint: This uncertainty is related to the objective of improving the quantity, timing, and distribution of flows into Lake Okeechobee to maintain ecologically desired lake stage ranges (Objective 1).

Region(s): Lake Okeechobee

Associated Project Feature: Deep Reservoir

Driver or Uncertainty Type: Ecological and Operational

What is expected to be learned by addressing this uncertainty (i.e., how will LOCAR benefit from addressing this uncertainty)? This will improve the understanding and control of invasive and nuisance species dynamics within the lake and the efficacy of implementing these types of sites elsewhere in the region to achieve habitat restoration.

Expectations or hypotheses to be tested to address uncertainty, and attribute(s) that will be measured to test each. The expectation is that the effect of reduced frequency and duration of high lake stages may have differential effects on invasive or nuisance flora and fauna in the lake. During high lake stages, nuisance species like cattail (*Typha* spp.) can expand into higher elevations and displace desirable native communities. This issue is likely to be mitigated by reduction of high stage durations through creation of watershed storage associated with this Project. However, slight increases in low stage durations may occur with the Project relative to FWO, which may cause expansions of other exotic species like torpedograss (*Panicum repens*), which tends to expand downslope during low stages and is subsequently difficult to eradicate. The proposed vegetation mapping will detect this and identify areas for control or management. It is expected that this type of work will be more intensive if there are dry periods in the early phases of the Project but should reduce in scale with regular maintenance activities. The attributes to be monitored are the location, percentage, and types of invasive flora and fauna in the lake. More detailed monitoring for invasive vegetation will be covered in the Invasive and Nuisance Species Management Plan for LOCAR (**Annex F**).

Is this attribute complemented by other monitoring programs within and/or outside of the project effects area? If so, provide reference to other monitoring. Note the monitoring paid for by others in the budget spreadsheet. Little new monitoring is proposed in this AM strategy other than annual aerial/satellite imagery collection and classification for the littoral marsh. However, continuation of many ongoing monitoring efforts in Lake Okeechobee conducted by various entities and updating analyses will be key to addressing these uncertainties. Much of the necessary monitoring is already being performed by South Florida Water Management District (SFWMD) including classifying littoral vegetation, when available, while various faunal groups are monitored by the Corps and Florida Fish and Wildlife Conservation Commission (FWC).

What is the time frame in which changes to this attribute are expected to be measurable? Although changes could occur any time, we expect the greatest change and potential need for action to occur within 5 years of Project operation, particularly if dry climatic conditions persist.

When during LOCAR's life cycle should this monitoring begin? Within 12 months of beginning operations.

Methodology for testing each expectation or hypothesis. Assessment of sites via aerial or photographic interpretation in conjunction with ground surveys. Invasive or nuisance communities may be mapped to show location and species composition. Pre- and post-treatment surveys may report the percentage of invasive species controlled or eliminated.

Threshold that may trigger need for AM action: A significant increase in invasive or nuisance species. Species targets are identified in the EAV RECOVER PM and could be used as thresholds for invasive and nuisance species as well.

Management options that may be chosen based on monitoring results. Should a threshold be crossed that may trigger the need for AM, a primary management option would be to manipulate operations to affect lake stages so that they better align with needs of specific flora or fauna. For example, if operations appear to be increasing abundance or distribution of invasive or nuisance flora or fauna, beneficial operational changes might be feasible via procedural updates to the POM (Annex C).

The efforts of the INSMP and the AM strategy will be coordinated to minimize redundancy. Remediation techniques (flooding, burning, or herbicide) may be appropriate for cost and efficacy. Please refer to **Annex F**, the LOCAR INSMP.

Additional management options that support the health and abundance of native desirable species may also be utilized, or additional monitoring for faunal (e.g., invasive fish) species will be implemented as necessary.

Table D-2. LOCAR Objective 1: Lake Okeechobee Ecological Monitoring and Adaptive Management Strategies.

Uncertainty Tracking ID#	Attribute or Indicator	Proposed Property to be Measured and Frequency	Timeframe to Detect Change of Attributes*	Decision Criteria: Threshold(s) for Management Action	Management Action Options Suggestions
#25 Will ecological indicators respond to lake stage changes as expected? **#26** Will fish and wildlife communities benefit from the project's effect on lake stages, or will additional	- *Chara* - Vascular SAV - Cyanobacteria - EAV species groups in littoral zone: bulrush, sawgrass, beakrush/spikerush, cattail, willow, floating leaf, torpedo grass, other invasive (native and/or non-native) or undesirable species,	Annual - Acreage of total SAV in nearshore - EAV species composition in the littoral zone - Monitoring of *Chara*, vascular SAV, nearshore SAV, phytoplankton, and littoral EAV. - Wading-bird abundance and nesting	1-5 years	-SAV coverage of less than 35,000 acres and/or fewer than half of select littoral zone species coverage values are met. - Annual wading bird abundance reduced by 50% and reduction in nesting effort/success of 50%. - Snail kite reduction to below the 3-year moving average in nesting effort/success. - Annual fish composition/catch rate/age	-Adjust water level operational guidance per the Project Operating Manual (POM) (**Annex C**) - Additional management operations, e.g., invasive or undesirable vegetation

Uncertainty Tracking ID#	Attribute or Indicator	Proposed Property to be Measured and Frequency	Timeframe to Detect Change of Attributes*	Decision Criteria: Threshold(s) for Management Action	Management Action Options Suggestions
management be needed?	and woody vegetation - Wading birds - Snail kites - Fish	effort/success - Snail kite nesting effort/success - Fish composition/catch rate/age distribution		distribution reduced by 50%. - TBD for other attributes	removal, prescribed burning, plantings, etc. (In INSMP **Annex F**) - Implement additional faunal monitoring or analyses
#17 How will new hydrologic regimes affect the occurrence of invasive (native and/or non-native) or undesirable flora and fauna in Lake Okeechobee?	- EAV species groups in littoral zone: bulrush, sawgrass, beakrush/spikerush, cattail, willow, floating leaf, torpedo grass, other invasive (native and/or non-native) or undesirable species, and woody vegetation - Fish and other fauna	Annual - EAV species composition in the littoral zone - Fish composition/catch rate/age distribution	1-5 years	- Fewer than half of select littoral zone species coverage values are met. - Decrease in desirable fish composition/catch rate - TBD for other faunal attributes	- Adjust water level operational guidance per the Project Operating Manual (POM) (**Annex C**) - Additional habitat management operations, e.g., invasive or undesirable vegetation removal, prescribed burning, plantings, etc. (In INSMP **Annex F**) - Implement additional faunal monitoring or analyses.

*Timeframe could be shorter or longer, depending upon prevailing weather patterns and attribute being measured.
EAV–emergent aquatic vegetation; SAV–submerged aquatic vegetation.

D.1.2.5 LOCAR Objective 2

Improve the timing and volumes of freshwater flows from Lake Okeechobee to improve the salinity regime and the quality of habitats for oyster, submerged aquatic vegetation (SAV), and other estuarine communities in the Northern Estuaries.

Flows into the St. Lucie and Caloosahatchee Estuaries can greatly influence salinity gradient throughout the estuaries and impact vital habitat such as oysters and submerged aquatic vegetation (SAV). RECOVER has developed preferred flow and salinity envelopes for each estuary, which modeling has predicted LOCAR implementation will improve for oysters and SAV. As such, these will serve as the attributes to measure for Project success in meeting Objective 2. For this objective, three attributes will be monitored: 1) Lake Okeechobee flows to the Northern Estuaries; 2) SAV shoot count, density, and canopy cover; and 3) oyster abundance, health, and distribution. Lake flow data will be leveraged from existing monitoring networks and the LOCAR Hydrometeorological Monitoring Plan (**Annex D, Part 3**). The monitoring methodology includes gage data at Structure 79 (S-79) and Structure 80 (S-80). Ecological data for oysters and SAV will be leveraged from the RECOVER MAP.

Estuaries Ecological Indicators

LOCAR is expected to benefit estuarine communities of the St. Lucie and Caloosahatchee Estuaries by improving the quantity, timing, and distribution of flows from Lake Okeechobee, resulting in more ecologically desired salinity gradients. These expectations are based on known or assumed relationships of certain indicators such as oysters and SAV to estuary inflow, based on varying periods of record. Oyster and SAV health can serve as proxies for the health of the estuary itself and will be monitored to determine progress in achieving Objective 2. Monitoring for these ecological indicators will be leveraged from ongoing efforts via the RECOVER MAP. Oyster data include density, live and dead counts, growth, disease, predation, reproductive development, and recruitment. SAV data include a nested, multi-tiered monitoring approach that looks at regional, patch, and shoot-level responses to environmental change, and may include aerial mapping, random-stratified sampling, and Braun-Blanquet densities, shoot counts, and biomass metrics to better understand within-bed productivity, respectively. The detailed field methodology to accomplish this objective is described in the RECOVER MAP.

D.1.2.6 Estuaries Uncertainties

- When flows from Lake Okeechobee are reduced and salinity regimes for SAV are improved, what changes to SAV extent and species composition/diversity will occur in the estuaries? (ID#12; LOCAR Objective 2)
- When flows from Lake Okeechobee are altered, and salinity regimes for oysters are improved, what changes to oyster abundance, density, extent, and recruitment will occur in the estuaries? (ID#16; LOCAR Objective 2)

D.1.2.7 LOCAR Estuaries Adaptive Management Strategies

LOCAR AM Uncertainty #12 – When flows from Lake Okeechobee are altered, are the appropriate salinity regimes for SAV established with the estuaries, and is this evident by changes in SAV abundance, extent, and species composition/diversity?

LOCAR Objective or Constraint: This uncertainty is related to the objective of improving estuary flows from Lake Okeechobee to improve the salinity regime and the quality of habitats for oyster, SAV, and other estuarine communities in the Northern Estuaries.

Region(s): St. Lucie and Caloosahatchee River and Estuary

Associated LOCAR Features: Deep reservoir

Driver or Uncertainty Type: Ecological and Operational

What is expected to be learned by addressing this uncertainty, i.e., how will LOCAR benefit from addressing this uncertainty? SAV plays a critical role in influencing the population, community, and ecosystem dynamics of estuarine environments. Elucidating how restoration performance via estuary inflow may influence SAV in the Northern Estuaries is imperative so that AM actions can be undertaken, ensuring restoration success.

Expectations or hypotheses to be tested to address the uncertainty, and attribute(s) that will be measured to test each. Altered hydrologic activity (e.g., freshwater flows) influence the abundance and distribution of SAV, including estuarine seagrasses, and have marked positive effects on SAV with a lower salinity tolerance. If target freshwater flows are not achieved, there may be neutral or deleterious effects to SAV distribution, abundance, and productivity in the downstream systems.

What is the timeframe in which changes to this attribute are expected to be measurable? Although minimal changes could occur with the first couple of years after operations, we expect the greatest change to occur within 5 years of Project operation.

Is this attribute complemented by other monitoring programs within and/or outside of the project effects area? If so, provide reference to other monitoring. Note the monitoring paid for by others in the budget spreadsheet. This monitoring is captured under the RECOVER MAP program efforts of the Northern Everglades Northern Estuaries SAV Ecosystem Assessment (NESEA). Additional methodology information can be found in the RECOVER MAP documents and South Florida Environmental Report (SFER 2024 Volume I).

When during the project lifecycle should this monitoring begin and end? As this monitoring component leverages MAP efforts, monitoring has been ongoing and is part of the CERP system wide assessment, which continues to assess system responses to CERP projects. The duration of monitoring is not coupled to the lifecycle of this specific project.

Methodology for testing each expectation or hypothesis: RECOVER SAV MAP monitoring for the Northern Estuaries was updated in Spring 2018. The new protocol, the Northern Everglades Northern Estuaries SAV Ecosystem Assessment (NESEA), applies a nested, three-tiered hierarchical approach to address multiple scales of SAV monitoring in the Northern Estuaries region, namely: 1) landscape, 2) patch, and 3) shoot-level scales.

Threshold that may trigger need for AM action: To assess the LOCAR performance or whether there is a need for AM action as it pertains to SAV, decision criteria to trigger management action needs to be developed for each of the estuaries based on the best available science and known seagrass ecology and population dynamics.

Management options that may be chosen based on monitoring results: Optimize flows per procedural updates to the POM (**Annex C**) to establish salinity regimes that better align with needs of the SAV species distribution along the estuary gradient.

LOCAR AM Uncertainty #16 – When flows from Lake Okeechobee are altered, are the appropriate salinity regimes for oysters established with the estuaries, and is this evident by changes in oyster abundance, density, extent, and recruitment?

LOCAR Objective or Constraint: This uncertainty is related to the objective of improving estuary flows from Lake Okeechobee to improve the salinity regime and the quality of habitats for oyster, SAV, and other estuarine communities in the Northern Estuaries.

Region(s): St. Lucie and Caloosahatchee River and Estuary

Associated LOCAR Features: Deep reservoir

Driver or Uncertainty Type: Ecological and Operational

What is expected to be learned by addressing this uncertainty, that is, how will LOCAR benefit from addressing this uncertainty? Oysters play a critical role in influencing the population, community, and ecosystem dynamics of estuarine environments. Determining how restoration performance via estuary inflow may influence oysters in the Northern Estuaries is imperative so that AM actions can be undertaken, ensuring restoration success.

Expectations or hypotheses to be tested to address the uncertainty, and attribute(s) that will be measured to test each. Altered hydrologic activity (e.g., freshwater flows) influence the abundance and distribution of oysters. The timing and volume of freshwater flows affects the capacity of recruitment in the estuary.

What is the timeframe in which changes to this attribute are expected to be measurable? Although minimal changes may be observed in recruitment with the first couple of years after operations, in regard to an observable change to acres of live oysters, we expect the greatest change to occur within 5 years of Project operation.

Is this attribute complemented by other monitoring programs within and/or outside of the project effects area? If so, provide reference to other monitoring. Note the monitoring paid for by others in the budget spreadsheet. This monitoring is captured under the RECOVER MAP program efforts, which are conducted through a contract with FWC.

When during the project lifecycle should this monitoring begin and end? As this monitoring component leverages MAP efforts, monitoring has been ongoing and is part of the CERP system wide assessment, which continues to assess system responses to CERP projects. The duration of monitoring is not coupled to the lifecycle of this specific project. Within and between years there will be seasonal and inter-annual conditions which may, in the short term, dampen the ability to detect changes to oysters between short-term environmental conditions post-restoration; therefore, mapping should occur pre-restoration, and then again 5 years after restoration implementation, and once every 5 years after to track long-term change and inform AM.

Methodology for testing each expectation or hypothesis: RECOVER Oyster monitoring for the Northern Estuaries will be leveraged for LOCAR ecological monitoring and AM. Oyster metrics are collected at 18 sites at varying frequencies: Growth, disease prevalence, predation, recruitment, and reproductive development are collected monthly, and oyster density and live/dead counts are conducted two times a year. Large scale oyster mapping is conducted every few years. Additional methodology information can be found in the RECOVER MAP documents and the South Florida Environmental Report (SFER 2024 Volume I).

Threshold that may trigger need for AM action: To assess the LOCAR performance or whether there is a need for AM action as it pertains to oysters, decision criteria to trigger management action needs to be developed for each of the estuaries based on the best available science and known oyster ecology and population dynamics.

Management options that may be chosen based on monitoring results: Optimize flows per procedural updates to the POM (**Annex C**) to establish salinity regimes that better align with needs of oysters to optimize abundance, distribution, and resilience.

Table D-3. LOCAR Estuaries Ecological Monitoring and Adaptive Management Strategies

Uncertainty Tracking ID#	Attribute or Indicator	Proposed Property to be Measured and Frequency	Timeframe to Detect Change of Attributes	Decision Criteria: Threshold(s) for Management Action	Management Action Options Suggestions
#12 When flows from Lake Okeechobee are altered, are the appropriate salinity regimes for SAV established with the estuaries, and is this evident by changes in SAV abundance, extent, and species composition/diversity?	SAV	**Tier 1** - Landscape scale – aerial mapping every 2 years. **Tier 2** - Patch-scale – species-specific cover and abundance at the end of the dry and wet seasons. **Tier 3** - Fixed-point sampling – cover, abundance, shoot-density, canopy height, and above-ground and below-ground biomass sampling occurs every other month from April through November.	5 years	TBD	Adjust water level operational guidance per the Project Operating Manual (POM) (**Annex C**)
#16 When flows from Lake Okeechobee are altered, are the appropriate salinity regimes for oysters established with the estuaries, and is this evident by changes in oyster abundance, density, extent, and recruitment?	Oysters	- At 18 existing sites monitor: growth, disease, predation, reproductive development, recruitment, density (monthly); live and dead counts (twice per year–spring and fall) - Estuary-wide substrate mapping for spatial extent and distribution of oyster and oyster shell every 3-5 years	5 years (acres of live oysters)	TBD	Adjust water level operational guidance per the Project Operating Manual (POM) (**Annex C**)

SAV–submerged aquatic vegetation

D.1.3 LOCAR Ecological Monitoring and Adaptive Management Plan Implementation

The LOCAR AM team, which includes a member of RECOVER in an advisory role, will work with the LOCAR 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 Ecological Monitoring and AM Plans. Additional technical expertise should be engaged as needed. Monitoring will be implemented in sequence with the Project components being implemented (see Figure D-1). 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.

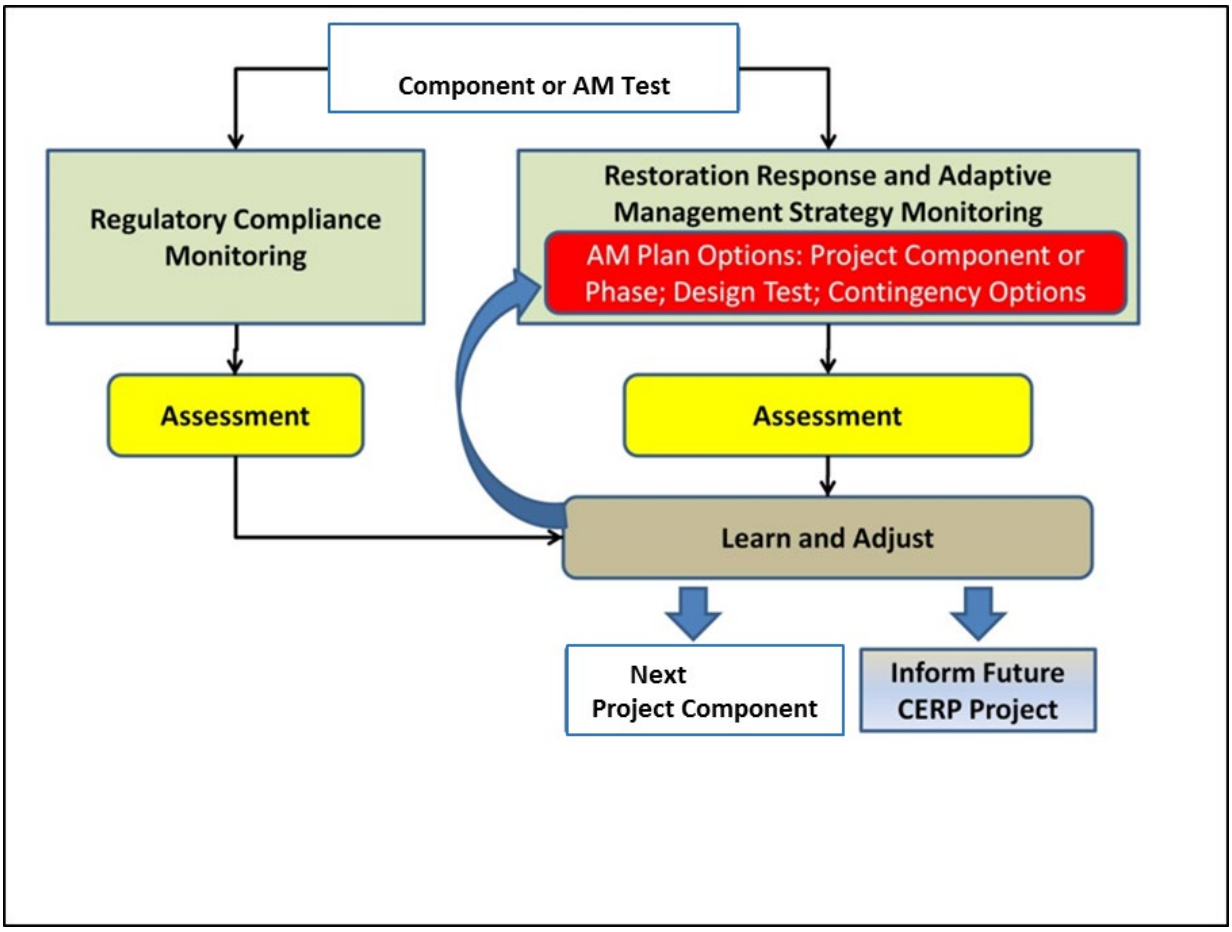

Figure D-1. Adaptive Management strategies and Project implementation diagram.

Project components will be implemented in a staggered fashion due to budget (i.e., amount of funds available each year), regulatory requirements (i.e., permits and compliance monitoring feedback), and LOCAR dependency constraints (i.e., state and federal projects required prior to implementation of a specific LOCAR Project component). Time needed to conduct certain Ecological monitoring and Adaptive Management activities and tasks to inform subsequent Project components is incorporated in the LOCAR implementation schedule and the strategies section of the LOCAR Ecological Monitoring and AM Plan. Each AM 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 LOCAR implementation. Figure D-1 shows that AM can proceed associated with a Project component, phase, full Project component, or test, with associated monitoring, to inform subsequent restoration actions. Monitoring should be implemented before and after Project implementation and operation as described in the Plan. 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 AM strategies and the information can be used to inform future CERP projects.

AM during LOCAR's 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. For this learning to occur, AM strategies will need to be implemented in sequence with the Project schedule.

D.1.4 Design

AM activities may also be executed during the PED phase of the Project. AM strategies may involve operational tests and phased implementation and will be discussed during value engineering and detailed design to determine the full scope of each test, Project construction phase, and implementation. Members of the LOCAR AM team tasked with overseeing LOCAR AM will coordinate with the engineers and water managers to ensure that Project designs, tests, and project operations manual allow flexibility for AM implementation, as well as ensure monitoring plan designs, thresholds-triggers, and reporting are consistent with engineering design and water management needs. AM strategies will also involve updates to monitoring and assessment plans to better develop designs, monitoring locations, and analysis methods, as well as initiate baseline monitoring data. Some 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 LOCAR Project components is completed.

D.1.5 Monitoring and Experimental Design

Other agency monitoring, and other contracts (e.g., RECOVER MAP) that are being relied upon to inform the LOCAR implementation as identified in the Ecological Monitoring and Adaptive Management Plan (**Table D-4**) will be reviewed to determine if changes in scope and frequency are needed to better capture LOCAR effects. The activities described here fall within the approved LOCAR Ecological Monitoring and Adaptive Management Plan budget. LOCAR-specific monitoring identified in the Plan will require scopes of work, schedules, and assessment protocols to be developed and coordinated by the LOCAR AM team to determine details and potential updates to the monitoring plan. Data analysis and modeling may be needed to inform the statistical sampling design needed for monitoring to be able to test LOCAR 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. LOCAR monitoring plan design will leverage existing data where possible, for example, RECOVER and other agency monitoring efforts. AM 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.

D.1.5.1 Baseline Monitoring

In cases where there is not sufficient pre-Project data monitoring, contracts will need to be initiated prior to construction of specific LOCAR components. Final assignment of agency monitoring responsibilities will be made after state and federal regulatory permits are issued for a component. The LOCAR AM team will 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 the AM team as stated in the Ecological Monitoring and Adaptive Management Plan.

D.1.5.2 Pre-construction Engineering and Design

Project component designs will be reviewed to ensure Project component designs are consistent with the testing objectives identified in the AM Plan uncertainties. Further data analysis or review of other Project design and monitoring information may be required to inform the design of LOCAR Project. 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 LOCAR AM team. 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 Plan. Members of the LOCAR AM team will also be responsible for conveying results from annual monitoring reports to the PED team to help determine options for improving Project designs.

D.1.5.3 Project Operating Manuals

Project operating manuals (POMs) 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 the LOCAR AM team to understand what hydrologic analysis is needed to inform operational criteria to be used as part of AM tests. In addition, the LOCAR AM team will work with water managers, planners, and hydrologists to ensure that flexibility is incorporated into the Project operational plan to allow for potential adjustments in the future consistent with regulatory constraints and National Environmental Policy Act (NEPA) analysis. The LOCAR AM team 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 applicable at pertinent Project meetings. Draft Project operating manuals will be reviewed by the LOCAR AM team and regulatory agencies to coordinate with the AM strategies outlined in the Plan and with regulatory permit requirements.

D.1.6 Construction

Construction schedules, construction contract language, and implementation progress will be coordinated with the LOCAR AM team to ensure that appropriate flexibility is included as needed to be effective in fulfilling the intent of the Plan. Schedules and implementation should include monitoring and operational tests consistent with the AM strategies described in the Plan to learn from Project component

implementation. In some cases, when agreed to by the implementing agencies, AM strategies may require adjustment to construction schedules 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.

D.1.7 Post-construction Monitoring and Operations, Maintenance, Repair, Replacement, and Rehabilitation

This subsection discusses how AM will handle post-construction monitoring and operations, maintenance, repair, replacement, and rehabilitation (OMRR&R).

D.1.7.1 Post-construction Monitoring

The LOCAR-specific Project monitoring, RECOVER systemwide monitoring, and other agency monitoring will be assessed by the LOCAR AM team to determine the restoration performance related to key Project components or groups of components. 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 thresholds outlined in the AM 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 LOCAR 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 LOCAR operations or construction of subsequent Project components.

D.1.7.2 Post-construction Assessment, Reporting, and Linking to Decision-making

The LOCAR assessment results will be reported to the implementing agencies and LOCAR partner agencies as part of the RECOVER system-status report, South Florida Environmental report, and applicable reporting independent of these forums may also be pursued by the LOCAR AM team. 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 of 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” to the “Quarterly Executive Team”, and the “Quality Review Board” to the “Quarterly Agency Team”.

Monitoring results will be reported in the context of the thresholds identified in the AM strategies (e.g., if performance remains within the 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 thresholds that are “triggered” will be reported to LOCAR implementing agencies and associated regulatory agencies with suggestions of management options to implement, as stated in the AM Plan strategies, 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 LOCAR 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 annually.
2. NEPA Covered Options, No Modeling Needed: LOCAR AM 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: LOCAR AM plan options that are covered by NEPA, but may require model runs to determine best option.
4. Not NEPA Covered: LOCAR AM 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 LOCAR AM Plan: In some cases, the monitoring results may indicate the need for an option not identified in the AM plan or Section 203 Study. This may result in agency-approved temporary adjustment to LOCAR implementation and operations to avoid the constraint while potential Project adjustments are further scoped, analyzed, approved, and budgeted for implementation.

The Corps Jacksonville District, in consultation with federal and state resource agencies, the Corps South Atlantic Division, and SFWMD, will guide decisions on determining whether restoration success has been achieved or additional operational, structural, or other contingency options identified in the AM Plan strategies need to be implemented.

D.1.8 LOCAR Ecological Monitoring and Adaptive Management Plan Cost Estimate

Identification of the LOCAR ecological monitoring and AM plan contained in **Annex D.1** was guided partly by two objectives. First, it must be complete from a LOCAR perspective in that it must provide the monitoring required to address LOCAR-specific needs. Second, it must be integrated with other Everglades monitoring to leverage existing monitoring efforts, knowledge, and information and thereby leverage dollars committed and spent elsewhere to avoid redundancies and ensure cost effectiveness. These two objectives guided development of the Ecological Monitoring and Adaptive Management Plan, Hydrometeorological Monitoring Plan, and the Water Quality Monitoring Plan. Where possible, LOCAR 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 LOCAR Monitoring Plans is limited to the additional, marginal increase in monitoring resources and analysis efforts needed to address LOCAR-specific questions. It is assumed that the monitoring programs will continue for at least the time needed by LOCAR.

Given the new knowledge and answers to key questions, the AM strategies and options proposed may need refinement. Therefore, items included in this plan are not guaranteed to be funded as-is but will be considered again when LOCAR 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. Costs for recommended Ecological Monitoring and AM Plan may be different during

implementation. Therefore, several detailed estimates provided in this Plan may be lower than the amounts shown in the cost summary tables that include the contingency in **Section 6**, and **Table D-5**. 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.

Table D-4 summarizes the Ecological Monitoring and AM plan estimated costs and includes (1) objective, (2) area monitoring, (3) uncertainty, (4) attributes, (5) LOCAR costs, and (6) leveraged cost from other ongoing monitoring efforts. LOCAR monitoring costs are shown as if all monitoring will take place in one 10-year window. Therefore, LOCAR costs here are a "worst case," whereas the actual monitoring schedule is expected to be staggered over the LOCAR implementation schedule as shown in Table D-4 and would therefore cost the Project less per year.

Table D-4. LOCAR Ecological Monitoring and Adaptive Management Cost Breakdown

LOCAR Objective	Category or Specific LOCAR Area	Uncertainty	Proposed Attributes to be Monitored	LOCAR 1-yr Cost	Leveraged 1-yr Cost from Other Ongoing Monitoring Efforts	Notes
1	Lake Okeechobee	Will ecological indicators respond to lake stage changes as expected? #25 Will fish and wildlife communities benefit from the Project's effect on lake stages or will additional habitat management be needed? #26	- *Chara* - Cyanobacteria - SAV - EAV - Wading birds - Snail kites - Fish	Littoral EAV: $25,000 (per year)	Wading bird nesting: $100,000 (RECOVER) Chara, cyanobacteria, SAV: $201,610 (SFWMD) Snail Kites: $150,000 (Corps regulatory) Wading Bird Foraging: $25,000 (SFWMD) Fish: $25,500 (FWC electrofishing)	
1	Lake Okeechobee	How will new hydrologic regimes affect the occurrence of invasive (native and/or non-native) or undesirable flora and fauna in Lake Okeechobee? #17	- EAV - Fish - Other Fauna	Littoral EAV (covered above) Fish and other fauna: $60,000	Covered above	Other fauna may need to be monitored and will be determined following LOCAR authorization. Much of overall monitoring and cost covered in INSMP (Annex F), but fish and other fauna costs included here.
2	Estuaries	When flows from Lake Okeechobee are altered, and salinity regimes for SAV are improved, what changes to SAV abundance, extent, and species composition/diversity will occur in the estuaries? #16	SAV	$0	$105,000 for Tiers 2 and 3; $200,000 every 2 or 5 years for Tier 1 mapping	RECOVER maps SAV approximately once every 5 years (CRE), and S-IRL through a partnership with SJRWMD mapped approximately every 2 years.
2	Estuaries	When flows from Lake Okeechobee are altered and salinity regimes for oysters are improved, what changes to oyster abundance, extent, density, and recruitment will occur in the estuaries? #12	Oysters	$0	Annually: $155,000 Mapping every 3-5 years: $300,000	RECOVER oyster mapping was completed in 2019 and will be repeated approximately every five years.

AM–adaptive management; Corps–U.S. Army Corps of Engineers; CRE–Caloosahatchee River and Estuary; EAV–emergent aquatic vegetation; LOCAR–Lake Okeechobee Storage Reservoir Section 203 Study; PM–performance measure; RECOVER–Restoration Coordination and Verification; SAV–submerged aquatic vegetation; SJRWMD–St John's River Water Management District; yr.–year.

D.1.9 Biological Opinion Monitoring and Regulatory Monitoring

The LOCAR Monitoring Plan includes monitoring and associated costs required under the BO and other agency permits that are needed to protect and conserve natural resources. More information can be found in Annex A: FWCA and ESA Compliance.

Table D-5. Total Cost Estimate for Ecological Monitoring and Adaptive Management. Project cost first, followed in parentheses by leveraged monitoring efforts funded by ongoing inter and intra agency monitoring.

Part	1-year Project Cost (leveraged cost)	2 to 5-year Project Cost (leveraged cost)	10-year Project Cost (leveraged cost)
Ecological Monitoring and Adaptive Management	$85,000 ($762,110)	$340,000 ($3,408,440)	$425,000 ($4,535,550)
Biological Opinion	TBD	TBD	TBD
Total Project Cost	**$85,000***	**$340,000***	**$425,000***

Project–Lake Okeechobee Storage Reservoir Section 203 Study

* Cost does not include final cost estimate for BO efforts

D.1.10 LOCAR Screened Uncertainties

Table D-6 lists the uncertainties screened out of the AM Plan per Corps planning guidance and CERP AM guidance.

Table D-6. Uncertainties Screened from the AM Plan.

Uncertainty ID #	Category	Risk or Question or Uncertainty	Meeting Notes and Discussions	Rationale of Uncertainty Removal
23, 24	Lake Okeechobee	Are we meeting lake stage envelope with projected frequency?	Not screened out initially, went through the prioritization process.	Tier 3 of prioritization, so not carried forward.
16	Fauna	Will displacement of upland species (T&E and others) from reservoir footprint result in impacts to adjacent landowners?	Not screened out initially, went through the prioritization process.	Tier 3 of prioritization, so not carried forward.
30	Reservoirs	If ideal design is implemented and negative impacts to fish/other spp. occur, are there other options that could be implemented to offset those negative effects?	Not screened out initially, went through the prioritization process.	Tier 3 of prioritization, so not carried forward.
35	Water Quality	Will the Project result in mobilization of pollutants (i.e., nitrogen and phosphorus) from the reservoir?	Not screened out initially, went through the prioritization process.	Tier 3 of prioritization, so not carried forward.
42	Water Supply	Will there be unanticipated changes in water levels that impact existing level of service to nearby residential areas?	Not screened out initially, went through the prioritization process.	Tier 3 of prioritization, so not carried forward.
6	Climate Change	Will a major storm event overwhelm the flows to reservoirs and flows to estuaries?	If a severe weather event overwhelms reservoirs, AM strategies may not be feasible/effective, and may be secondary to health and safety concerns.	AM not feasible.
7	Climate Change	Will climate change have effects on water supply and reservoir operations?	Depending on context this may be a program- or system-scale uncertainty; what AM strategies could be implemented to offset climate change at a Project level?	Systemwide, not Project-level AM.
8	Climate Change	Will Project changes offset SLR effects? How will it affect what we are trying to do?	Depending on context this may be a program- or system-scale uncertainty; what AM strategies could be	Systemwide, not Project-level AM.

Uncertainty ID #	Category	Risk or Question or Uncertainty	Meeting Notes and Discussions	Rationale of Uncertainty Removal
			implemented to offset climate change at a Project level?	
9	Engineering	How will the southern reservoir affect this Project?	Effects from outside projects would be addressed under their respective scopes.	Not Project-level.
10	Engineering	Reservoir - will there be seepage through the berm of the reservoir?	Strategies to address seepage may not fall under AM Plan; concern to be reported to Engineering team.	Engineering design concern - covered in PED, not AM.
11	Engineering	Reservoir - will there be seepage into the groundwater table?	Strategies to address seepage may not fall under AM Plan; concern to be reported to Engineering team.	Engineering design concern - covered in PED, not AM.
15	Estuaries	How will Lake Okeechobee water quality affect our ability to restore the estuaries?	Water quality is not an objective of the Project.	Not Project-level.
27	Land Use	How will land use in the watershed outside of the Project feature?	This may exceed Project scale and would be addressed under NEPA.	Not Project-level and Project-level uncertainties covered in the EIS under NEPA.
28	Operations	How will a change in lake regulation schedule affect this Project?	This would be addressed during Plan Formulation.	Addressed during plan formulation.
29	Reservoirs	Maintain reservoir levels - drought, dry season, wet season.	Need additional information/specific question; none proposed by team in subsequent discussions.	No specific uncertainty identified.
24	Lake Okeechobee	Extreme high and low - duration and frequency.	Discussed during teleconferences; concept merged with Uncertainties 23 and 25.	Merged with Uncertainties 23 and 25.
31	Reservoirs	Will there be recreational access to the reservoirs?	This would be addressed under NEPA.	Not an AM uncertainty - addressed in the EIS.
32	Reservoirs	Buffer lands around the reservoirs to protect uplands in the area.	This would be addressed during Project design.	Not an AM uncertainty - addressed during PED.
33	Reservoirs	Effect of reservoirs on groundwater levels.	There is existing knowledge/modeling for anticipated effects to groundwater levels. Also, how would this be related	Not tied directly to a Project objective or constraint.

Uncertainty ID #	Category	Risk or Question or Uncertainty	Meeting Notes and Discussions	Rationale of Uncertainty Removal
			back to at least one of the stated objectives or constraints?	
34	Reservoirs	Impacts to uplands/wetlands in reservoir footprints.	This would be addressed under NEPA.	Not an AM uncertainty - addressed in the EIS.
39	Water Quality	Nutrient inflows into Lake Okeechobee.	Need additional information/specific question; none proposed by team in subsequent discussions.	No specific uncertainty identified and not at a Project-level.
47	Lake/Estuaries	How do unrelated habitats affect restoration?	Outside Project scope.	Not in Project scope.
48	Wildlife	Will species (T&E) impact our ability to manage the features for the benefit of the Project?	This will be addressed under NEPA/ESA section 7 consultation.	Not an AM uncertainty - addressed in the EIS and under Section 7 ESA consultation.

AM–adaptive management; EIS–; Environmental Impact Statement; ESA–Endangered Species; NEPA–National Environmental Policy Act; PED–preconstruction engineering and design; Project–Lake Okeechobee Storage Reservoir Section 203 Study; SLR–sea level rise; T&E–threatened and endangered

D.1.11 References

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Part 2: Water Quality Management Plan

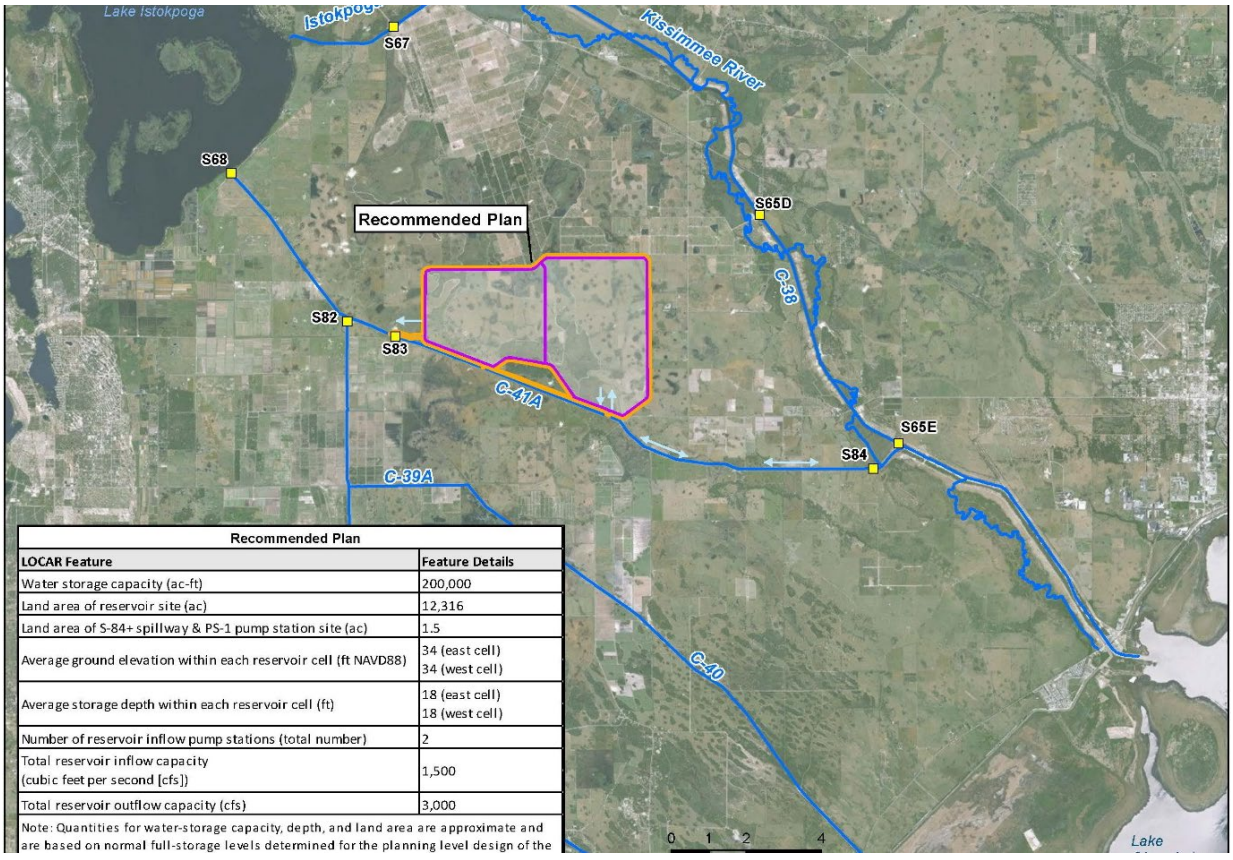
D.2 Introduction to the LOCAR Water Quality Monitoring Plan

This document serves as a preliminary reference for monitoring surface water quality for LOCAR, including features proposed in the LOCAR Recommended Plan (**Figure D-2**). Monitoring will be conducted to evaluate LOCAR's performance with regard to restoration goals and compliance with water quality standards. Specifically, the Project is intended to improve the quantity, timing, and distribution of water entering Lake Okeechobee; provide for better management of lake water levels; reduce high volume flows to the Northern Estuaries from Lake Okeechobee; improve systemwide operational flexibility; increase the spatial extent and functionality of wetland habitat; and improve water supply to existing legal water users of Lake Okeechobee. The area of the Recommended Plan extends east from Canal 40 (C-40) to the Kissimmee River. The proposed LOCAR aboveground storage feature is located northwest of the lake. Figure D-2The plan is organized into geographic areas: Lake Okeechobee Watershed, Lake Okeechobee, and the Northern Estuaries.

D.2.1 Project Description

The LOCAR Project features include the following elements:

1. Storage;
2. Distribution and conveyance; and
3. Seepage management.



Recommended Plan	
LOCAR Feature	**Feature Details**
Water storage capacity (ac-ft)	200,000
Land area of reservoir site (ac)	12,316
Land area of S-84+ spillway & PS-1 pump station site (ac)	1.5
Average ground elevation within each reservoir cell (ft NAVD88)	34 (east cell) 34 (west cell)
Average storage depth within each reservoir cell (ft)	18 (east cell) 18 (west cell)
Number of reservoir inflow pump stations (total number)	2
Total reservoir inflow capacity (cubic feet per second [cfs])	1,500
Total reservoir outflow capacity (cfs)	3,000
Note: Quantities for water-storage capacity, depth, and land area are approximate and are based on normal full-storage levels determined for the planning level design of the	

Figure D-2. Recommended Plan footprint map.

D.2.2 Water Quality Monitoring Objectives

The monitoring stations described in this document are referenced to satisfy requirements of LOCAR and requirements of (issued or pending) Corps 404 permits and/or State of Florida 373.1502 Comprehensive Everglades Restoration Plan Regulation Act permits for Start Up and Operational Phase Monitoring. This plan provides a preliminary outline for quantifying the quality of surface water entering and downstream of the Project Area for a period of 10 years. This plan 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 SFWMD's DBHYDRO database (SFWMD 2023) and in the annual South Florida Environmental Report. The U.S. Geological Survey also collects 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 SFWMD.

The water quality data obtained under this program will be used for these purposes:

1. Evaluate water quality status and trends;
2. Assess compliance with federal and state water quality statutes; and
3. Guide mid- and long-term resource management decisions as part of the AM Plan for the Project.

D.2.3 Surface Water Monitoring

The goal of surface water quality monitoring is to ensure that surface water quality released from the reservoir will not negatively impact the downstream area(s) and is in compliance with applicable state and federal water quality standards. The water quality monitoring plan presents a conceptual outline for surface water monitoring in relation to the operation and subsequent releases into adjacent waterways.

Surface water would be pumped from downstream of Structure 65E (S-65E) upstream of Structure 84 (S-84) into Canal 41A (C-41A). Flow out of the reservoir would be discharged upstream or downstream of S-83 via a canal and culvert into C-41A. Seepage from the reservoir would collect in the canal and be returned to the reservoir via seepage pump stations. If the seepage pump stations were not operational, the seepage collected in the canal would eventually overflow into the C-41A via overflow weir structures.

Surface water quality criteria are defined in the Florida Administrative Code, Chapter 62-302, *Surface Water Quality Criteria*. The state of Florida sets water quality criteria consistent with the Clean Water Act. The final surface water quality monitoring plan (inclusive of location of monitoring points, frequency of sampling, and required analytes) will be developed during the permitting process. **Figure D-2** illustrates surface water routing and flow directions.

D.2.4 Surface Water Quality Monitoring Cost Estimate

The following describes the minimal surface water monitoring needs for the three surface water impoundment cells, within the reservoir, included in the LOCAR Recommended Plan. **Table D-7** includes the cost of surface water monitoring. The purpose of the surface water quality monitoring is to address the expected surface water regulatory monitoring requirements and the startup monitoring required for mercury/toxicants required by CGM 42. The SFWMD is in the process of finalizing evaluation of the Project lands for hazardous, toxic, and radioactive waste and legally applied residual agricultural amendments.

Some remediation may be conducted by the SFWMD (e.g., removal of aboveground fuel tanks, etc., if necessary). Pending any new information acquired from that investigation (to be completed before start of any construction activity), the surface water quality monitoring plan may have to be revisited and potentially amended. The final surface water quality monitoring plan will be developed during the permitting process.

Table D-7. Summary of Surface Water Quality Monitoring Costs.

Budget Area	Year 1	Years 2-5 Annual Cost	Years 6-50 Annual Cost
Capital (sampling platforms, equipment, vehicle cost, etc.)	$164,700	$0	$2,440
Fuel and maintenance	$12,200	$12,200	$12,200
Consumables	$0	$0	$0
Surface Water Nutrients and Ions	$793	$793	$793
Surface Water Mercury (Hg) and Toxins	$153	$0	$0
Small Fish Hg	$122	$122	$0
Small Fish Toxicants	$31	$0	$0
Large Fish Hg	$31	$31	$0
Sediment Hg and Toxins	$31	$31	$31
Annual Sums	$178,059	$13,146	$15,433
Analytical	-	-	-
Surface Water Nutrients and Ions	$199,600	$119,600	$119,600
Surface Water Hg and Toxins	$30,820	$0	$0
Small Fish Hg	$12,000	$12,000	$0
Small Fish Toxicants	$15,000	$0	$0
Large Fish Hg	$22,000	$22,000	$0
Sediment Hg and Toxins	$18,400	$0	$0
Annual Sums	$297,820	$141,600	$119,600
Staff	-	-	-
Surface Water Nutrients and Ions	$147,308	$147,308	$147,308
Surface Water Hg and Toxins	$6,412	$0	$0
Small Fish Hg	$30,217	$30,217	$0
Large Fish Hg	$14,640	$14,640	$0
Sediment Hg and Toxins	$8,433	$0	$0
Annual Sums	$207,010	$192,165	$147,308
Annual Totals	$682,889	$346,910	$282,341
Number of Years	1	4	45
Item Subtotals	$682,889	$1,387,641	$12,705,331
Grand Total			$14,775,860

D.2.5 References

SFMWD (South Florida Water Management District). 2023. DBHYDRO (Environmental Data). Available online at: https://www.sfwmd.gov/science-data/dbhydro.

Part 3: Hydrometeorological Monitoring Plan

D.3 Hydrometeorological Monitoring

This SFWMD hydrological monitoring plan follows all standard operating procedures (SOPs) for site installation, data collection, data processing, and quality assurance/quality control (QA/QC) established by Infrastructure Management Bureau's Supervisory Control and Data Acquisition Instrumentation & Telemetry Section and Hydro Data Management Section.

D.3.1 Data Quality Objectives

Developing Data Quality Objectives (DQO) is an integral and important part of a systematic planning process 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. It will also be used 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 December 7, 2010. The DQOs are further outlined in **Subsection 3.1.1** of this document.

D.3.2 Monitoring Data Elements, Indicators, and Cost Estimate

Hydrometeorological and hydraulic monitoring data will be collected, at a minimum, at each of the new structures; gate openings at gated structures; and pump stations. **Table D-8** provides a list of existing gauges at main structures within the LOCAR Project Area. Structures proposed in the Recommended Plan are subject to change during PED.

describes a preliminary list of minimal gauging needs for the reservoir. This table lists the necessary gaging parameters to be collected as part of LOCAR, which are in addition to current monitoring stations that will be leveraged for LOCAR. 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 Corps-required standard for these parameters. Breakpoint data for a pump is collected when changes to the revolutions per minute (RPM) are made, up to a frequency of 1 minute. The hydrologic and meteorological data collection equipment used for this Project would be installed either as part of the construction contract or via a separate contract with construction funding. Hydrometeorological parameters, such as surface and groundwater stages, require accurate estimates of the water elevation height compared to a known reference. All new surface water monitoring installations will be surveyed to a first order accuracy using the nearest geodetic benchmark. Reference elevations will be reported in both the North American Vertical Datum of 1988 and NGVD29. Several of the structures are located within proximity to each other and/or existing gages and, therefore, fewer new gages will be needed. See **Figure D-3** for a map of the conceptual structures proposed in the reservoir.

Table D-8. Monitoring Gauges at Existing Structures in LOCAR.

Structure	Gauge Parameter	Frequency of Reading
S-84	Headwater and tailwater stage	15-minutes
S-65E	Headwater and tailwater stage	15-minutes
S-77	Headwater and tailwater stage	15-minutes
S-78	Headwater and tailwater stage	15-minutes
S-79	Headwater and tailwater stage	15-minutes
S-308	Headwater and tailwater stage	15-minutes
S-80	Headwater and tailwater stage	15-minutes

LOCAR–Lake Okeechobee Storage Reservoir Section 203 Study

The Corps-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, U.S. Geological Survey, and Everglades National Park.

As the Recommended Plan is optimized and further developed during PED, estimates and contingencies for hydrometeorological monitoring during Operational Testing and Monitoring Period and OMRR&R are expected to change. For the purpose of this planning phase, the cost to monitor minimal gauging needs for the reservoir is $210,000 per year. The total cost of the hydrometeorological monitoring plan is summarized in **Section 6**. This cost is also captured in **Section 6**.

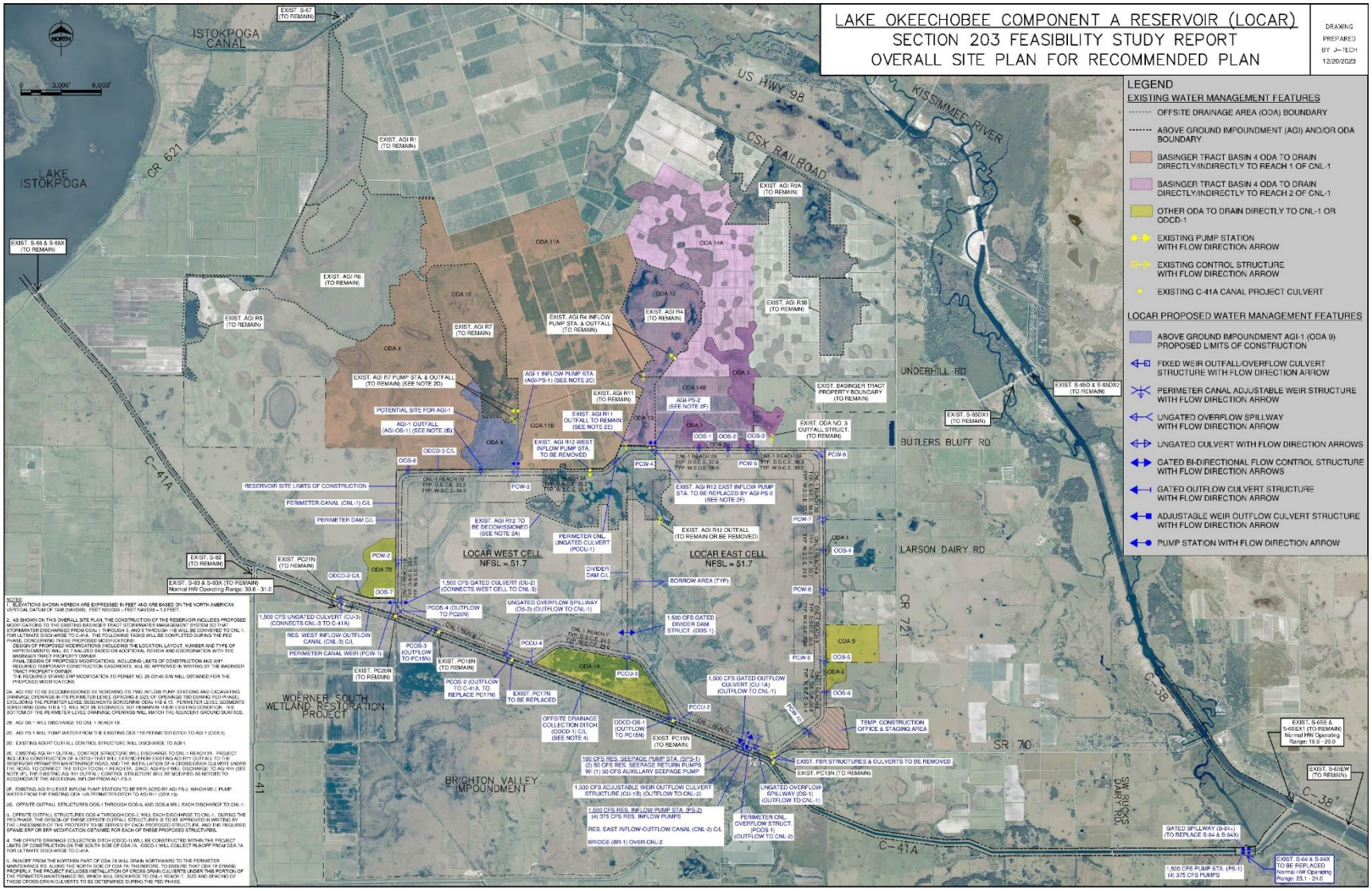


Figure D-3. Overall Site Plan with structures.

D.3.3 Procedures and Methods

Measurements will be recorded in the manner outlined in CERP's *Quality Assurance Systems Requirements*, Chapter 6, Table 6.1, dated December 7, 2010.

To summarize, surface water stages will be measured using a Serial Digital Interface (SDI) encoder at each monitoring location. The accuracy required is ±0.02 ft for critical sites and ±0.03 ft for noncritical sites. The reported resolution will be 0.01 ft and the instrument range will be 0 to 20 ft. The precision will be ±0.01 ft. The sampling frequency likely will be in 15 minute-increments (at a minimum), at zero, 15, 30, and 45 minutes past each hour (e.g., at 1,500 hours, 1,515 hours, 1,530 hours, and 1,545 hours), though breakpoint sampling may be done.

Groundwater stages will be measured using an SDI encoder at each monitoring location. The accuracy required is ±0.03 ft. The reported resolution will be 0.01 ft and the instrument range will be zero to 30 ft. The precision will be ±0.01 ft. The sampling frequency likely will be in 15-minute increments (at a minimum).

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 likely will be in 15 minute-increments (at a minimum). At this time, the location of rainfall gauges has not yet been determined.

Gate positions will be measured using gate position indicators with an accuracy of ±0.05 ft, a reported resolution of 0.01 ft, and a gate position range of either zero to 75 inches or zero to 550 inches. The precision required is ±0.02 percent full stroke. The reporting frequency will be at least and likely 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 zero to 3,000 RPMs. The reporting frequency will be 1 to 360 samples per hour.

Computed flows will have an accuracy uncertainty limit of 95 percent confidence interval. The accuracy will be ±10 percent for inland spillways, ±15 percent for culverts, and ±15 percent for pumps. The velocity instrumentation will have a precision of ±0.01 ft/second. The reporting frequency likely will be in 15-minute increments (at a minimum).

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 using hardened cases and natural or unnatural intrusions (e.g., inclement weather and animals). 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.3.4 Rationale for Indicator Selection

The indicators selected for inclusion are required under CERP's *Quality Assurance Systems Requirements*, Chapter 6, Table 6.1, dated December 7, 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.3.5 Sampling Frequency and Duration

The sampling frequency and duration is governed by CERP's *Quality Assurance Systems Requirements*, Chapter 6, Table 6.1, dated December 7, 2010.

The recording frequency for the surface water stages likely will be conducted in 15 minute-increments (at a minimum), at zero, 15, 30, and 45 minutes past each hour (e.g., at 1,500 hours, 1,515 hours, 1,530 hours, and 1,545 hours). The recording frequency for the groundwater stages likely will be conducted in 15 minute-increments (at a minimum). Rainfall recording frequency presumably will be 15 minutes. Gate positions recording frequency likely will be in 15-minute increments (at a minimum). Pump RPMs recording frequency will be by break point, with a minimum of 1 recording per hour, up to 360 recordings per hour. Computed flows computing frequency will be 15 minutes.

D.3.6 Assessment Process and Decision Criteria (Triggers and Thresholds)

Trigger elevations for surface water will take into consideration the design headwater and tailwater at the gauges' respective structures to ensure that design limits are not reached. In addition, the decision criteria will be further refined as the operations of LOCAR are developed.

D.3.7 Data Collection

This section outlines the data collected.

D.3.7.1 Sample and Data Collection Standards and Ethics

No physical samples will be collected for hydrometeorological monitoring. Data will be collected following the required standards as described in this document.

D.3.7.2 Sample Submission

No samples will be collected for hydrometeorological monitoring.

D.3.7.3 Chain of Custody

No samples will be collected for hydrometeorological monitoring.

D.3.7.4 Quality Control Samples

No samples will be collected for hydrometeorological monitoring.

D.3.7.5 Data Validation

Data validation processes will follow the current SOPs at the time of data collection. The current Corps data validation process is subject to Engineering Regulation (ER) 1110-2-8155, *Hydrometeorological Data Management and Archiving*, dated July 31, 1996, and ER 1110-2-249, *Management of Water Control Data Systems*, dated August 31, 1994. The Corps data validation may be accomplished by automated or manual means. This process may include estimating values for missing or erroneous data.

Data collected by the SFWMD will be kept as raw archive files. The adjusted (i.e., QA/QC-ed) data will be stored as processed archive files. Data collected by the Corps is maintained in databases and further computations are applied to generate addition databases of computed data.

D.3.7.6 Data Validation Processing

Data validation processing will follow the current SOPs at the time of data collection. The current Corps data validation process is subject to ER 111028155, *Hydrometeorological Data Management and Archiving*, dated July 31, 1996, and ER 11102249, *Management of Water Control Data Systems*, dated August 31, 1994.

Data processing shall 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) knowledge management.

D.3.7.7 Data Storage and Archiving

Data collected will be stored and archived in accordance with ER 1110-2-8155, *Hydrometeorological Data Management and Archiving*, dated July 31, 1996. The Corps maintains databases where all collected and computed water management data is stored and archived.

For the SFWMD, after the data validation process (generally with 1 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 DataOne. Field notes are maintained on an internal server either by scanning actual field note pages as Portable Document Formats or by uploading narratives from field computers as 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.3.8 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.
- Training logs must be provided and samplers should be properly trained.

D.3.9 Field Notes

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.3.10 Field Instrument Calibration Documentation

Records of field instrument calibration will be kept and SFWMD's or Corps' SOPs for calibration will be followed.

D.3.11 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, and initialing and dating the change. On occasion, a detailed explanation of the error may be required.

D.3.12 Quality Assurance and Quality Control

The following sections are referenced within the QA/QC procedures.

D.3.13 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 in compliance with FDEP's Comprehensive Quality Assurance Plan Rule, 62-160 Florida Administrative Code and associated SOPs.

D.3.14 Data Quality Qualifiers

The data quality standards for hydrometeorological data are determined by the Corps' and SFWMD's respective guidance and will be followed in compliance with FDEP's Comprehensive Quality Assurance Plan Rule, 62-160 Florida Administrative Code and associated SOPs.

D.3.15 Field Audits

The data quality standards for hydrometeorological data are determined by the Corps' and SFWMD's respective guidance and will be followed in compliance with FDEP's Comprehensive Quality Assurance Plan Rule, 62-160 Florida Administrative Code and associated SOPs.

D.3.16 Data Analyses and Records Management

The Corps process is subject to ER 1110 2 8155, *Hydrometeorological Data Management and Archiving*, dated July 31, 1996, and ER 1110 2 249, *Management of Water Control Data Systems*, dated August 31, 1994.

The SFWMD procedures are described in its *2008 South Florida Environmental Report*, Appendix 2 1: Hydrological Monitoring Network of the South Florida Water Management District.

D.3.17 Data Quality Evaluation and Assessment

The data quality standards for hydrometeorological data are determined under the Corps' and SFWMD's respective guidance and will be followed in accordance with FDEP SOPs.

D.3.18 Adaptive Management Considerations

D.3.18.1.1 Total Adaptive Management and Monitoring Costs

Table D-9 below shows the total cost estimate for AM monitoring, ecological monitoring, water quality monitoring and hydrometeorological monitoring over the lifecycle of the Project.

Table D-9. LOCAR Total Cost Estimate for Monitoring Plans including Ecological Monitoring and Adaptive Management, Water Quality, Hydrometeorological, and Biological Opinion.

Part	Annual (1-year)	2 to 5-year	10-year[1]	6 to 50-year
Ecological Monitoring and AM	$85,000	$340,000	$425,000	N/A
Biological Opinion	TBD	TBD	N/A	N/A
Water Quality	$682,889	$1,387,641	N/A	$12,705,331
Hydrometeorological	$1,615,158	$8,075,790	N/A	$80,757,900
Total	$2,383,047+	$9,497,431+	$425,000+	$93,463,231+

[1] Ecological Monitoring and Adaptive Management Plan costs are construction funded up to 10 years post construction, per U.S. Army Corps of Engineers Headquarters implementation guidance on Section 1161 of 2016 Water Resources Development Act.
[*Preparer's Note: Costs for monitoring defined in the Biological Opinion will be included in the Final Report*.]

Part 4: Florida Panther Mitigation Plan

D.4 Florida Panther Mitigation

According to the U.S. Army Corps of Engineers (USACE) Biological Assessment prepared in 2023 for the proposed Project, LOCAR would result in the conversion of approximately 12,392 acres of panther habitat to an aboveground reservoir. The U.S. Fish and Wildlife Service (USFWS) Panther Tool was used to determine how many Panther Habitat Units (PHUs) would be impacted due to construction of the Project. PHUs are determined based on which Florida panther zone(s) the habitat impacts occur in (Primary/Dispersal Zone, Secondary Zone, and Other Zone); the type of habitats being impacted; and the base ratio used within the Panther Tool. The base ratio is based on USFWS's 2012 Panther Habitat Assessment Methodology (USFWS 2012) that documents the methods and data used to calculate the base ratio. The Project would result in a net loss of approximately 42,006 PHUs within the panther Dispersal Zone. The USFWS documented that for this Project, which is not located in any Primary/Dispersal Zone or Secondary Zone, and is entirely within the "Thatcher's 2006 Least Cost Model Dispersal Pathways", an Other Zone, the value of the impacts from the Project would thus equal the value of the Other Zone; therefore, as shown below, the Other Zone was used in the USFWS Panther Tool to calculate the total number of PHUs impacted.

PROJECT WORKSHEET

Habitat Type	Assigned value	Habitat types of land to be developed: Primary/d Zone	Secondary Zone	Other Zone	Primary Equivalent Habitat Units	Habitat types of land after development: Primary/d Zone	Secondary Zone	Other Zone	Primary Equivalent Habitat Units
Pine forest	9.5	0			0				0
Hardwood-Pine	9.3				0				0
Cypress swamp	9.2				0				0
Hardwood swamp	9.2			12	37				0
Hardwood Forest	9				0				0
Dry prairie	6.3			39	82				0
Unimproved pasture	5.7			1895	3601				0
Shrub swamp/brush	5.5			22	40				0
Improved pasture	5.2			7534	13059				0
Cropland	4.8			19	30				0
Orchards/groves	4.7				0				0
Marsh/ wet prairie	4.7			2776	4349				0
Xeric scrub	4.5				0				0
Exotic/Nuisance plants	3				0				0
Coastal wetlands	3				0				0
Barren/Disturbed lands	3			17	17				0
Water	0			4	0				0
Urban	0			74	0				0
Reservoirs*					0				0
STA*					0				0
TOTAL		0.00	0.00	12392.00	21214.93	0.00	0.00	0.00	0.00

CONTINUE

CLEAR SHEET

COMPENSATION TO OFF-SET
42006
Habitat Units

*NOTE: The assigned value for Reservoirs and STAs varies by size, proposed future management, and their position in the landscape.
See the associated methodology document for guidance on starting values and considerations.

USACE mitigation policy requires that mitigation target the habitat functions that would be affected by the given project. Applying this policy to LOCAR requires acknowledging how the LOCAR reservoir would affect the basic functions of the habitat, especially regarding the primary species of concern—Florida panthers. It would affect the panther's habitat functions of feeding, breeding, and denning, as well as their corridor functions of movement, dispersal, and range expansion. The LOCAR reservoir would have negative effects on panther range expansion (corridor), primarily because the reservoir would block, and thereby reduce, panther movements through the land corridor between Lake Okeechobee and Lake Istokpoga. This corridor is important for panther range expansion northward, and the width of this corridor would be reduced by approximately 7 miles and 54 percent when the reservoir is built. Reducing the size of this corridor would reduce the number of panthers that can move through the corridor and

continue range expansion. The need to mitigate or offset impacts to both habitat functions and corridor functions would inform the mitigation.

From 1980 through most of 2016, all occurrence data demonstrated that female panthers were present only south of the Caloosahatchee River and most reproduction occurred in Collier, Hendry, Lee, and Miami-Dade counties. However, since late 2016, occurrence data of female panthers north of the Caloosahatchee River has demonstrated the high value of these areas for the recovery and expansion of the Florida panther. Therefore, lands considered as compensation for the PHUs needed to mitigate for the LOCAR would receive credit as follows (PHU calculations for Primary Zone and Dispersal Zone are being equal):

- **Primary Zone equivalent:** For Florida panthers located north of the Caloosahatchee River and located within the "Primary Dispersal/Expansion Area" as indicated in Figure 1.
- **Dispersal Zone equivalent:** For Florida panthers located north of the Caloosahatchee River and located within Thatcher's 2006 Least Cost Model Dispersal Pathways as indicated in Figure 1.
- **Other Zone equivalent:** For Florida panthers located north of the Caloosahatchee River and outside of the #1 and #2 designated areas.

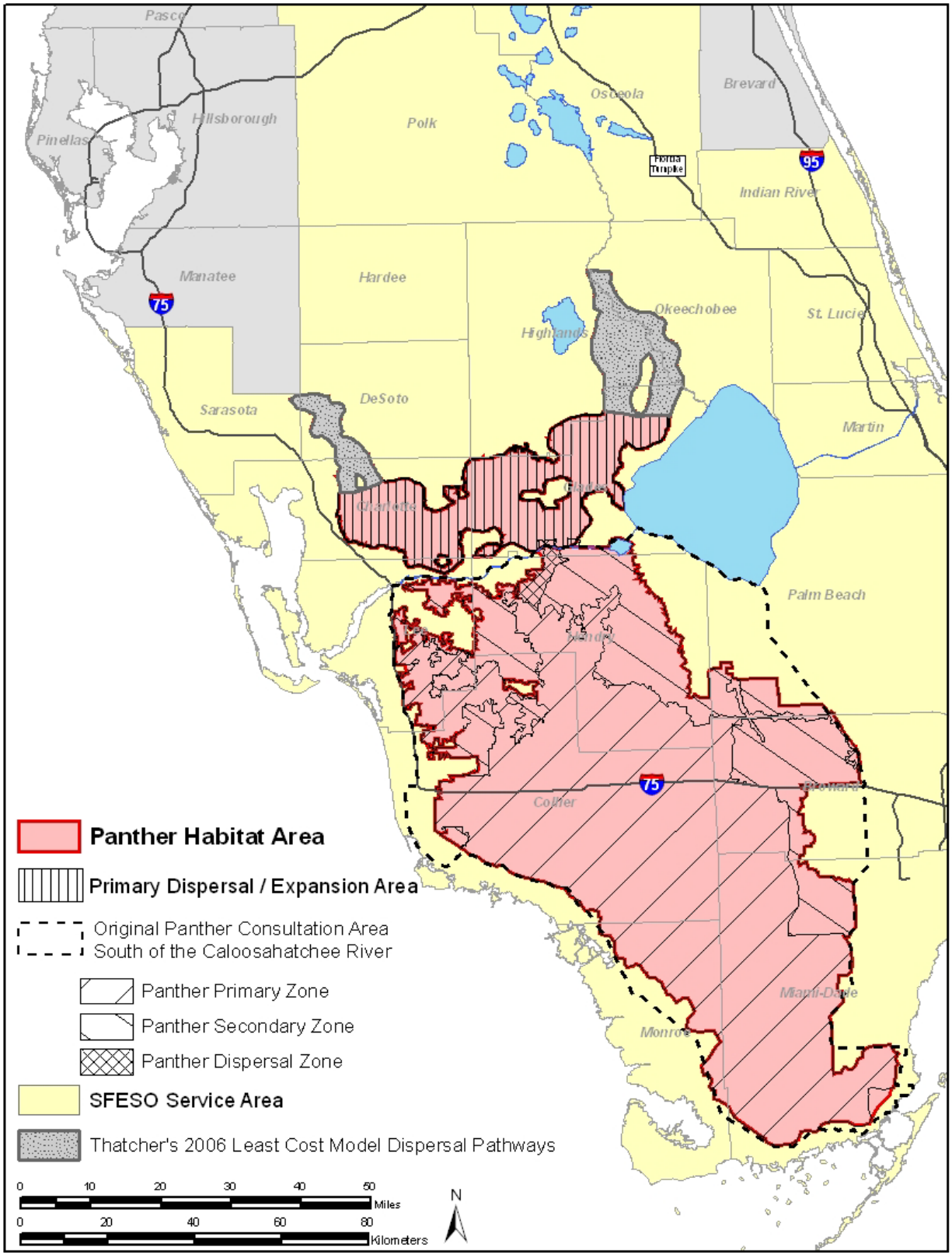


Figure D-4. Panther Habitat Area

The mitigation objectives for this Project are:

- Objective 1: Mitigate for the habitat functions lost by using the panther habitat model, resulting in a minimum of 42,006 PHUs.
- Objective 2: Utilize options for mitigation for habitat functions that maximize the mitigation for corridor functions.

D.4.1 Mitigation Options

D.4.1.1 Design Modifications

While it was originally anticipated that the proposed LOCAR construction may allow panthers to use the constructed reservoir levees (perimeter levees and interior divider levees) to cross the Project footprint and travel along the Thatcher Dispersal Pathways, input from experts indicates that panthers are not likely to utilize this area. However, the 474 acres of land to be preserved for the environmentally sensitive area on the south side of the reservoir could serve as panther corridor habitat. Habitat units were included in the options proposed for the environmentally sensitive area.

Performance Measure – Since the only action is to maintain the environmentally sensitive area, and no betterment to the land is planned, a performance measure or monitoring is not needed.

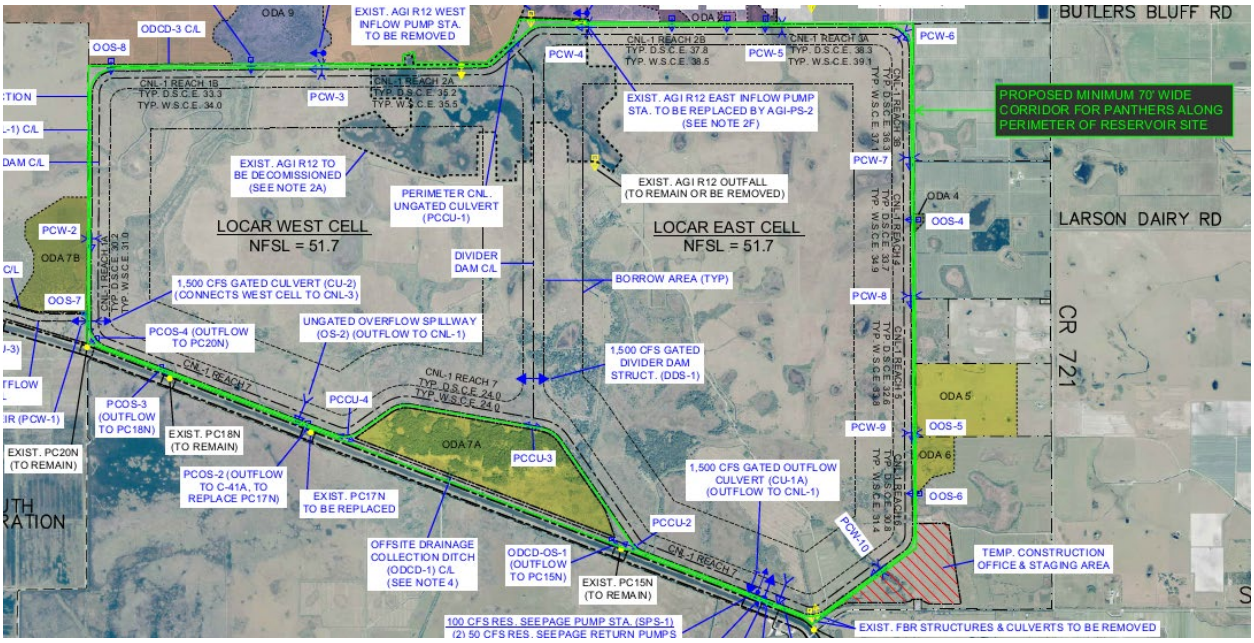


Figure D-5. Proposed panther corridor surrounding reservoir levee.

D.4.1.2 Use of Credits from Picayune Strand Restoration Project

The USACE and SFWMD have invested millions of dollars for ecosystem restoration at the Picayune Strand Restoration Project (PSRP) for more than a decade. The restoration work and maintenance of PSRP has allowed for the PSRP to be used as a mitigation bank to offset impacts to panthers for Comprehensive Everglades Restoration Plan (CERP) projects. While PSRP can readily provide mitigation for impacts to

habitat function, it cannot provide mitigation for the impacts LOCAR would have on corridor functions nor on the impacts to habitat north of the Caloosahatchee River. LOCAR is 80 miles north of PSRP and is north of the Caloosahatchee River. LOCAR sits entirely within the part of the Panther Focus Area identified as the Thatcher Model Dispersal Pathways. These are the most likely dispersal routes, based on the least cost-pathway models in *An Assessment of Habitat North of the Caloosahatchee River for Florida Panthers* (Thatcher et al. 2006), to potential panther habitats to the north.

The PSRP, the Additional Lands of Big Cypress National Preserve, and the Florida Panther National Wildlife Refuge provide the natural lands the panthers need to breed and forage and contribute to the success of the species. It is estimated that the population has increased from an estimated 90 to 120 adults in 2007 to 120 to 230 adults in 2023. In the early to mid-2010s population levels in these areas were estimated at one panther per 15 to 30 square miles (Sollmann et al. 2013; Dorazio and Onorato 2015). However, each breeding unit, consisting of one male and two to five females, has been estimated to require about 200 square miles, indicating that more area is needed to support a larger population. This is why the dispersal routes represent critical corridors for panthers, so they can continue to expand their breeding range northward. This northward expansion of breeding range is currently the most vital factor in panther recovery. For this reason, it is not possible to only use PSRP to mitigate the loss of habitat functions caused by LOCAR.

Since there are two mitigation objectives, one for habitat and one for corridors, the maximum use of PSRP to mitigate the loss of habitat functions caused by LOCAR would be 50 percent. However as outlined above, the lands upon which LOCAR would be built are critical for panther habitat expansion; thus, the maximum habitat mitigation credits from PSRP would be reduced to 25 percent.

The total number of credits assigned to the PSRP is 473,112 PHUs based on 55,149 acres of habitat. All CERP projects that have impacts to panther habitat have used PHUs from this compensation area to offset the loss. Currently, there are still over 319,500 credits available. LOCAR would be using 25 percent (10,502) of the credit from PSRP, resulting in approximately 462,610 credits remaining in the compensation area available for other CERP projects (Table D-10).

Table D-10. CERP Projects and Other Related Restoration Projects Assuming Credits to Date Against the Picayune Strand Restoration Project Panther Compensation Area

Project Name	BO Date	Total Acres	Primary Acres	Secondary Acres	Dispersal Acres	Other Acres	Pre-Project PHU	Post-Project PHU	PHU change (Post-Pre)	PHU needed (negative) or credit (positive)*
Picayune Strand Panther Compensation Area										
Picayune Strand Restoration	3/12/2009	55,149	55,149	0	0	0	461.753	484,470	22,717	473,112
Completed Projects using Picayune credits										
EAA Reservoir (FEBs)	04/14/06	33,740	(1	0	0	33,740	44.598	4,529	-40,069	-100,173
C43 Reservoir	07/23/07	10.335	144	5,236	0	4,955	19,438	665	-18,773	-46.933
PSRP impacts	Ongoing	264	264	0	0	0	2,054	0	-2,054	-5.135
Tamiami Trail Next Steps	10/18/10	101	101	0	0	0	1,278	0	-1,278	-1,278
SUM of PHU debits to date		44,339	408	5,236	0	38.695	66,090	5.194	-60,896	-153,519
Remaining PSRP Credits										**319,593**

*PHU needed includes 2.5 multiplier, PHU credits are 1/2 the lift of the restoration plus the original value of the property

D.4.1.3 Land Acquisition

Land acquisition in and of itself generates PHUs; however, by acquiring land in the vicinity of LOCAR, it would also fulfill the need to mitigate impacts to corridor function. Ensuring a corridor of passable land remains intact after LOCAR construction is one of two elements that are essential to making sure that LOCAR does not have a negative effect on panther range expansion. An evaluation of lands within the vicinity of the Project was conducted to prioritize properties that may be used to mitigate the impacts to both habitat and corridors. Based on conversations with the USFWS, the highest priority is for lands in pine and cypress/hardwood swamps/forests, unimproved pasture, and dry and marsh/wet prairies that would be considered by USFWS as Primary Zone based on their value as corridor lands, even though those lands are located in the Other Zone. These lands are potential pathways and corridors that Florida panthers may use when expanding their range north of the Caloosahatchee River. Costs for land acquisition are considered similar to that estimated for land acquisition for the Project itself.

Performance Measure – Since the only action is to acquire the land and no betterment to the land is planned, a performance measure or monitoring is not needed.

D.4.1.4 Conservation Easements

In addition to land acquisition, another option is working with landowners and/or organizations to obtain conservation easements to preserve panther habitat. Florida Forever is Florida's premier conservation and recreation lands acquisition program—a blueprint for conserving Florida's natural and cultural heritage. This organization creates a yearly list documenting priority lands requiring conservation. Florida Forever categorizes lands on the priority list as critical natural lands, partnerships and regional incentives, less-than-fee, climate change lands, and critical historical resources. It is important to note that less-than-fee lands require purchasing a conservation easement and not outright purchase of land. Per acre, less-than-fee is less expensive than fee simple (purchase of lands outright) when mitigating for habitat impacts.

A SFWMD GIS analysis has already identified one less-than-fee Florida Forever priority property named Fisheating Creek Ecosystem that is less than 5 miles from the LOCAR Project and is also located within the USFWS Panther Focus Area and Primary Dispersal/Expansion Area. The Primary Dispersal/Expansion Area has a high equivalency value when compared to the USFWS Panther Focus Area Secondary Zone or Other Zone.

Working with Florida Forever to purchase a conservation easement in the Fisheating Creek Ecosystem has a number of potential benefits including its location in the Primary Dispersal/Expansion Area; cheaper per-acre mitigation costs since a conservation easement would be purchased and not outright purchase of land; land management responsibilities remaining with the landowner; the property being less than 5 miles from LOCAR; a possible opportunity for grants from Florida Forever to help reduce the non-federal cost of purchasing priority properties; the property containing high-value panther habitats when analyzed using the USFWS Panther Tool; and as documented by Florida Forever, conserving the Fisheating Creek Ecosystem would help preserve the Florida panther, Audubon's crested caracara, and other native plant and animal species that depend on these critical lands. These species, among others, may benefit from conservation of Florida panther habitat.

Performance Measure – Since the only action is to acquire a conservation easement and no betterment to the land is planned, a performance measure or monitoring is not needed.

D.4.1.5 Foster Panther Education Opportunities and Outreach

While land acquisition in the vicinity of LOCAR can help mitigate impacts to corridor function, it could also result in more panther/human interactions, resulting in possible resistance to panther migration. The main factors that impede panther range expansion are inter-related and can have compounding effects. There is concern that reservoir construction could increase resentment and resistance to panthers. Providing funding to a Payment for Ecological Services (PES) program is anticipated to reduce resistance to panther range expansion through education and monetary reimbursement for impacts directly or indirectly. A $1 million dollar monetary donation to this fund would provide approximately 1,455 PHUs by increasing the value of the habitat units from land acquisition or conservation easements by 5 percent.

Performance Measure – Since the only action is to provide funds to an education program to work with local landowners, a performance measure or monitoring is not needed.

While USACE policy requires that mitigation amounts be based on functional analysis, using the same model that was used to calculate the impacts, there is currently no model to calculate the corridor function. Rather, the options for mitigation focused on those that would fulfill the functional habitat units while still providing corridor functions in the impact area. Thus, mitigation options such as 100 percent or 50 percent from PSRP were screened out.

Six Panther Mitigation Options were carried forward based on the objectives. The tables below summarize the habitat function, PHUs offset, acreage needed, and estimated costs for each Mitigation Plan. Four habitat types were considered for the worksheet model based on the predominant land use types of the Florida Department of Environmental Protection (FDEP) Florida Forever conservation lands and lands that are located within the Fisheating Creek subwatershed.

Option #1: 25% PHUs from PSRP and 75% from New Mitigation (Environmentally Sensitive Area and Land Acquisition in the Primary Dispersal Areas)

Type	Percentage	PHUs Offset	Acreage	Estimated Costs	Notes
Picayune Strand Restoration Project (PSRP)	25%	10,502	N/A	$0	Includes exotic treatment/removal within the PSRP
Environmentally Sensitive Area	<1%	952	474 (Worksheet 1)	$0 Land acquisition included in project costs	
Land Acquisition	~74%	30,552	4,410	$41,895,000	Acquiring suitable lands throughout Glades/Highlands and Okeechobee County to benefit Panther and ensuring the long-term survival of a population of Florida panthers north of the Caloosahatchee River.
TOTAL				**$41,895,000**	

Option #2: 25% PHUs from PSRP and 75% from New Mitigation (Environmentally Sensitive Area, Land Acquisition in the Primary Dispersal Areas, and Payment for Ecological Services Program)

Type	Percentage	PHUs Offset	Acreage	Estimated Costs	Notes
Picayune Strand Restoration Project (PSRP)	25%	10,502	N/A	$0	Includes exotic treatment/removal within the PSRP
Environmentally Sensitive Area	<1%	952	474 (Worksheet 1)	$0 Land acquisition included in project costs	
Land Acquisition	~70%	29,097	4,205	$38,947,500	Acquiring suitable lands throughout Glades/Highlands and Okeechobee County to benefit Panther and ensuring the long-term survival of a population of Florida panthers north of the Caloosahatchee River.
Payment for Ecological Services	~5%	1,455		$1,000,000	Reduces human/panther conflicts
TOTAL				**$39,947,500**	

Option #3: 25% PHUs from PSRP and 75% from New Mitigation (Environmentally Sensitive Area and Land Acquisition outside of the primary dispersal areas)

Type	Percentage	PHUs Offset	Acreage	Estimated Costs	Notes
Picayune Strand Restoration Project (PSRP)	25%	10,502	N/A	$0	Includes exotic treatment/removal within the PSRP
Environmentally Sensitive Area	<1%	952	474 (Worksheet 1)	$0 Land acquisition included in project costs	
Land Acquisition	~74%	30,552	16,076	$152,722,000	Acquiring suitable lands throughout Glades/Highlands and Okeechobee County to benefit Panther and ensuring the long-term survival of a population of Florida panthers north of the Caloosahatchee River.
TOTAL				$152,722,000	

Option #4: 25% PHUs from PSRP and 75% from New Mitigation (Environmentally Sensitive Area, Land Acquisition in the outside of primary dispersal areas, and Payment for Ecological Services Program)

Type	Percentage	PHUs Offset	Acreage	Estimated Costs	Notes
Picayune Strand Restoration Project (PSRP)	25%	10,502	N/A	$0	Includes exotic treatment/removal within the PSRP
Environmentally Sensitive Area	<1%	952	474 (Worksheet 1)	$0 Land acquisition included in project costs	
Land Acquisition	~70%	29,097	15,334	$144,673,000	Acquiring suitable lands throughout Glades/Highlands and Okeechobee County to benefit Panther and ensuring the long-term survival of a population of Florida panthers north of the Caloosahatchee River.
Payment for Ecological Services	~5%	1,455		$1,000,000	Reduces human/panther conflicts
TOTAL				$145,673,000	

Option #5: 25% PHUs from PSRP and 75% from New Mitigation (Environmentally Sensitive Area and Conservation Land Acquisition in the Primary dispersal area)

Type	Percentage	PHUs Offset	Acreage	Estimated Costs	Notes
Picayune Strand Restoration Project (PSRP)	25%	10,502	N/A	$0	Includes exotic treatment/removal within the PSRP
Environmentally Sensitive Area	<1%	952	474 (Worksheet 1)	$0 Land acquisition included in project costs	
Land Acquisition	~74%	30,552	4,410	$33,075,000	Acquiring suitable lands throughout Glades/Highlands and Okeechobee County to benefit Panther and ensuring the long-term survival of a population of Florida panthers north of the Caloosahatchee River.
TOTAL				$33,075,000	

Option #6: 25% PHUs from PSRP and 75% from Mitigation (Environmentally Sensitive Area, Conservation Areas Land Acquisition in the Primary dispersal area, and Payment for Ecological Services)

Type	Percentage	PHUs Offset	Acreage	Estimated Costs	Notes
Picayune Strand Restoration Project (PSRP)	25%	10,502	N/A	$0	Includes exotic treatment/removal within the PSRP
Environmentally Sensitive Area	<1%	952	474 (Worksheet 1)	$0 Land acquisition included in project costs	
Land Acquisition	~70%	29,097	4,205	$30,537,500	Acquiring suitable lands throughout Glades/Highlands and Okeechobee County to benefit Panther and ensuring the long-term survival of a population of Florida panthers north of the Caloosahatchee River.
Payment for Ecological Services	~5%		1,455	$1,000,000	Reduces human/panther conflicts
TOTAL				$31,537,500	

COMPENSATION WORKSHEET

Habitat Type	Assigned value	Habitat types of land being offered as compensation: Primary/d Zone	Secondary Zone	Other Zone	Primary Equivalent Habitat Units	Habitat types of compensation land after restoration: Primary/d Zone	Secondary Zone	Other Zone	Primary Equivalent Habitat Units
Pine forest	9.5				0				
Hardwood-Pine	9.3				0				
Cypress swamp	9.2				0				
Hardwood swamp	9.2			67	205				
Hardwood Forest	9				0				
Dry prairie	6.3				0				
Unimproved pasture	5.7			242	460				
Shrub swamp/brush	5.5			12	22				
Improved pasture	5.2			153	265				
Cropland	4.8				0				
Orchards/groves	4.7				0				
Marsh/ wet prairie	4.7				0				
Xeric scrub	4.5				0				
Exotic/Nuisance plants	3				0				
Coastal wetlands	3				0				
Barren/Disturbed lands	3				0				
Water	0				0				
Urban	0				0				
Reservoirs*					0				
STA*					0				
SubTotal		0.00	0.00	474.00	952.47				

CONTINUE

CLEAR SHEET

COMPENSATION PROPOSED 952 Habitat Units

952

Worksheet 1: PHUs Offset from Environmentally Sensitive Area

COMPENSATION		Habitat types of land being offered as compensation				Habitat types of compensation land after restoration			
Habitat Type	*Assigned value*	Primary/d Zone	Secondary Zone	Other Zone	Equivalent Habitat Units	Primary/d Zone	Secondary Zone	Other Zone	Equivalent Habitat Units
Pine forest	9.5	910			8645				
Hardwood-Pine	9.3				0				
Cypress swamp	9.2				0				
Hardwood swamp	9.2				0				
Hardwood Forest	9	895			8055				
Dry prairie	6.3				0				
Unimproved pasture	5.7	1610			9177				
Shrub swamp/brush	5.5				0				
Improved pasture	5.2				0				
Cropland	4.8				0				
Orchards/groves	4.7				0				
Marsh/ wet prairie	4.7	995			4677				
Xeric scrub	4.5				0				
Exotic/Nuisance plants	3				0				
Coastal wetlands	3				0				
Barren/Disturbed lands	3				0				
Water	0				0				
Urban	0				0				
Reservoirs*					0				
STA*					0				
SubTotal		4410.00	0.00	0.00	30553.50				

CONTINUE

CLEAR SHEET

COMPENSATION PROPOSED
30554
Habitat Units

30554

Worksheet 2: PHUs Offset from 75% Land Acquisition in Primary Zone

COMPENSATION		Habitat types of land being offered as compensation				Habitat types of compensation land after restoration			
Habitat Type	*Assigned value*	Primary/d Zone	Secondary Zone	Other Zone	Primary Equivalent Habitat Units	Primary/d Zone	Secondary Zone	Other Zone	Primary Equivalent Habitat Units
Pine forest	9.5	850			8075				
Hardwood-Pine	9.3				0				
Cypress swamp	9.2				0				
Hardwood swamp	9.2				0				
Hardwood Forest	9	850			7650				
Dry prairie	6.3				0				
Unimproved pasture	5.7	1600			9120				
Shrub swamp/brush	5.5				0				
Improved pasture	5.2				0				
Cropland	4.8				0				
Orchards/groves	4.7				0				
Marsh/ wet prairie	4.7	905			4254				
Xeric scrub	4.5				0				
Exotic/Nuisance plants	3				0				
Coastal wetlands	3				0				
Barren/Disturbed lands	3				0				
Water	0				0				
Urban	0				0				
Reservoirs*					0				
STA*					0				
SubTotal		4205.00	0.00	0.00	29098.50				

CONTINUE

CLEAR SHEET

COMPENSATION PROPOSED
29099
Habitat Units

29099

Worksheet 3: PHUs Offset from 70% Land Acquisition in Primary Zone

COMPENSATION WORKSHEET		Habitat types of land being offered as compensation				Habitat types of compensation land after restoration				
Habitat Type	*Assigned value*	Primary/d Zone	Secondary Zone	Other Zone	Equivalent Habitat Units	Primary/d Zone	Secondary Zone	Other Zone	Equivalent Habitat Units	
Pine forest	9.5			825	2613					
Hardwood-Pine	9.3				0					
Cypress swamp	9.2				0					
Hardwood swamp	9.2				0					
Hardwood Forest	9			820	2460					
Dry prairie	6.3				0					
Unimproved pasture	5.7			5576	10594					
Shrub swamp/brush	5.5				0					
Improved pasture	5.2			5300	9187					
Cropland	4.8			2975	4760					
Orchards/groves	4.7				0					
Marsh/ wet prairie	4.7			580	909					
Xeric scrub	4.5				0					
Exotic/Nuisance plants	3				0					
Coastal wetlands	3				0					
Barren/Disturbed lands	3				0					
Water	0				0					
Urban	0				0					
Reservoirs*					0					
STA*					0					
SubTotal		0.00	0.00	16076.00	30522.23					30522

CONTINUE

CLEAR SHEET

COMPENSATION PROPOSED
30522
Habitat Units

Worksheet 4: PHUs Offset from 75% Land Acquisition in Other Zone

COMPENSATION		Habitat types of land being offered as compensation				Habitat types of compensation land after restoration				
Habitat Type	*Assigned value*	Primary/d Zone	Secondary Zone	Other Zone	Primary Equivalent Habitat Units	Primary/d Zone	Secondary Zone	Other Zone	Primary Equivalent Habitat Units	
Pine forest	9.5			800	2533					
Hardwood-Pine	9.3				0					
Cypress swamp	9.2				0					
Hardwood swamp	9.2				0					
Hardwood Forest	9			800	2400					
Dry prairie	6.3				0					
Unimproved pasture	5.7			5000	9500					
Shrub swamp/brush	5.5				0					
Improved pasture	5.2			5300	9187					
Cropland	4.8			2915	4664					
Orchards/groves	4.7				0					
Marsh/ wet prairie	4.7			519	813					
Xeric scrub	4.5				0					
Exotic/Nuisance plants	3				0					
Coastal wetlands	3				0					
Barren/Disturbed lands	3				0					
Water	0				0					
Urban	0				0					
Reservoirs*					0					
STA*					0					
SubTotal		0.00	0.00	15334.00	29097.10					29097

CONTINUE

CLEAR SHEET

COMPENSATION PROPOSED
29097
Habitat Units

Worksheet 5: PHUs Offset from 70% Land Acquisition in Other Zone.

D.4.2 Cost Effectiveness/Incremental Cost Analysis:

Options 1, 3, and 5 were screened out since they do not meet both mitigation objectives – only providing the offset of panther habitat functions without providing the monetary donation for the panther conservation and panther corridor expansion. While the exact lands for Options 2, 4, and 6 are unknown, they provide offset for both habitat functions and corridor functions north of Lake Okeechobee. Based on the estimated costs, Options 5 and 6 are the most cost effective. However, Option 6 meets both objectives of the Mitigation Plan and is the most cost-effective plan. There are some additional benefits in acquiring lands from the Florida Forever Fisheating Creek Ecosystem property such as proximity to LOCAR (less than

5 miles away), contribution toward premier conservation and recreation lands acquisition program, and purchasing conservation easements for less-than-fee versus purchasing lands outright.

Option	Total PHUs Needed	25% Picayune PHUs	PHUs-25% Picayune	Env Sensitive Area HU	Bonus HU from PES	Mitigation HU Needed from Option	Acres to be Obtained	Land cost	Total Cost
Opt 1: Primary Dispersal Land Acquisition	42,006	10,502	31,504	952		30,552	4,410	$41,895,000	$41,895,000
Opt 2: Primary Dispersal Land Acquisition + PES	42,006	10,502	31,504	952	1,455	29,097	4,205	$39,947,500	$40,947,500
Opt 3: Other Zone Land Acquisition	42,006	10,502	31,504	952		30,552	16,076	$152,722,000	$152,722,000
Opt 4: Other Zone Land Acquisition + PES	42,006	10,502	31,504	952	1,455	29,097	15,334	$145,673,000	$146,673,000
Opt 5: Conservation Acquisition	42,006	10,502	31,504	952		30,552	4,410	$33,075,000	$33,075,000
Opt. 6: Conservation Acquisition + PES	42,006	10,502	31,504	952	1,455	29,097	4,205	$31,537,500	$32,537,500

D.4.3 References

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